PGV*IQ-F200-B21-V1D

Data Matrix Positioning System

Manual

EtherCAT®

Your automation, our passion.

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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.

Note

For specific device information such as the year of construction, scan the QR code on the device. As an alternative, enter the serial number in the serial number search at www.pepperl-fuchs.com.

The documentation comprises the following parts:

- This document
- Datasheet

In addition, the documentation may comprise the following parts, if applicable:

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

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

1.4 Trademarks

EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

2 Product Description

2.1 Use and Application

Intended Use

The read head uses invisible infrared light. This read head version is therefore especially suitable for positioning in areas where no visible light may be used. Either Data Matrix code tapes or Data Matrix tags are used to ensure absolutely reliable navigation.

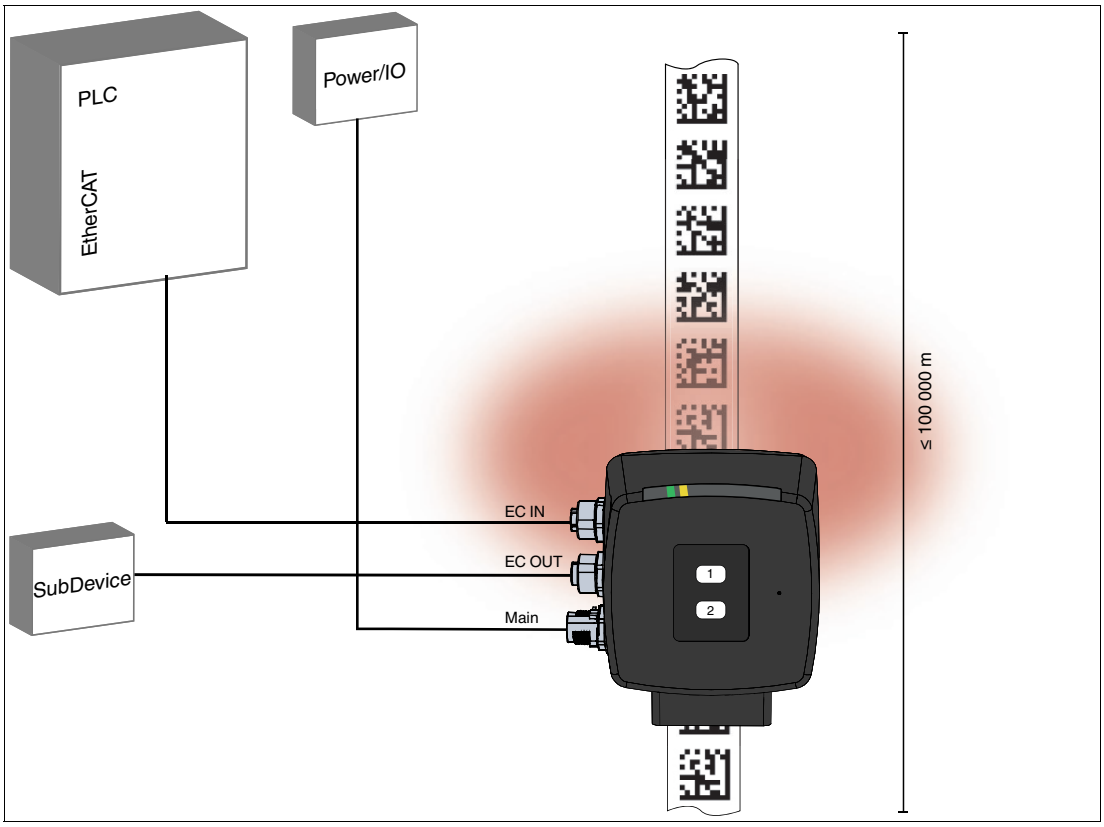

Figure 2.1 Schematic structure of the positioning system

The read head forms part of the positioning system in the Pepperl+Fuchs incident light process. The read head includes a camera module and an internal illumination unit. The read head uses this equipment to detect control codes and position markers that are affixed to the floor in the form of Data Matrix codes printed on a self-adhesive code tape. The read head detects Data Matrix tags to navigate within a grid.

Maximum Data Matrix Code Tape Length

The code tape length of up to 100 km is sufficient even for very large applications. It offers sufficient reserves for extensions or systems with several branches and parallel conveyor routes.

The read head can be optimally adapted to the respective application due to the comprehensive and simple parameterization and the freely configurable inputs and outputs.

Absolute Positioning

The Data Matrix code tape is used for the exact positioning of auto-guided transport systems (AGTS). The read head continuously reports the detected X position, the Y offset, the speed, and the angle of rotation of the AGTS.

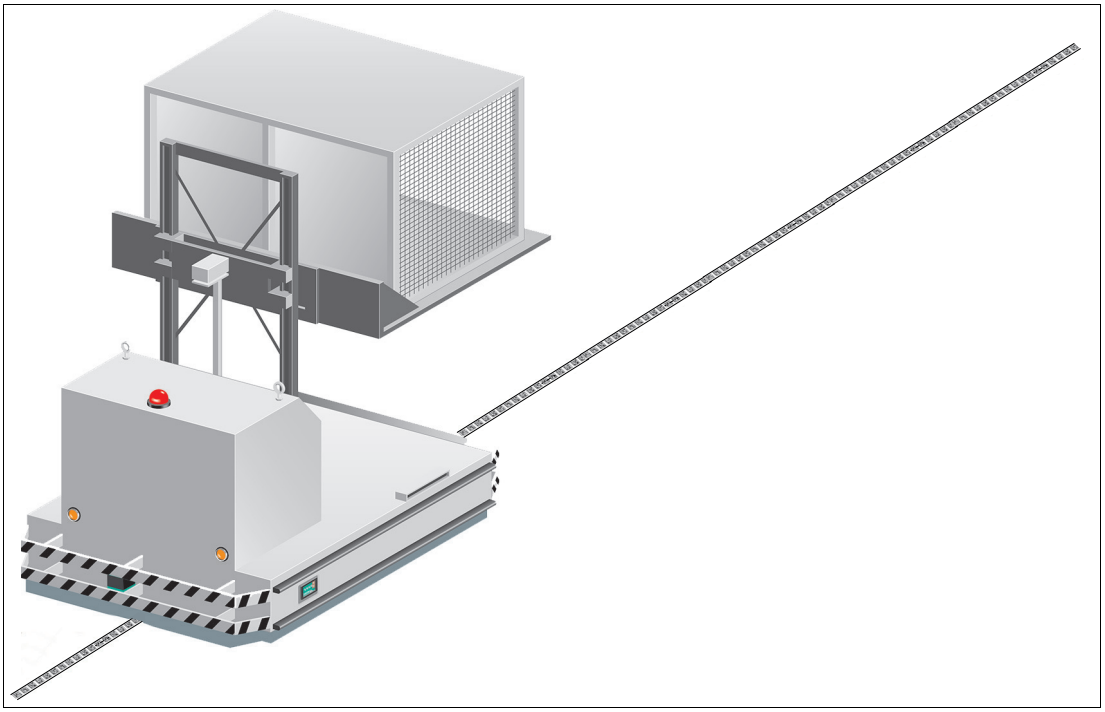

Figure 2.2 Auto-guided transport system with Data Matrix code tape

Data Matrix Tags

In addition to lane tracking, the read head can be used in tag mode. The read head detects Data Matrix tags, which are typically glued onto the floor in a grid. The individual Data Matrix tags are numbered (number range: 1 to 99999999) and contain position information. The reading head reports the tag number, the position, and the angle in relation to the zero point of the Data Matrix tag to the controller.

The tag mode allows the auto-guided transport system to move freely in as large a grid as desired, without having to mark the traverse paths with lane tapes.

The read head switches automatically between tag mode and lane tracking. This allows a transport system to be guided from one Data Matrix tag grid to another via a Data Matrix lane.

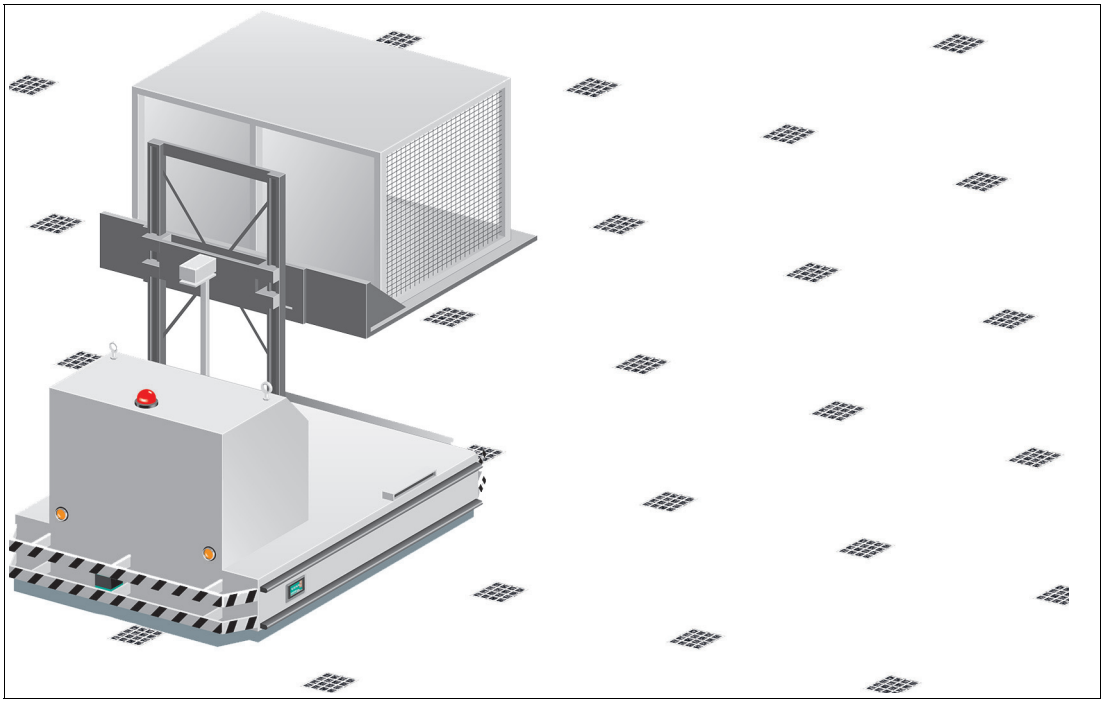

Figure 2.3 Auto-guided transport system with Data Matrix tags

Note

Security Information

From a security perspective, the following precautions must be taken for the product by the responsible application operator:

- Physically secure the device against unauthorized access
- Ensure that the device is only operated on an isolated network without connection to the company network, Internet, or cloud services;
  - The device may only communicate with a higher-level controller, or with a defined, trusted circle of network participants
- Ensure that only authorized users have access to the FoE feature on the network
  - The device supports file access over EtherCAT® (FoE). Firmware changes are always possible with the FoE function!

The EtherCAT® controller can be used to query the firmware version during initialization to detect firmware changes.

2.2 LED Indicators and Operating Elements

To ensure reliable device operation, the read head is equipped with 7 LEDs, which can be used for visual function control and quick diagnosis. The LEDs indicate the current status of the read head and can help you quickly detect and correct errors or problems. The meaning and function of the individual LEDs are described in more detail below.

With the two control buttons on the back of the read head, certain functions can be activated quickly and easily, or settings can be made.

- The integrated alignment aid can be activated using "**ADJUST**" control button 1, which supports the alignment of the read head and the detection of Data Matrix codes. The alignment aid can be used to set the position of the read head so that the codes on the Data Matrix code tape are optimally recorded and read.
- Control button 2 labeled "**CONFIG**" on the read head is reserved exclusively for Pepperl+Fuchs service personnel and has no function for the operator.

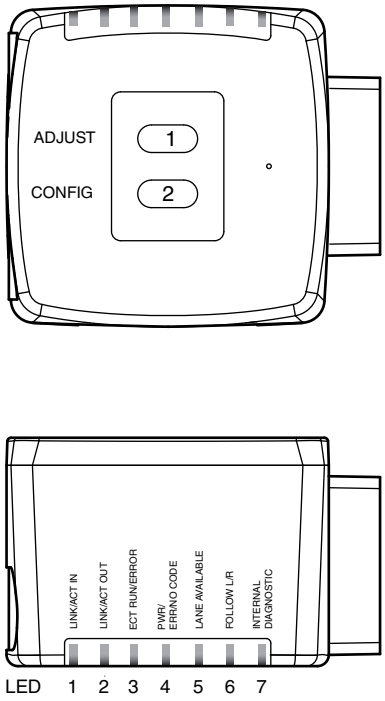

Figure 2.4 Overview of LED indicators and operating elements

LED status

Item	Designation	LED color		LED indicator	Meaning
1 2	LINK / ACT IN LINK / ACT OUT		Green	The Link/Activity LEDs 1 and 2 indicate the status of the physical connection and the activity on that connection.	
				On	Network connection OK
				Flickers	Data transfer in progress
				Off	No network connection

Item	Designation	LED color		LED indicator	Meaning
3	ECT RUN / ERROR		Green	Off	Device is in the "Initialization" state (normal state after switching on or after a restart).
				Flashing	Device is in the "Pre-Operational" state (configuration of the EtherCAT® network).
				Single light	Device is in the "Safe-Operational" state (e.g., due to a network malfunction).
				On	The device is in the "Operational" state (normal operating state).
			Red	On	No errors present.
				Flashing	Configuration errors No connection to the EtherCAT® network
				Single light	EtherCAT® status change due to an error
				Double lights	Watchdog timeout by the sync manager
4	PWR/ ERR / NO CODE		Green	On	Power
			Green	On	Connecting to the Vision Configurator
			Red	On	System error (configuration, check direction selection)
			Red	Flashing	No code tape or tag detected in the reading window
5	LANE AVAILABLE		Green	On	Lane detected
6	FOLLOW L/R		Green	On	Follow left lane
			Yellow	On	Follow right-hand lane
7	INTERNAL DIAGNOSTIC		Red/green/yellow	On	Internal error Return to Pepperl+Fuchs

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2.3 Accessories

Compatible accessories offer enormous potential for cost savings. Such accessories not only save you a great deal of time and effort during initial commissioning, but also when replacing and maintaining our products.

If products are used in harsh ambient conditions, appropriate Pepperl+Fuchs accessories can be used to extend the service life of these products.

Order code	Description
V19-G-ABG-PG9-FE	Grounding terminal and plug (kit)
PCV-SC12	Grounding clip
V1SD-G-GN*-PUR-E1S-V1D-G	Bus cable, Ethernet, M12 connector, straight to M12 connector, straight, D-coded, 4-pin, PUR cable green, Cat5e, shielded, suitable for drag chains
V1SD-G-GN*-PUR-E1S-V45-G	Bus cable, Ethernet, M12 connector, straight, D-coded to RJ45, Ethernet-coded, 4-pin, PUR cable green, Cat5e, shielded, suitable for drag chains
PCV-AG100	Alignment guide for read head
V19-G-*M-*	Configurable connection cable[1]
PCV-MB1	Mounting bracket for read head
V19-G-*M-PUR-ABG	Single-ended female cordset, M12, 8-pin, shielded, PUR cable
PCV-LM25	Marker head for code tape
PCV-KBL-V19-STR-USB	USB cable unit with power supply
PGV25M-CD*-CLEAR	Protective film
PGV*-CA25-*	Data Matrix code tape
PGV*-CC25-*	Data Matrix control codes
PGV-CT*	Data Matrix tag

1. Ask your contact person at Pepperl+Fuchs

3 Planning

3.1 Plant Design

Before selecting and using the product, the plant designer must evaluate whether this product is suitable for the intended application. Pepperl+Fuchs has no influence on the selection and use of this product. The warranty therefore only covers the consistent quality of the product.

Ensure that this device is used only in accordance with the technical specification described in these instructions. The device must not be used in a hazardous area.

Warning!

Danger due to ambiguous position information

Using double code areas can result in duplicate position information. This can lead to unclear position information. This can result in an incorrect control logic, which poses a risk to the personnel and plant.

During planning, make sure that the position information for the read head is unique in every component of the plant. Never use double code areas.

3.2 Introduction

The read head, when used together with code tapes affixed to the floor and tags with Data Matrix codes printed on them, constitutes a high-resolution positioning system. It can be used in all applications where auto-guided transport systems (AGTS) must be positioned precisely at marked positions along a given lane.

The read head detects Data Matrix tags to navigate within a grid. The read head detects control codes and position markers in the form of Data Matrix codes printed on a self-adhesive code tape.

The Data Matrix code tape is affixed to the floor. The read head is located on an auto-guided transport system (AGTS) and guides this vehicle along the lane.

The large reading window allows up to five codes to be recorded simultaneously in one read operation, depending on the reading distance. Precise position detection is possible with just one code in the reading window. This means that large gaps in the Data Matrix code tape can be bridged. By using several Data Matrix codes as information carriers, data can be represented in a highly redundant manner.

The specified path is traveled automatically and at the same time the X position, Y offset, and speed of the Data Matrix code tape are continuously reported back to the controller. In conjunction with continuous status feedback, e.g., of quality grades, this provides high productivity, and safer and more efficient processes.

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System Overview

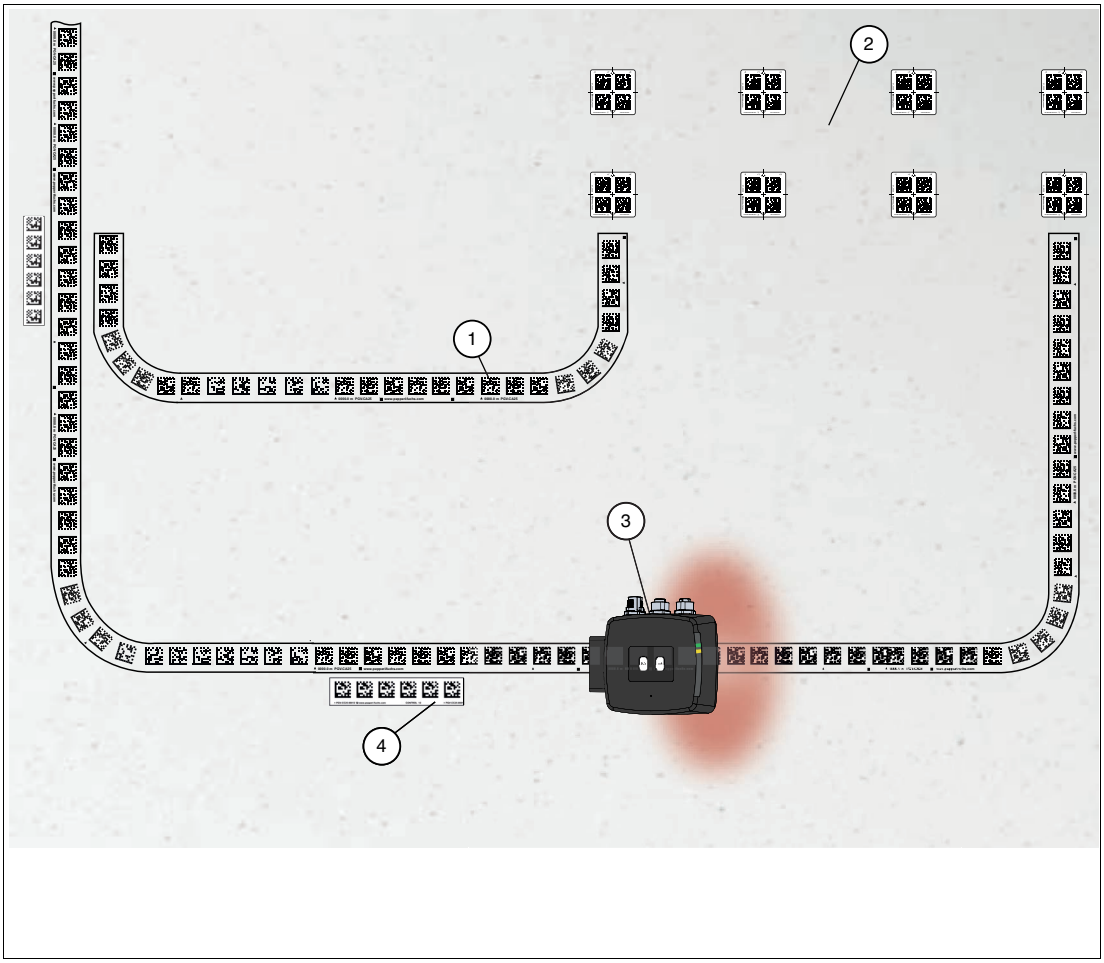


Figure 3.1 Schematic representation

1 Data Matrix positioning codes
2 Data Matrix tag grid
3 Read head
4 Data Matrix control codes

3.3 Positioning Targets

The portfolio for camera-based track guidance includes Data Matrix code tapes, Data Matrix tags, and control codes. The Data Matrix codes are available in a number of different designs to suit various requirements.

Note

Data Matrix metal code bars and color tapes are not compatible with infrared read heads.

3.3.1 Data Matrix Code Tape

Data Matrix code tapes enable the exact positioning of auto-guided transport systems. The read head continuously reports the detected position, speed, and rotation angle of the AGTS so that reliable goods transport is guaranteed at all times.

The Data Matrix code tape is made of silicone-free polyester film. There is a positioning target every 100 mm along the lower edge of the code tape. This positioning target is used for various functions, including ensuring that the Data Matrix code tape is positioned precisely when it is affixed to the floor. The reverse side of the Data Matrix code tape features a modified acrylate-based permanent adhesive.

The maximum length of the Data Matrix code tape is 100 km.

Figure 3.2

Characteristics of the Data Matrix Codes

The position marks in the code tape contain information about the absolute position of the tape, and serve as reference points for the read head. The read head uses its camera to capture the image of the code and uses the information contained in the position marks to determine the exact position of the code in the camera image. This enables accurate positioning of the read head.

The code tape uses fail-safe Data Matrix codes. This is the Data Matrix code (ECC200) that is encoded using the Error Correction Code (ECC) procedure. This means that it contains additional information to correct errors when reading or transmitting the code. This is especially important for the multiple redundancy provided by the additional codes, because the codes can be heavily used or soiled under certain circumstances.

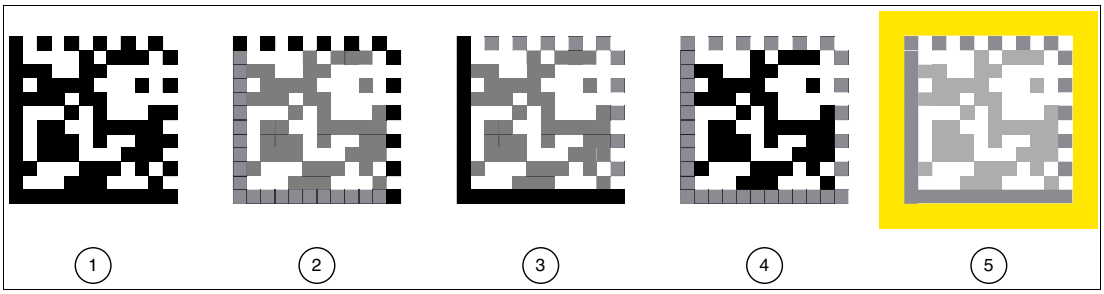


Figure 3.3 Data Matrix code ECC200

A Data Matrix code ECC200 consists of several areas that are relevant for code reading:

1 Data Matrix code according to ECC200, symbol size 12x12, black/white

2 **Alternating pattern**: The Alternating Pattern is a pattern of alternating black and white modules. The number of modules is even. It allows the data density to be determined. The Alternating Pattern is used for symbol size recognition and ECC200 type recognition.

3 **Finder pattern**: The Finder Pattern is a characteristic pattern of black modules arranged in an L shape. It is used to locate the Data Matrix code in any rotation. Distortions are also detected. The Finder Pattern is used to clearly determine the location and size of the Data Matrix code.

4 **Data range**: The data range is the actual data field in the Data Matrix code in which the information to be encoded is stored. It consists of a matrix of black and white squares representing the binary data.
Error correction range: The error correction range is a portion of the Data Matrix code that contains additional data to detect and correct errors in reading and transmitting the code. The error correction range is encoded using the Error Correction Code (ECC).

5 **Quiet zone**: The quiet zone (shown in yellow here) is a white area around the Data Matrix code. It is used to distinguish the code from other objects or the background. This makes it easier for the read head to read the code. The width of the quiet zone is 2 mm. To ensure that the read head can read the Data Matrix codes, the quiet zone of 2 mm around the Data Matrix code must not be violated when cutting the code tape.

Code Redundancy

As soon as at least one single Data Matrix code is detected in the field of view, the position output can be performed. The system therefore offers the highest possible pollution tolerance, and can also bridge expansion joints or gaps without losing position.

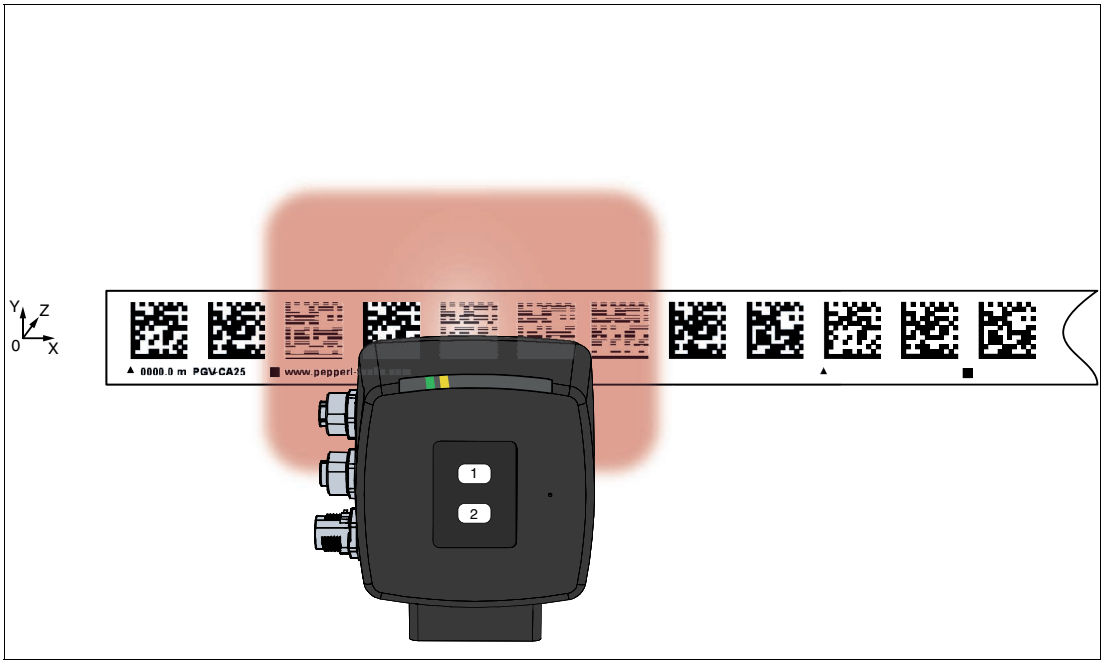


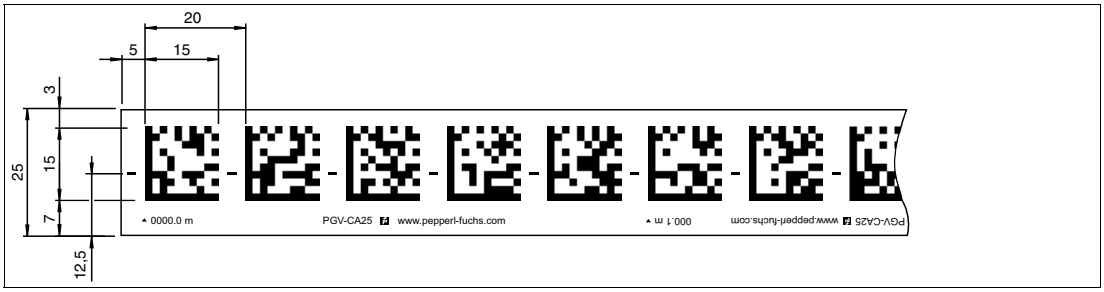
Figure 3.4 Code redundancy

Note

Note the Type of Code Tape.

The positioning system only works if the read head is used together with the suitable Data Matrix code tape. Please refer to the data sheet.

PGV*-CA25-*



Note

Center Line of the Code Tape

The center line of the code tape does not correspond to the center of the Data Matrix codes; these are slightly offset from the center line of the code tape.

The center line of the code tape corresponds to Y position = 0

Note

Behavior at X Position 0

It is recommended to use the code tape with the Data Matrix codes from a starting position greater than 100 mm. If the read head is started at a position value of less than 90 mm or if it moves sideways over the 0 mm position on the code tape, the "No Position Bit" remains set and the 0 mm position is permanently displayed to suppress the output of negative position values. A valid position output occurs as soon as the read head has passed the absolute position greater than 90 mm.

Note

Maximum of 2 Data Matrix Code Tapes in the Reading Window

The maximum number of Data Matrix code tapes in the reading window is limited to 2 and one control code.

Basics

Distances

The distance D between the lanes should be selected so that the lanes are always in the reading window () of the read head.

The distance between a Data Matrix position code and a Data Matrix control code must be between 0 mm and 5 mm.

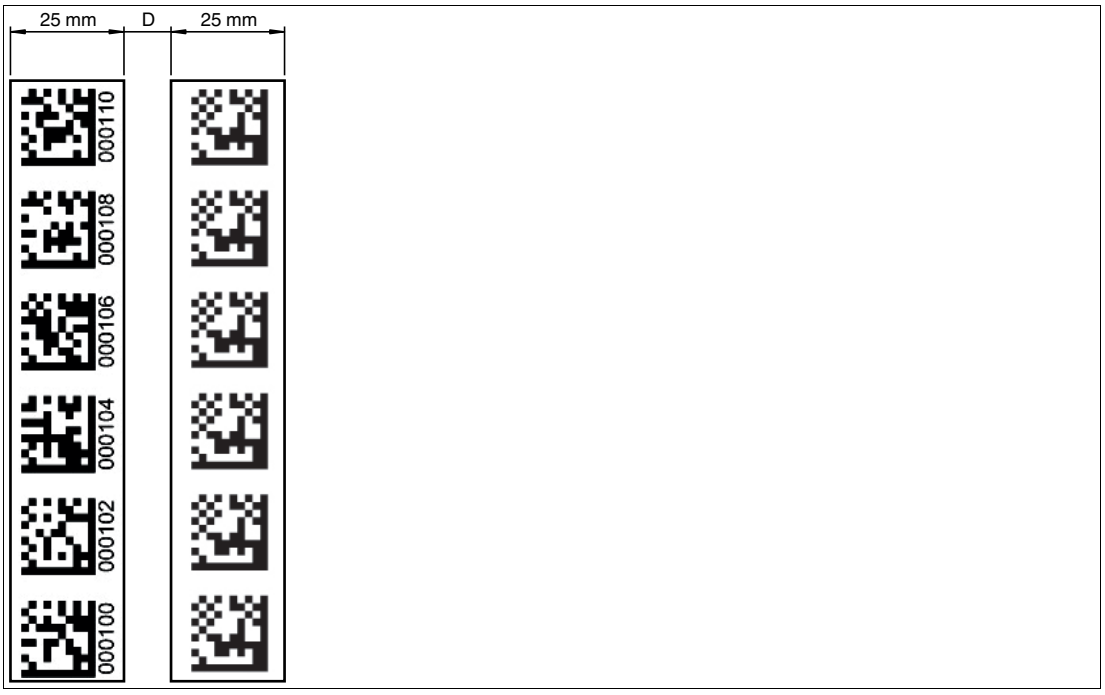


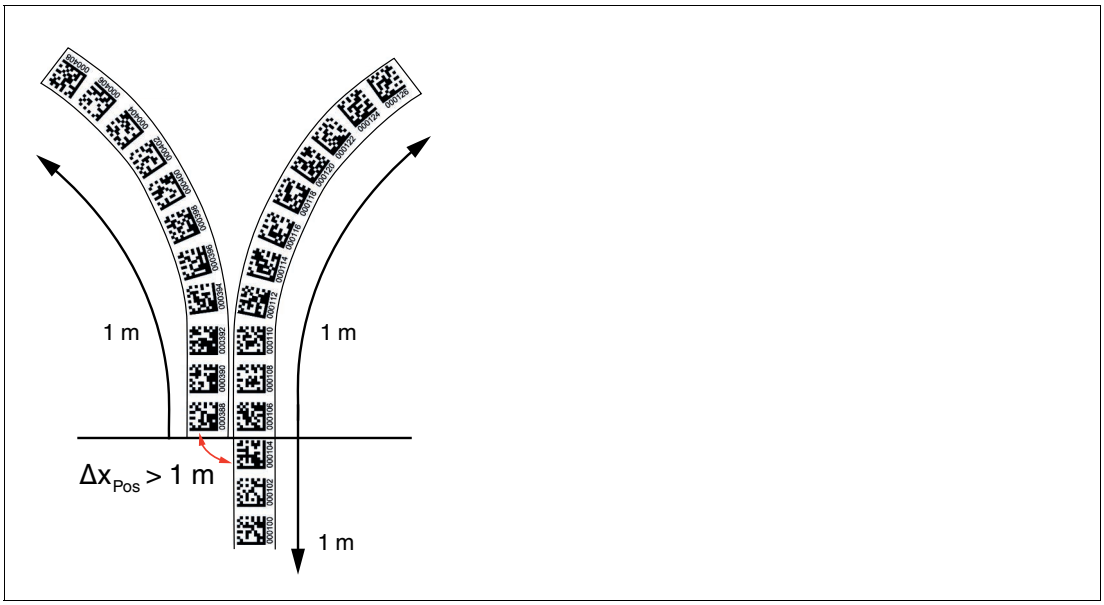
Figure 3.5 Distance: 0 mm ≤ D ≤ 5 mm

Branches/Intersections

- The read head detects one lane at the lower edge of the field of vision and two lanes at the upper edge of the field of vision; the read head therefore indicates this as a **branch**.
- The read head detects two lanes at the lower edge of the field of vision and one lane at the upper edge of the field of vision; the read head therefore indicates this as an **intersection**.

Before and after branches or intersections of lanes with position codes, the following specifications must be observed:

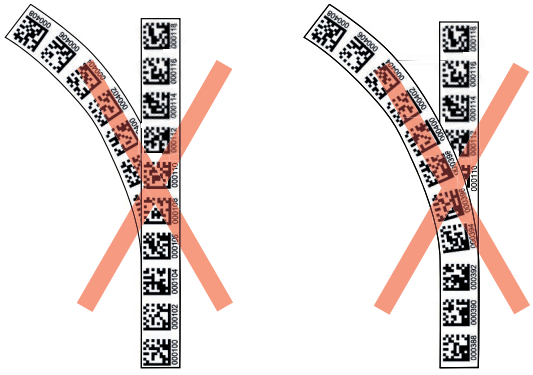
- The distance between the two lanes should be selected so that the newly added lane is always in the reading window of the read head. This ensures that the read head can correctly detect and read the new lane.
- The position codes of the branching or intersecting lane must be continuous over a length of 1 meter. This results in a minimum length of the main lane of 2 m.
- The difference between the absolute position of the main lane and the starting position of the branching/intersecting lane must be greater than one meter.



Note

Loss of Information

Make sure that Data Matrix codes are not glued over each other at a branch or intersection, since this could result in a loss of information.



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Branch with Control Code

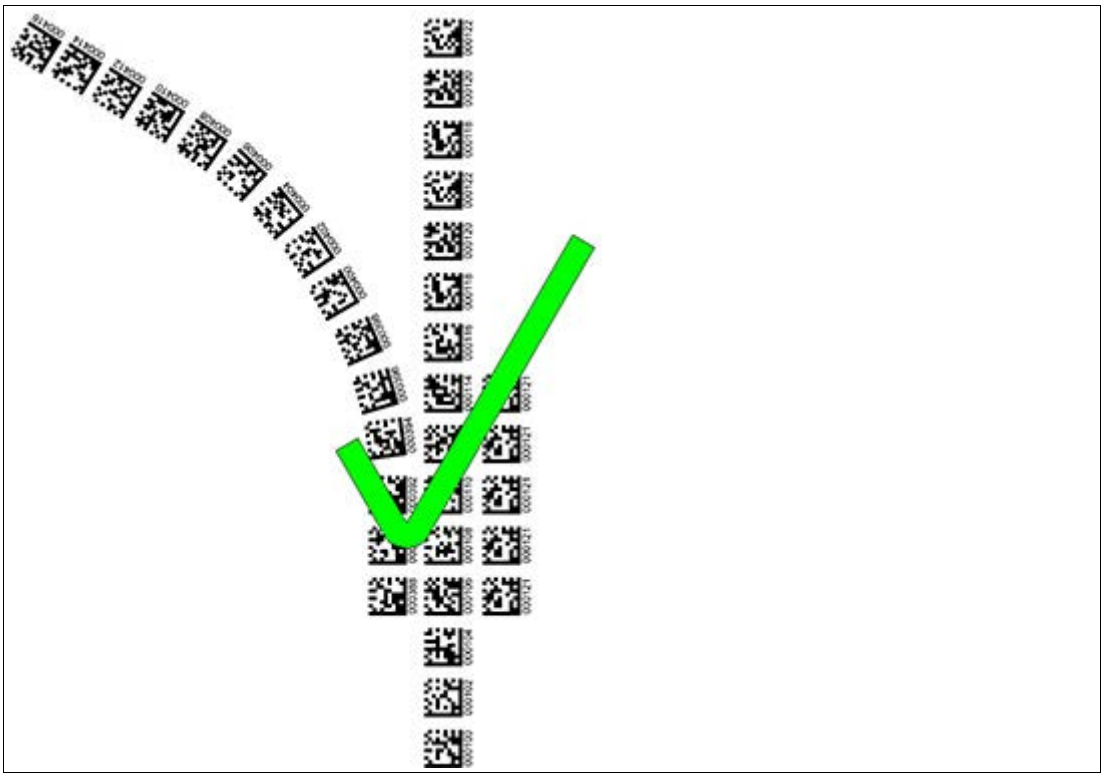

Figure 3.6 Branch with control code

Branches/Lane Change by Direction Decision or Control Logic

Normally, the AGTS is controlled at branches by the **direction decision**. The direction decision affects whether the position information is output from the right or left code tape. As long as the control logic keeps the vehicle in the lane only, the vehicle will follow the right or left lane. This is the simplest way to implement a branch, because no special control logic is required in this case.

Alternatively, a branch or lane change can also be triggered by the **control logic**. This procedure can be used, for example, for transitions from code tapes to tags or vice versa. Another application is intersections or branches in which the prerequisites for a branch with a direction decision are not met.

To change lanes using the **control logic**, the position of the branch or lane change is first stored in the controller by the plant planner. The change position (X position) from the old to the new lane is therefore known. When this position is reached, the lane change of the auto-guided transport system (AGTS) is initiated. To do this, the vehicle must be steered from the old to the new lane. As soon as only the new lane is recognized in the reading window, the lane change is complete.

To avoid losing the position when changing lanes, the position marks must be in the reading window of the read head at the same time (B). In this case, the read head has several positioning targets in its field of view that serve as reference points. Since the lane selection here cannot be made via the direction decision, it must be assumed that the read head randomly outputs the position based on one of the reference points. To ensure a safe lane change, the instructions in "Determining the position of ambiguous positioning targets" must be observed. Alternatively, the read head can ignore the position information until the lane change is complete.

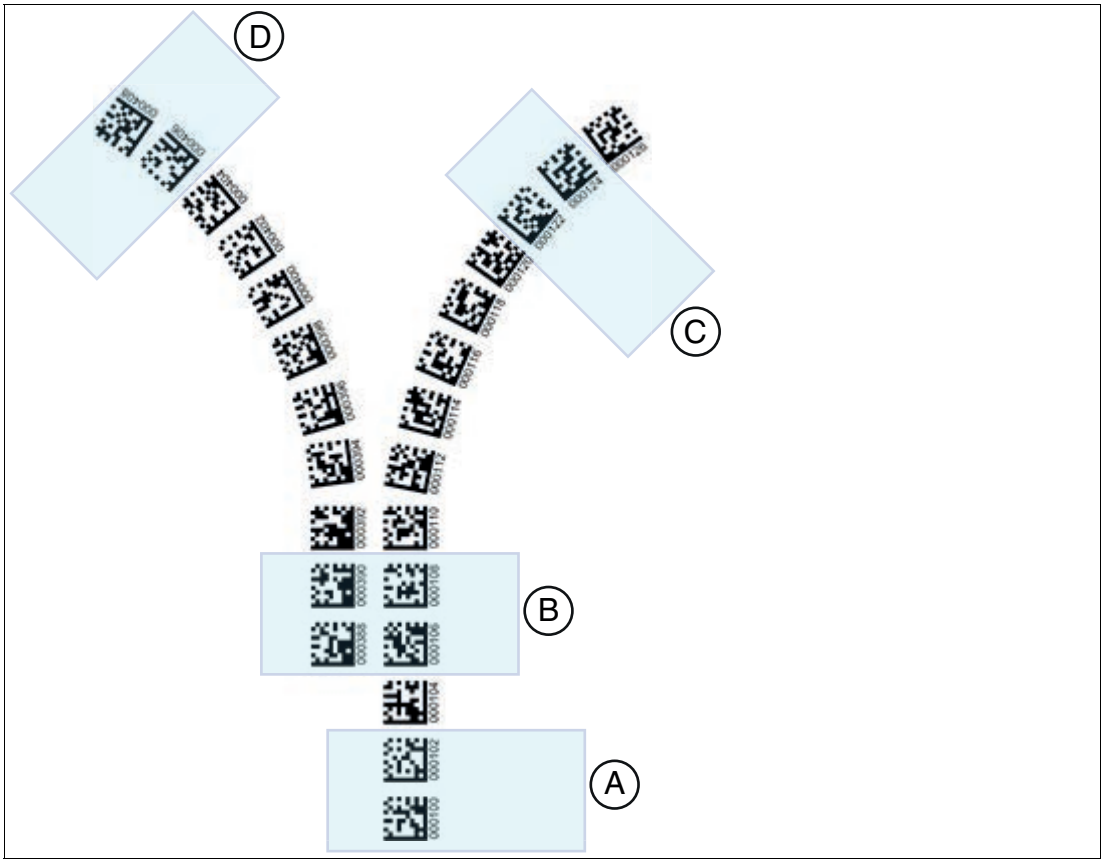

Figure 3.7 Branches/Intersections

Meaningful lane tracking	Lane selection
A —〉 B —〉 C	Right lane
A —〉 B —〉 D	Left lane
D —〉 B —〉 A	Lane with more detailed position information
C —〉 B —〉 A	Lane with more detailed position information

Determining the Position of Ambiguous Positioning Targets

If several lanes run in parallel and the specifications for branches are adhered to, the direction decision can be used to decide whether the position information for the right or left lane is output. If the read head has several position marks in the reading window where these specifications are not met, it cannot be ensured that the position output does not jump between the two reference points. This should therefore be avoided as far as possible. However, this is not always possible at intersections or special branches.

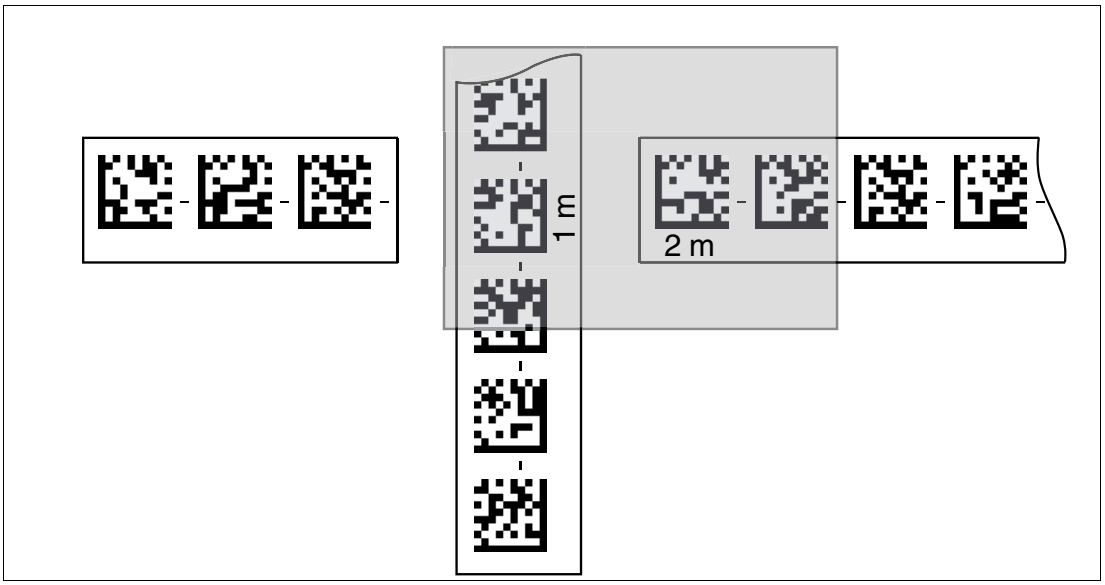

Figure 3.8

In the figure above, two different position outputs are possible, depending on which code is read.

Code at 1 m

- X: 1000 mm
- Y: -15 mm
- Angle: 0°

Code at 2 m

- X: 2000 mm
- Y: 0 mm
- Angle: 90°

If there are positions in the system where this behavior can occur, these must be taken into account. In the simplest case, the position jump is ignored. The optimal solution would be to define the position jump in the control logic as a permissible case and convert the position of the new reference point to the corresponding position of the old reference point.

3.3.2 Data Matrix Tags

In addition to lane tracking, the read head can be used in tag mode. In this mode, the read head detects Data Matrix tags, which are typically affixed to the floor in a grid. These tags are numbered in ascending order (number range: 1 to 99,999,999) and contain specific position information. The read head transmits the tag number, the position, and the angle of the auto-guided transport system (AGTS) in relation to the zero point of the recorded Data Matrix tag to the controller.

Data Matrix tags that consist of 4 to 16 Data Matrix codes offer a large tolerance range in terms of the X and Y axes. This ensures that data is transmitted reliably to the camera-based system and offers additional redundancy if individual codes become damaged or illegible.

The tag mode enables the AGTS to move freely within a specified grid as desired, without having to mark the crossing paths with lane tapes. In this case, the read head independently switches between tag mode and lane tracking, which allows the AGTS to move seamlessly from one Data Matrix tag grid to another via a Data Matrix lane.

Figure 3.9 Application example: Exact AGTS alignment when picking up goods carriers (picking of loads).

A Data Matrix tag contains position information in addition to a specific number. A cross in the center of the Data Matrix tag marks the zero point. The X and the Y axes are marked starting from the zero point. The black arrow indicates the positive axis and the white arrow indicates the negative axis.

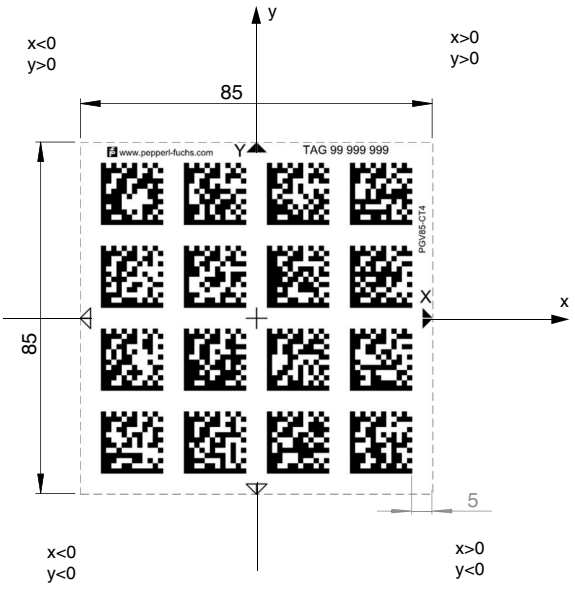

Figure 3.10 Data Matrix tag example with the number 99999999 and position information

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3.3.3 Operation Using Control Codes

Alongside the Data Matrix code tape, "control codes" can also be used to initiate starts, stops, and turns by the AGTS. Control codes are short code tape strips measuring 1 m in length. When using control codes, the positioning system delivers complete positioning information and issues a predefined control number every time a control code is read. The control code control numbers range between 001 and 999.

The layout of the lane can be adjusted according to the application in question. If an auto-guided transport system (AGTS) needs to be positioned exactly, a code tape is affixed for positioning purposes. If a process needs to be triggered at a particular position or a direction decision needs to be made, a control code is affixed parallel to the actual lane.

Only a specific event and the associated process have to be programmed into the plant control system. The position in which the corresponding control code is affixed next to the code tape does not have to be determined until the point of final commissioning of the plant. Even if subsequent changes are made to the layout of a plant, the relevant control code is simply moved and affixed in the new position. There is no need to change the program.

The read head sets the control code flag in its output data when it enters the range of a control code.

The 1-meter-long control code can be shortened. However, the minimum length must be 3 codes (60 mm). The greater the movement speed of the read head, the longer the control code strip must be. If the read head travels at maximum movement speed, a full-length control code of 1 m must be affixed next to the Data Matrix code tape.

Note

Calculating the Minimum Length of the Control Code

The minimum length of a control code can be calculated according to the following formula depending on the movement speed and trigger period. In the case of this read head, the trigger period is 40 ms:

$$L_{control\ code} = 60\ mm + V_{max}\ [m/s] * T_{Trigger}\ [s] \times 2$$

Example

Example calculation

At a speed of 3 m/s and with a trigger period of 40 ms, the minimum length of the control code strip is therefore:
$L_{control\ code}$ = 60 mm + 3 m/s * 40 ms * 2 = **300 mm**

Control codes are identified by the printed number, e.g., in this case "Control 12." The following illustration shows part of control code #12.

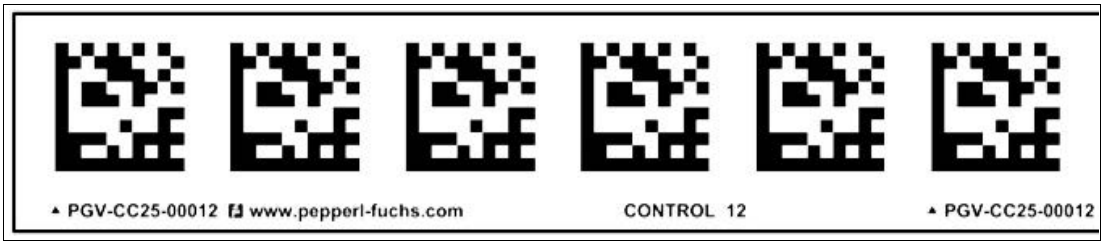

Figure 3.11 PGV-CC25-00012

Order Information (Example)

Control code numbers from **150** to **199** are required. The order is placed using the start number for the number range and the consecutive number for the number range. This results in the order designation **PGV-CC25-150-050-SET**. The number 50 in the order designation represents the number of control code strips each measuring 1 m in length.

The number of control code numbers is derived from **end code number - start code number + 1**.

Calculation example: 199 - 150 + 1 = 50 (number of control code strips each measuring 1 m in length)

Control code numbers from 1 to 999 can be ordered as required. In this example, the delivery consists of 50 control code strips, each measuring 1 m in length. The length of a single control code number is always 1 m. The control code strip is 1 m in length and can also be shortened if necessary. Please note that, depending on the travel speed and the measuring rate of the read head, the control code tape must have a minimum length to be detected reliably.

Status of Data Matrix Control Code

The orientation "O" describes the orientation of the Data Matrix control code in the reading window.

Orientation "O"

Bit1 = O1	Bit0 = O0	Description
0	0	The Data Matrix control code has the same orientation as the ascending Data Matrix position code.
0	1	Orientation of the Data Matrix control code rotated 90° clockwise relative to the ascending Data Matrix position code.
1	0	Orientation of the Data Matrix control code rotated 180° clockwise relative to the ascending Data Matrix position code.
1	1	Orientation of the Data Matrix control code rotated 270° clockwise relative to the ascending Data Matrix position code.

Side "S" specifies the side of the Data Matrix lane on which the Data Matrix control codes are present.

Side "S"

Bit1 = S1	Bit0 = S0	Description
0	0	No Data Matrix control code present or found
0	1	The Data Matrix control code is located to the right of the Data Matrix code tape.
1	0	The Data Matrix control code is located to the left of the Data Matrix code tape.
1	1	Data Matrix control code not detected

Note

Maximum of 2 Data Matrix Code Tapes in the Reading Window

The maximum number of Data Matrix code tapes in the reading window is limited to 2 and one control code.

The following illustrations are for illustrative purposes and are simplified. The maximum number of Data Matrix control codes in the reading window is limited to 1.

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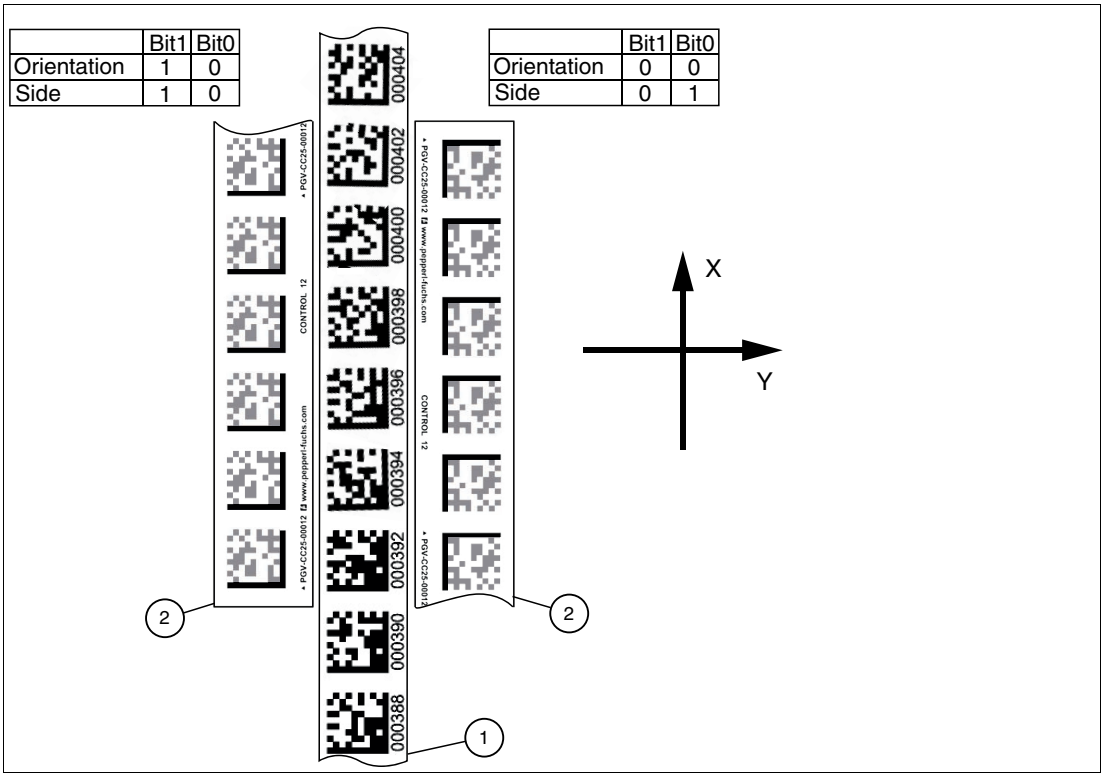
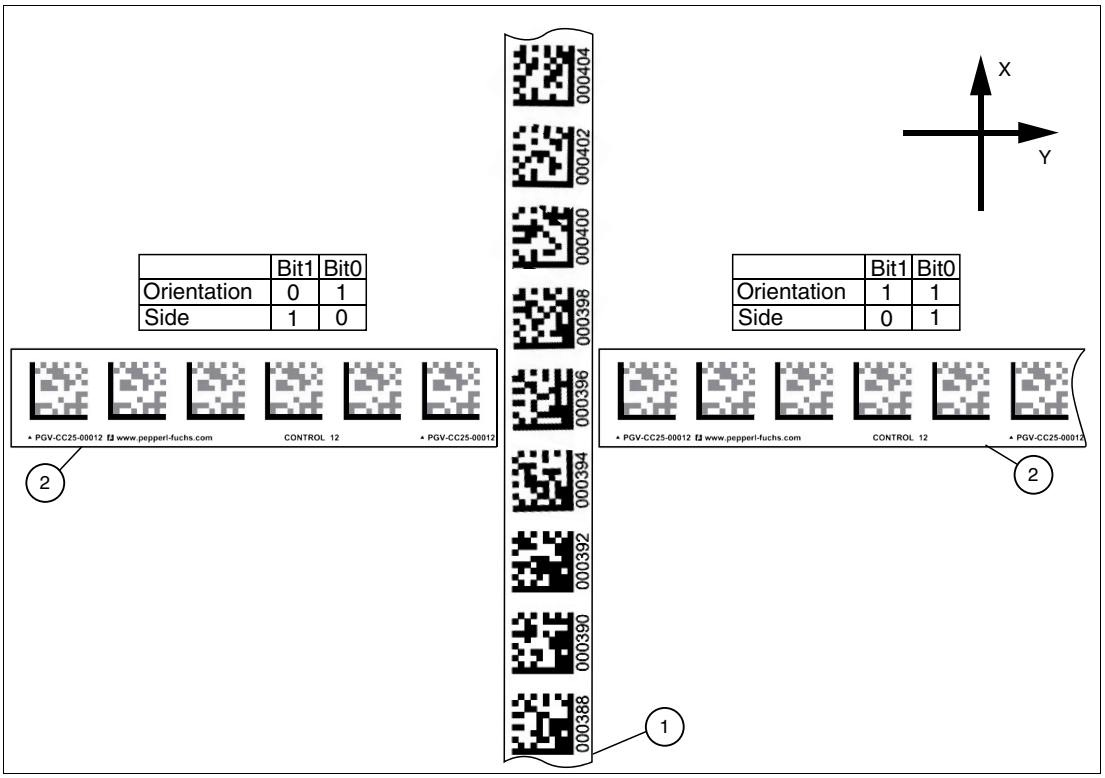


1. Data Matrix position code
2. Data Matrix control code



1. Data Matrix position code
2. Data Matrix control code

3.4 Angle and Distance Output

Angle Value

The read head detects the absolute angle "α" in relation to the code tape with a maximum resolution of 0.1°. The angle is specified as an absolute value relative to the tracked code tape, since a Data Matrix code tape contains direction information. The output angle covers the range from 0° to 360°. The resolution can be set to the following values:

- 0.1°
- 0.2°
- 0.5°
- 1°

Note

Absolute Values

Angles are specified as absolute values. The respective value is calculated from the resolution selected under "Angular Resolution." With a resolution of 0.1°, an angle of **60**° is output as 60°/0.1° = **600**.

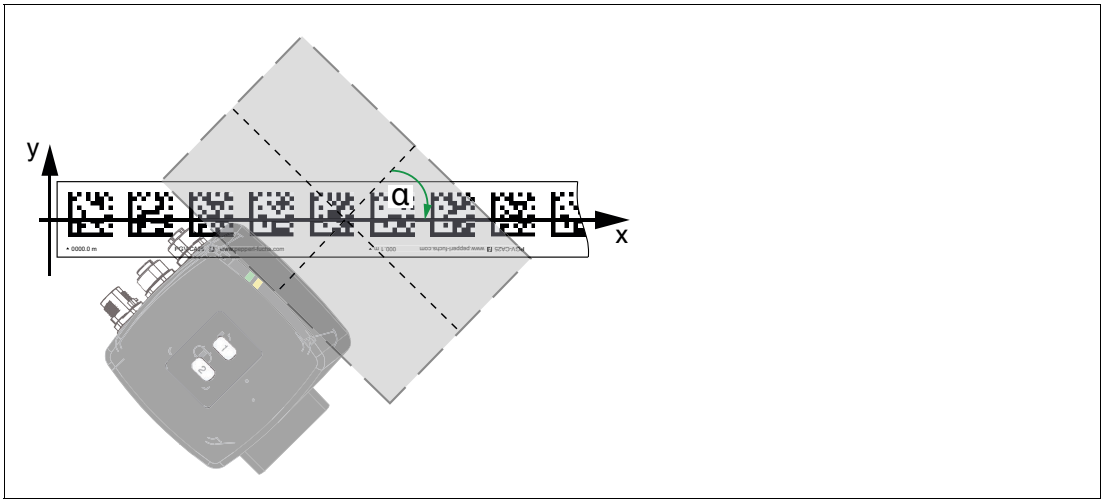


Figure 3.12 Absolute angle at 45°

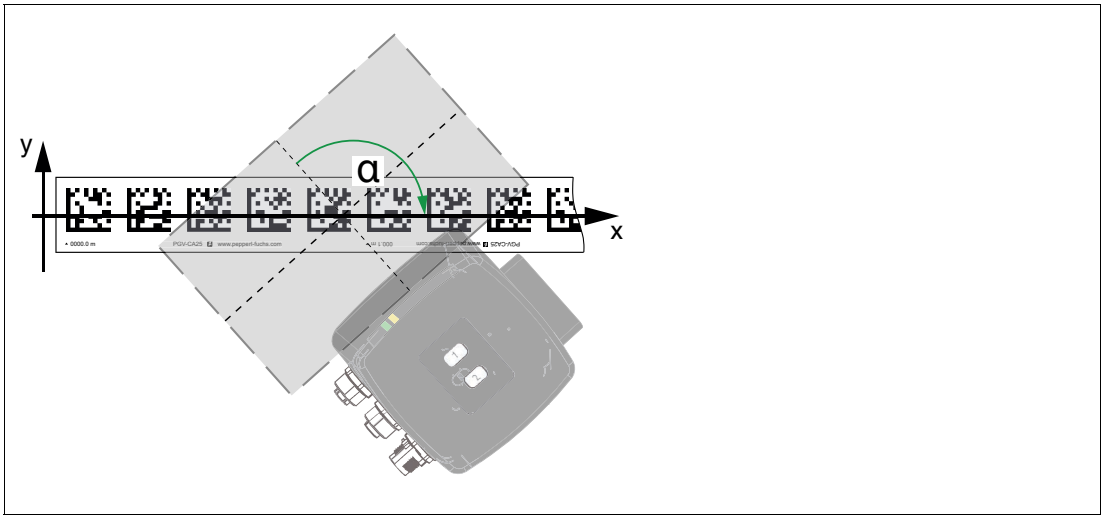


Figure 3.13 Absolute angle at 130°

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Distance Output

The read head detects the distance to the Y zero line of the Data Matrix code tape and passes this value on to the controller.

The read head outputs the vertical distance "A" relative to the Data Matrix code tape.

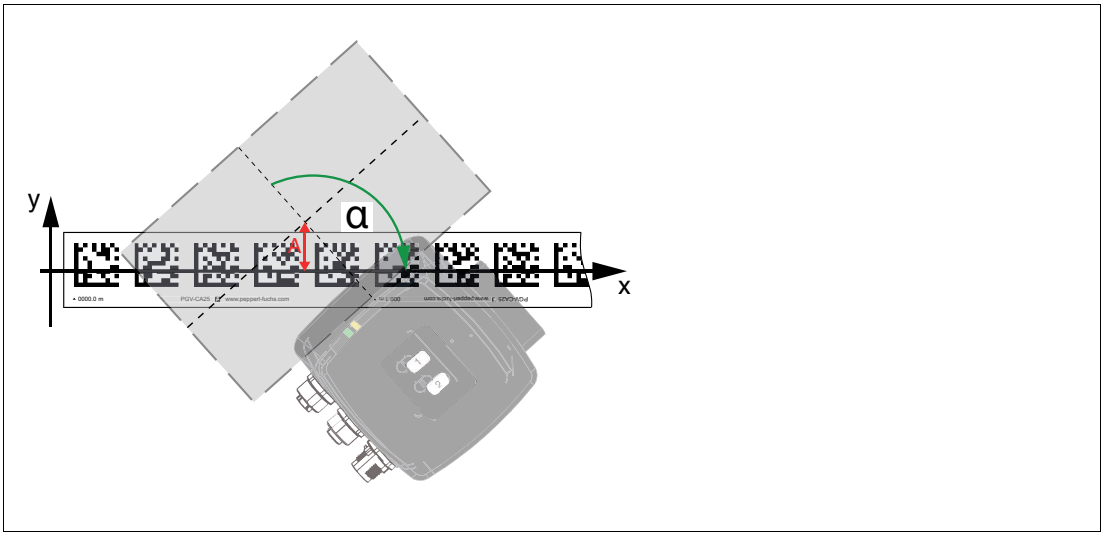

Figure 3.14 For example: Distance A = 20 mm and angle α = 130°

3.5 Reading Range of the Read Heads

The reading range is the part of the field of view of the read head in which Data Matrix codes can be decoded. It must be ensured that the Data Matrix code is completely in the reading range. Data Matrix codes require a quiet zone (white area without coding) of at least 2 mm around the code to ensure successful reading. This quiet zone must not be violated when cutting the code.

The field of view is the maximum image on the sensor chip that is determined by the optical properties of the camera. The size of the field of view varies with the distance between the read head and the Data Matrix code tape. If the read head is positioned farther away from the Data Matrix code tape, the field of view is larger. If the read head is closer to the Data Matrix code tape, the field of view is smaller due to the shorter distance.

Field of View of the Read Head PGV100IQ-F200-B21-V1D

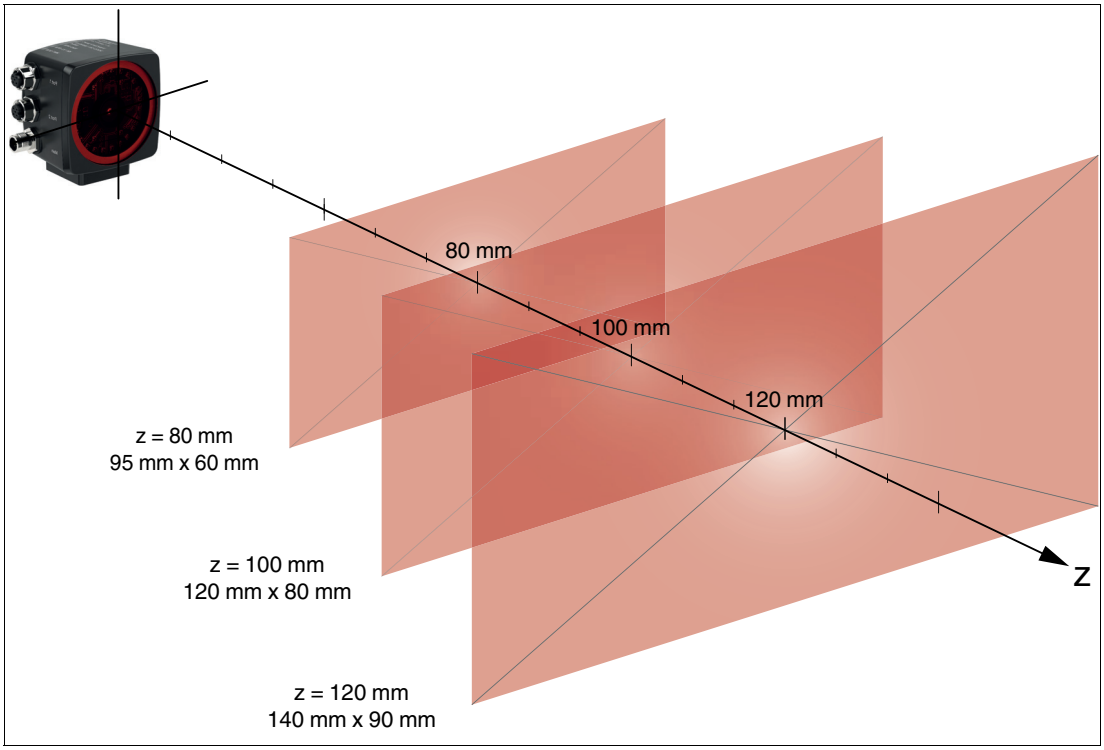

Figure 3.15 Size of the reading window of the read head in relation to the read distance z

Size of Reading Window at Nominal Distance 100 mm

Read distance z [mm]	80	100	120
Reading window size [mm]	95 x 60	120 x 80	140 x 90

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Field of View of the Read Head PGV150IQ-F200-B21-V1D

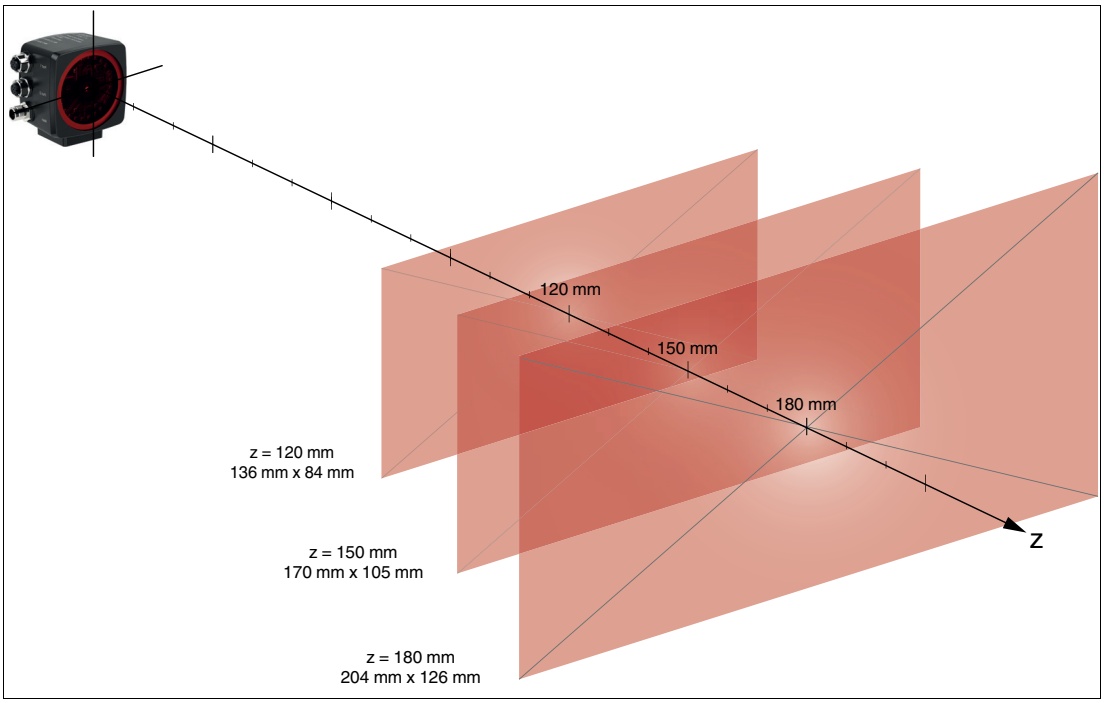


Figure 3.16 Size of the reading window of the read head in relation to the read distance z

Size of Reading Window at Nominal Distance 150 mm

Read distance z [mm]	120	150	180
Reading window size [mm]	136 x 84	170 x 105	204 x 126

3.6 Read Head Orientation

The read head offers reliable code detection from any angle. For optimal results, we recommend setting the alignment of the read head to 0° or 180° in relation to the Data Matrix code tape. In this alignment, the read head offers greater tolerance along the Y axis. Please note, however, that this alignment leads to a reduction in code redundancy.

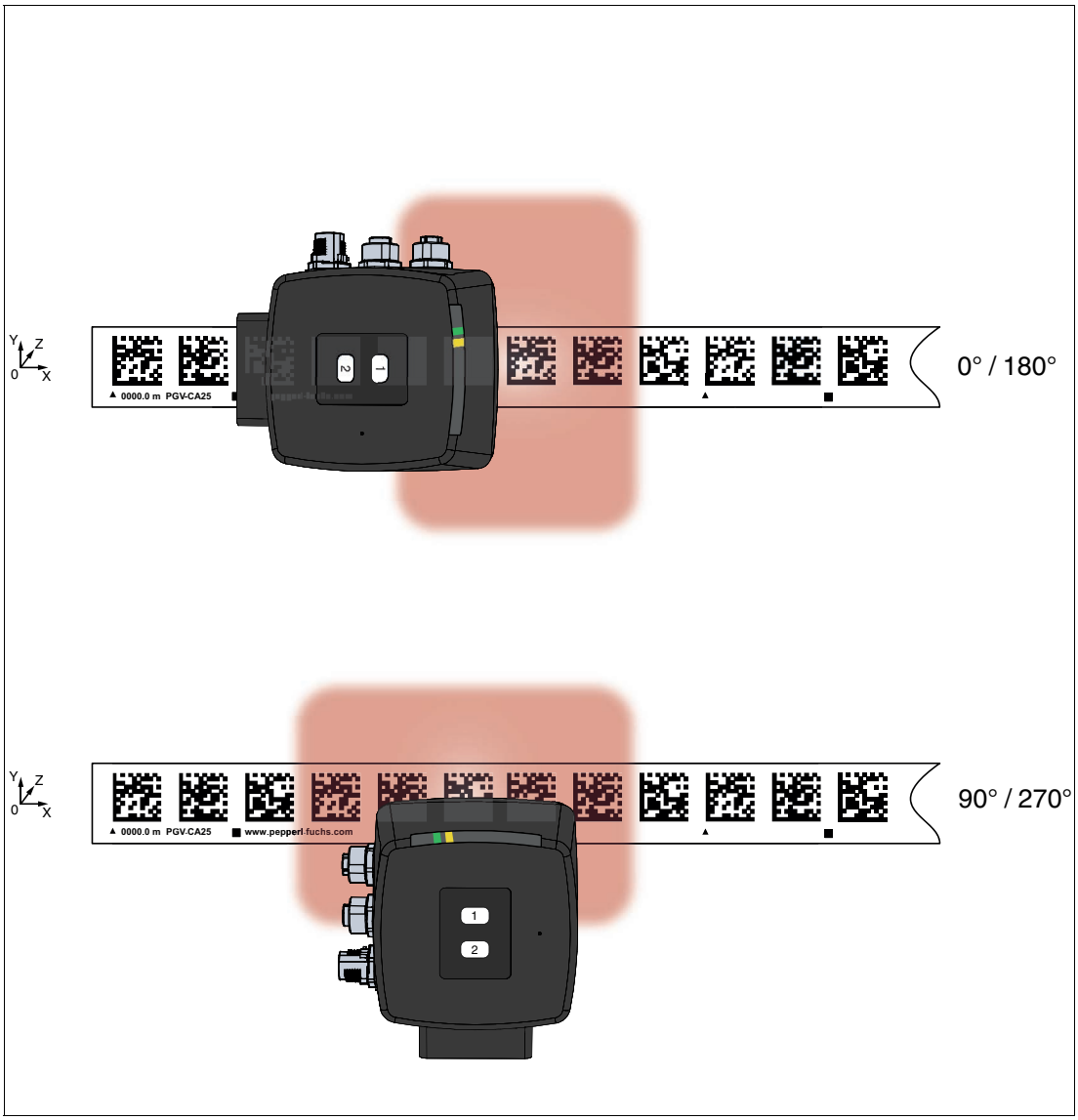


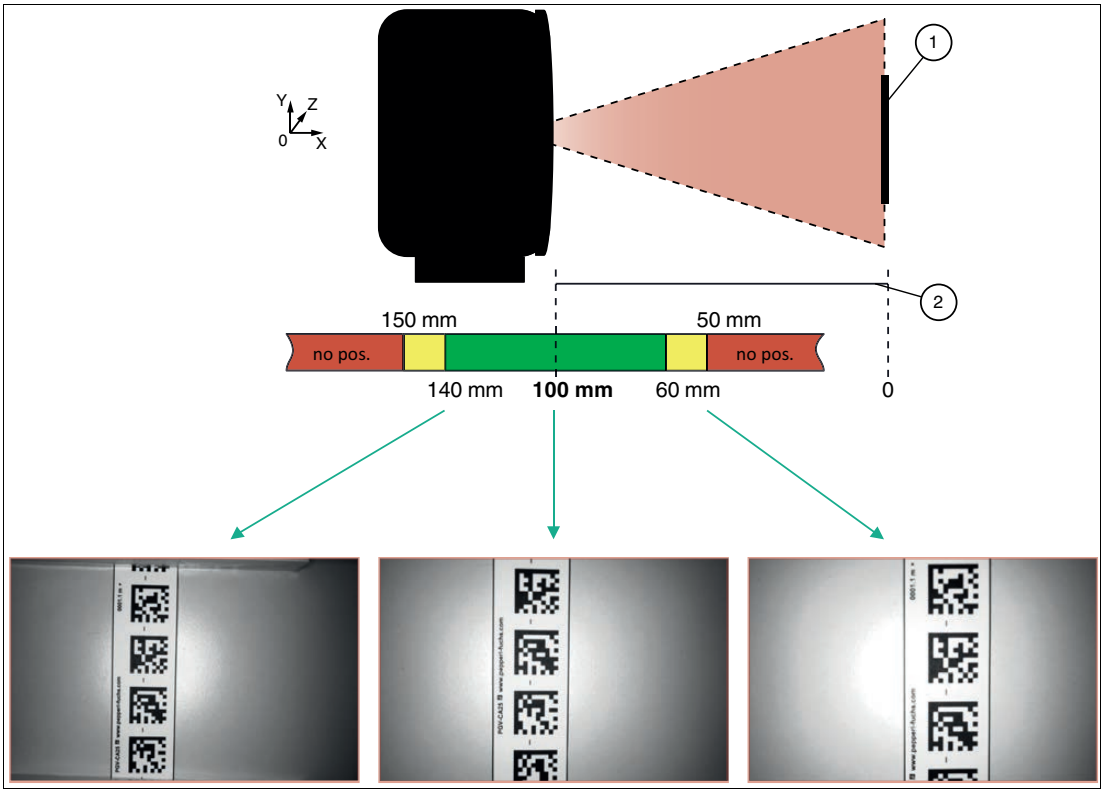
Figure 3.17 Read Head Orientation

3.7 Aligning the Read Head with the Data Matrix Code Tape

3.7.1 Horizontal Tolerance: Read Distance Z

The head offers a high depth of field at different reading distances. If the read head is mounted too close or too far away from the Data Matrix code tape, a warning message is issued. We recommend that the read head always be mounted at the nominal distance to ensure the highest possible availability of the system (due to resolution and code redundancy). Pay particular attention to the reduced mounting tolerance in the Y direction and the reduced gap width, especially at extremely close reading distances.

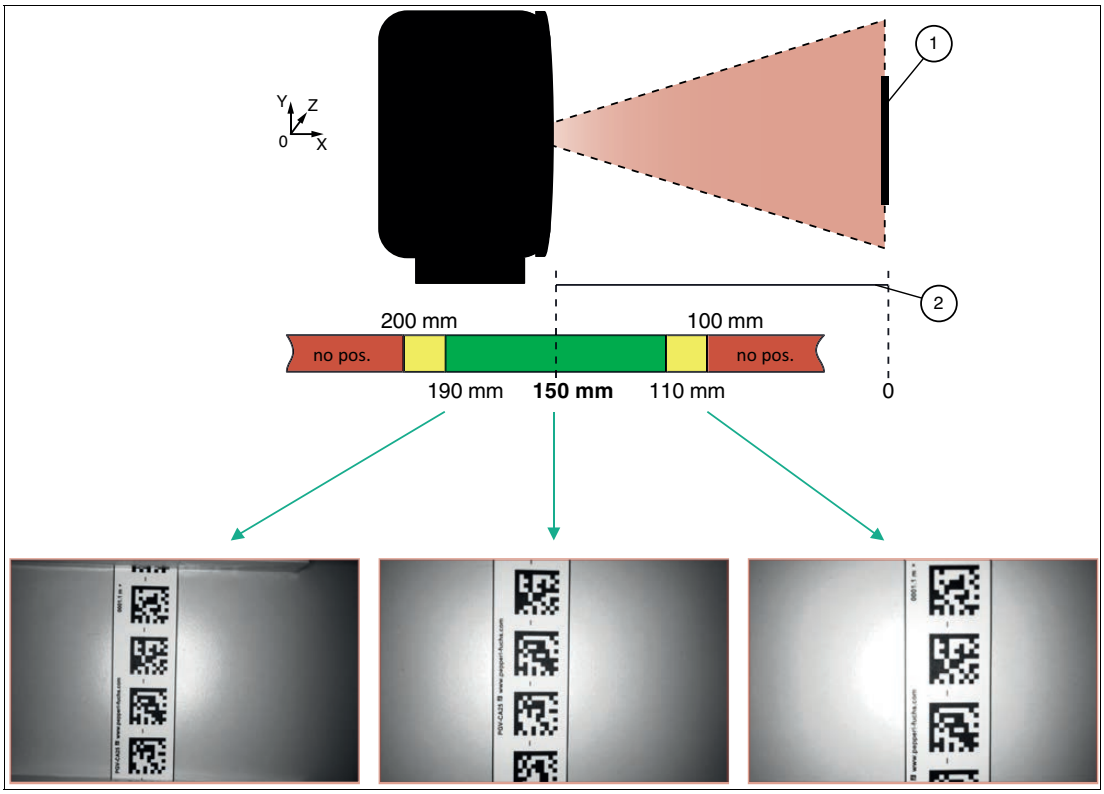
Nominal Distance 100 mm



1	Data Matrix code tape
2	Read distance to the Data Matrix code tape in Z direction
Green	Recommended reading range: Nominal value 100 mm ± depth of focus
Yellow	Range in which a "warning bit" is set
Red	Range in which a "no pos. bit" is set

Read distance (z)	Range "no pos." bit	Range "warning" bit
< 50 mm	x	
< 60 mm		x
100 mm		
> 140 mm		x
> 150 mm	x	

Nominal Distance 150 mm



1	Data Matrix code tape
2	Read distance to the Data Matrix code tape in Z direction
Green	Recommended reading range: Nominal value 150 mm ± depth of focus
Yellow	Range in which a "warning bit" is set
Red	Range in which a "no pos. bit" is set

Read distance (z)	Range "no pos." bit	Range "warning" bit
< 100 mm	x	
< 110 mm		x
150 mm		
> 190 mm		x
> 200 mm	x	

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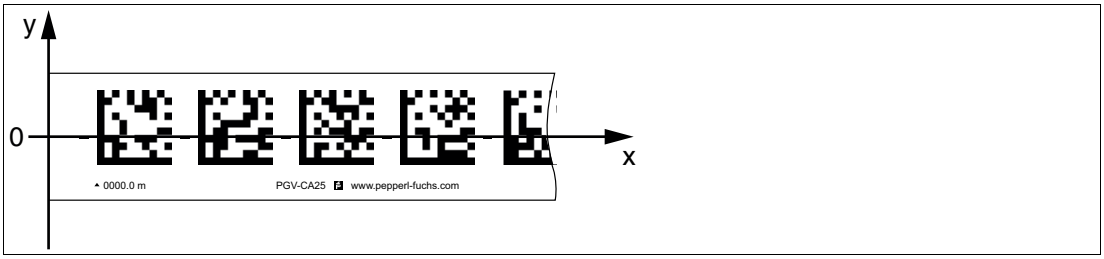
3.7.2 Vertical Tolerance - Height Tolerance Y

If the read head moves along the Data Matrix code tape (X axis) in the Y direction and leaves the zero line (Y = 0), the position is no longer detected from the value $\pm Y_0$. The read head continuously detects its position in relation to the Data Matrix code tape and compares the current limit value. If the error exceeds the limit value (shown in red in the following figures), the read head loses the position, and a "no position" message is output.

The Y position data is output as input data via the EtherCAT interface.

Zero line (Y = 0)

If the read head has detected a Data Matrix code tape, this Data Matrix code tape can move away from the zero point in the Y direction within the field of view. The maximum Y value at which the read head can still detect this distance from the zero line is set as $+Y_0$ or $-Y_0$. These values are dependent on the distance (Z) to the read head and the alignment of the read head. The values below are valid for the specified nominal distance.



Nominal Distance 100 mm (PGV100*)

Read Head Orientation	Height tolerance (Y)	Range "No position message"
0° or 180°	> 45 mm	x
	0 mm	
	< - 45 mm	x

Read Head Orientation	Height tolerance (Y)	Range "No position message"
90° or 270°	> 25 mm	x
	0 mm	
	< - 25 mm	x

Nominal Distance 150 mm (PGV150*)

Read Head Orientation	Height tolerance (Y)	Range "No position message"
0° or 180°	> 70 mm	x
	0 mm	
	< - 70 mm	x

Read Head Orientation	Height tolerance (Y)	Range "No position message"
90° or 270°	> 35 mm	x
	0 mm	
	< - 35 mm	x

Target Range

The read head is in an optimal position with respect to the Data Matrix code tape.

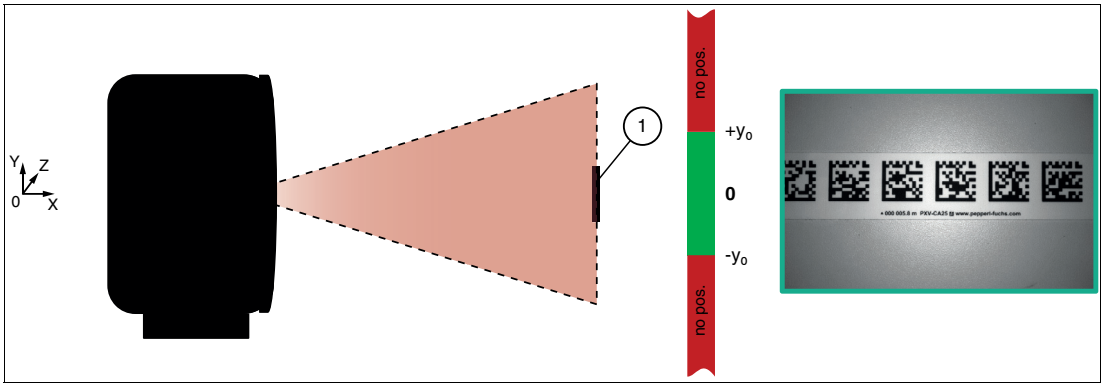


Figure 3.18 Green: recommended range

1: Data Matrix code tape

No-Position

The read head is positioned too low in relation to the Data Matrix code tape and loses the position. The message "No-Position" is output.

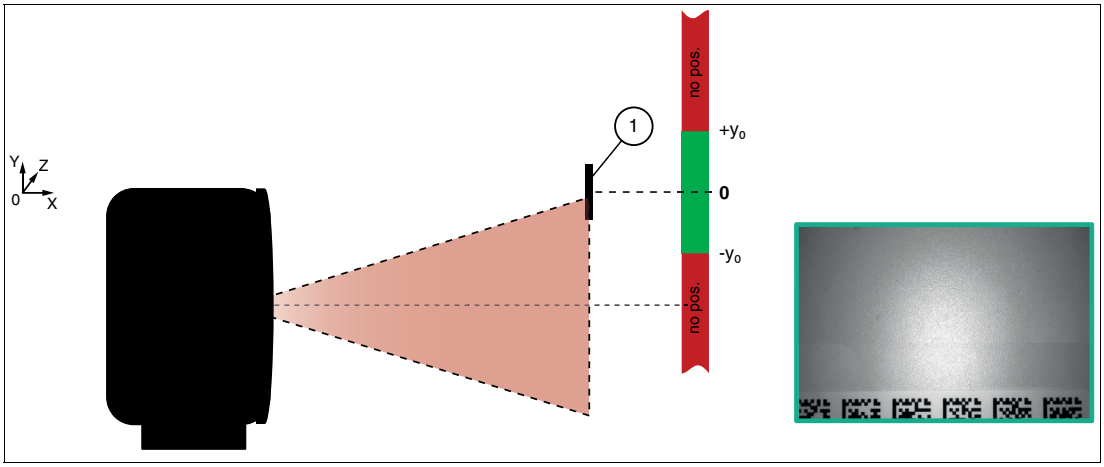


Figure 3.19 Red: Range in which a "No-position" message is set

1: Data Matrix code tape

3.7.3 Inclination Angle

Inclination angle of ± 30° possible. It should be noted that the extreme tolerances do not apply in total.

Simultaneous tilting possible in both X and Y directions.

Note

Simultaneous tilting in the X and Y directions is allowed. It is important to note that tilting the sensor shifts the reading window. If the sensor is tilted too much, this can cause the reading window to stop covering the Data Matrix codes.

Angle Tolerance on the Y Axis

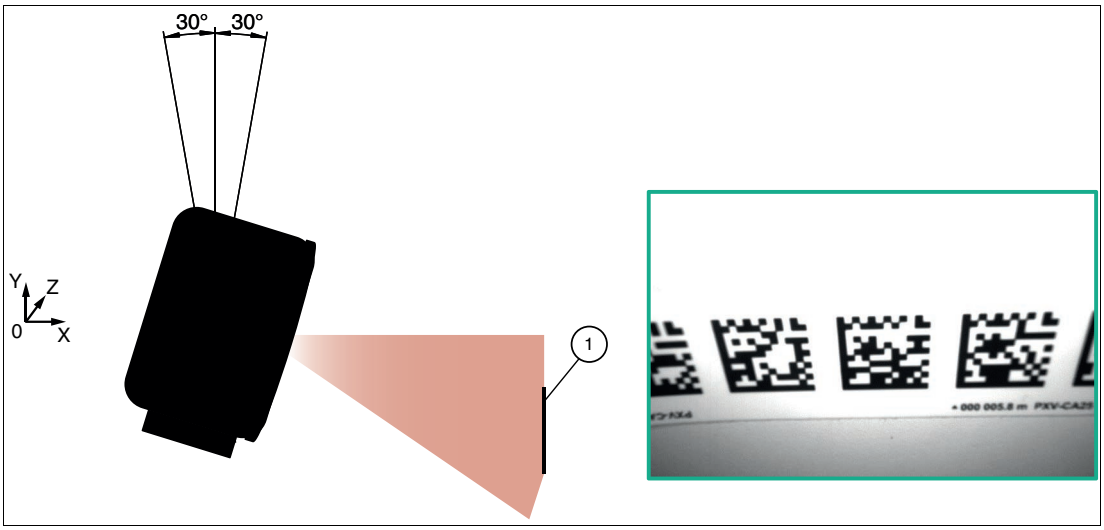


Figure 3.20 Vertical orientation tolerance

1 Data Matrix code tape

Angle Tolerance on the X Axis

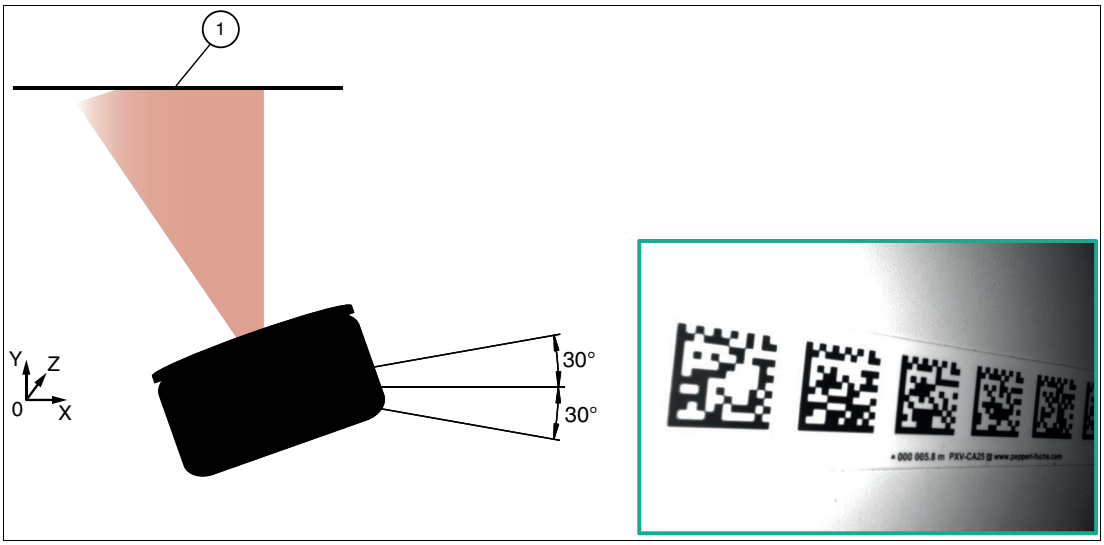


Figure 3.21 Horizontal orientation tolerance

1 Data Matrix code tape

3.8 Gaps/Interruptions

To compensate for length changes in plant structures, expansion joints are usually required for longer tracks. If a Data Matrix code tape is applied at such locations, we recommend that you interrupt the code tape at the edge of the expansion joint and continue with a fully readable Data Matrix code tape. The read head is able to drive over expansion joints and gaps without loss of position.

The maximum gap (D) refers to the distance between two fully readable Data Matrix codes. It is therefore necessary to observe the grid of the code tape and ensure that the gaps are within the grid. The maximum gap width (D) not only depends on the reading distance, but also on the orientation of the read head.

It is therefore recommended to determine and maintain the maximum gap width based on the specific reading distance, the alignment of the read head, and the pattern of the code tape. Below are some typical values for the maximum gap width (D) depending on the read distance and the alignment of the read head.

Note

Maintain the Quiet Zone!

A quiet zone (white space without coding) of 2 mm must be maintained around the Data Matrix codes. To ensure that the read head can read the Data Matrix codes, the quiet zone of 2 mm around the Data Matrix code must not be violated when cutting the code tape.

Note

The following values apply only to straight sections, not curves.

Maximum Gap for Read Head Orientation 0°/180°

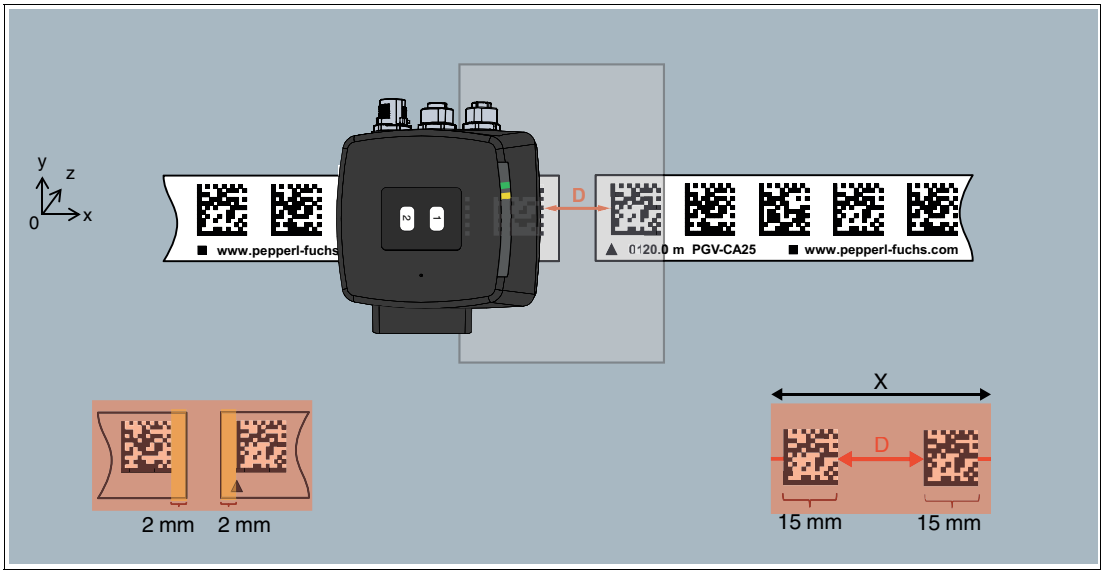


Figure 3.22 Expansion Joints / Gaps

Note

Please note that with this alignment of the read head, the code redundancy or the gap width is reduced.

Maximum Gap Width (D)

Read distance (Z)	Max. gap width (D)
80 mm	26 mm
100 mm	46 mm
120 mm	56 mm

Maximum Gap for Read Head Orientation 90°/270°

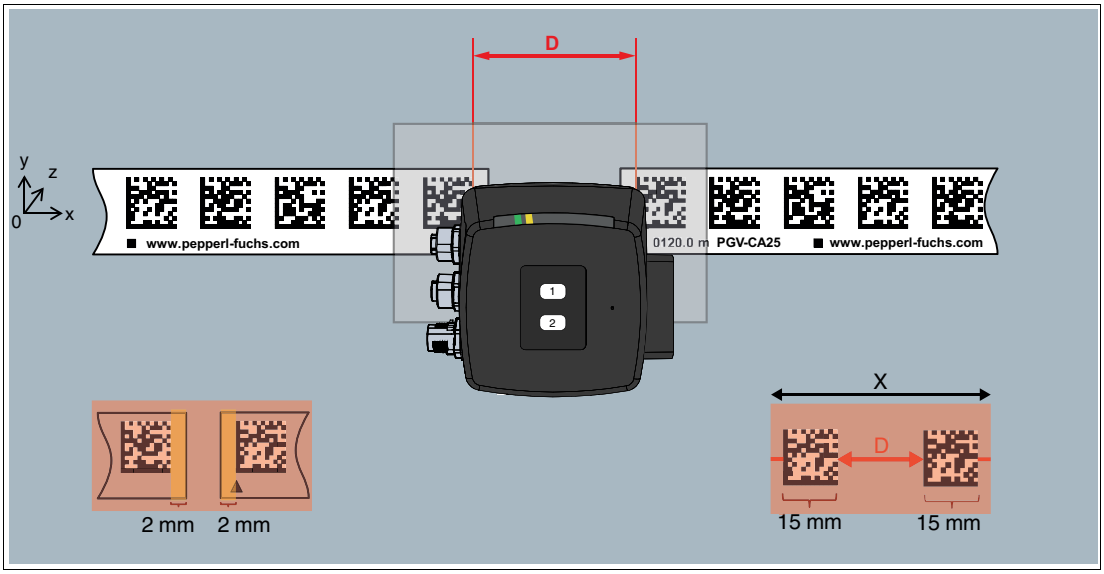


Figure 3.23 Expansion Joints / Gaps

Note

Please note that the gap width D defines the distance between two complete Data Matrix codes and not the actual mechanical gap width.

Maximum Gap Width (D)

Read distance (Z)	Max. gap width (D)
80 mm	61 mm
100 mm	86 mm
120 mm	106 mm

Examples of the Gap Width for Consecutive Missing Data Matrix Codes

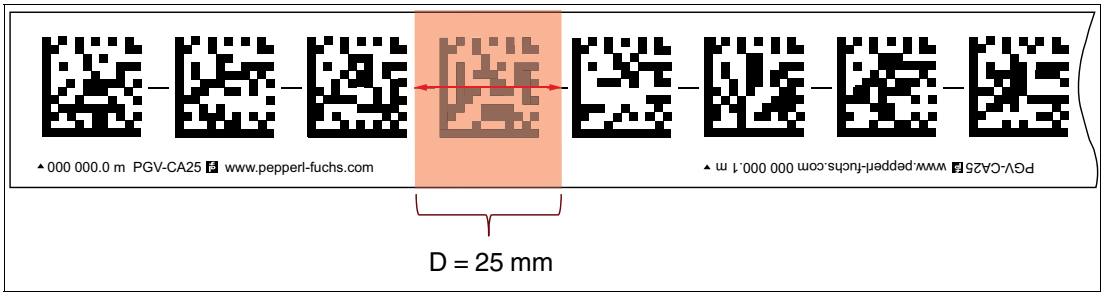
The read head expects Data Matrix codes with an ascending number sequence in a predefined grid. A new code every 20 mm. This grid should be adhered to as far as possible at the interruptions to avoid position jumps.

If the code tape is cut and glued directly to the next code number, this can lead to a position jump and therefore to a high speed value. This is because the next Data Matrix code does not come after 5 mm as expected by the positioning system, but over a longer distance, the gap width.

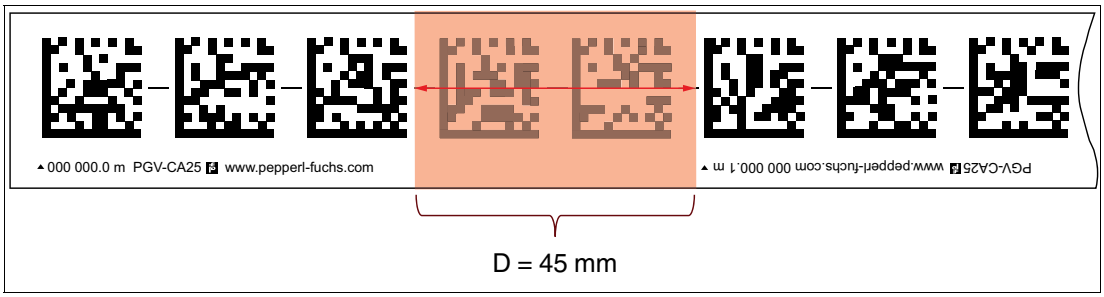
It is therefore recommended to cut the codes according to the gap width. The quiet zone of 2 mm around the code must always be observed.

The maximum number of consecutive missing Data Matrix codes is limited and depends on various factors. In particular, the reading distance, the alignment of the read head, and the pattern of the code tape are crucial here. These factors must be taken into account when applying the Data Matrix code tape. Below are some examples of the maximum allowable gap width.

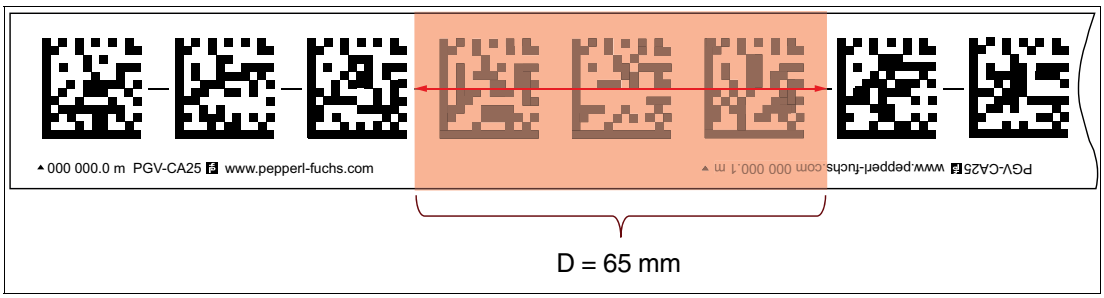
1 missing Data Matrix code



2 missing Data Matrix codes



3 missing Data Matrix codes



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Cutting Rule

The code tape is laid in ascending order of position, whereby the distances between the codes are defined by the pattern of the code tape.

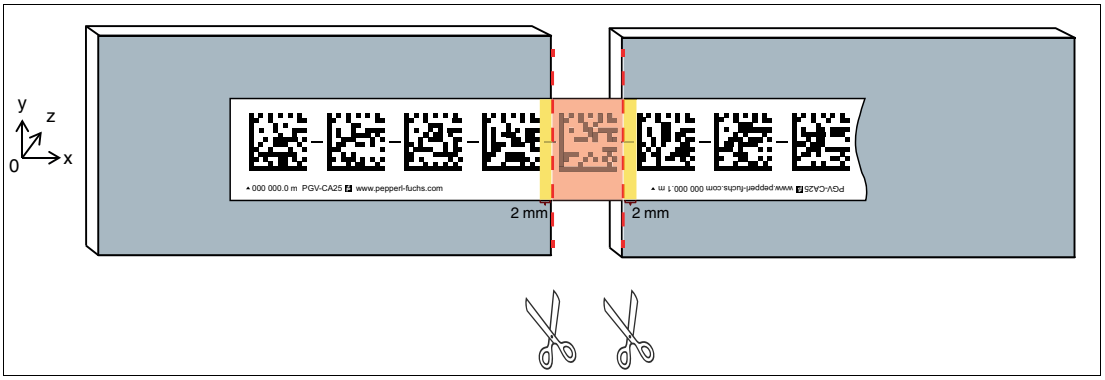

Figure 3.24

- Always cut the code tape centrally between two codes.
- In borderline situations, a projection of 2 mm of the white edge must be left.

There are several options for laying the Data Matrix code tape over gaps (e.g., expansion joints), three of which are shown below. For switch points, a position jump always takes place, so case 3 must be taken into account.

Case 1 - Continuous Bonding

Glue the Data Matrix code tape continuously and cut out the codes in the area of the gap.

Advantage: The codes remain continuously in the same position grid. Therefore, there is no difference between the logical and mechanical position.

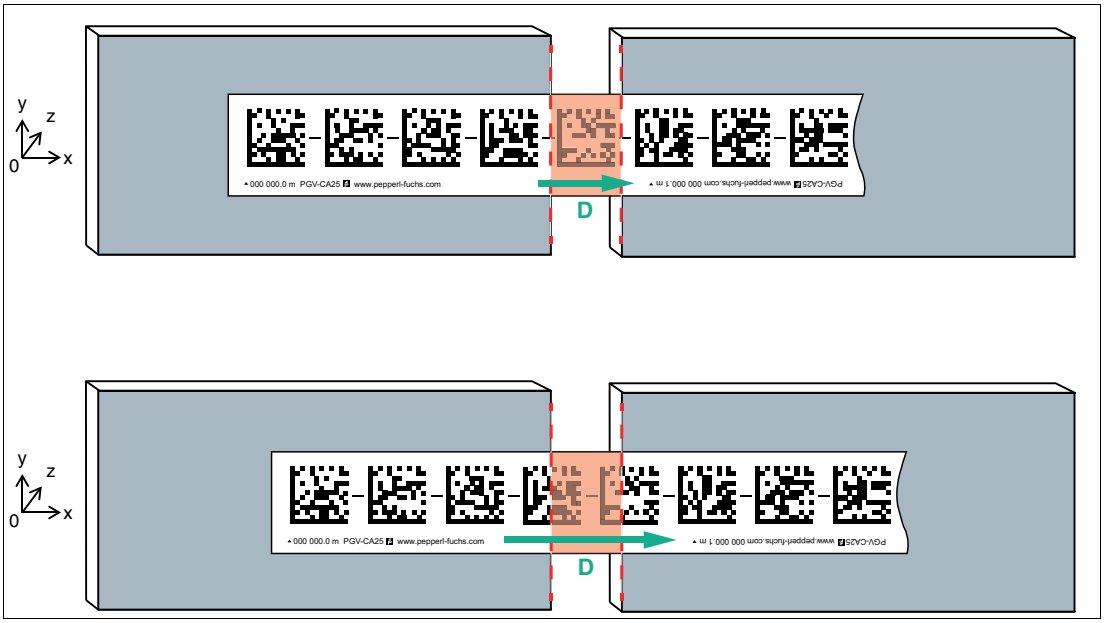

Figure 3.25

- Depending on the pattern of the Data Matrix code tape, a different number of codes can be cut out.
- The gap condition refers to the distance D between two complete Data Matrix codes. The figure below shows that the distance D is significantly larger than in the upper figure, although the gap to be bridged is the same.
- The maximum permissible gap in relation to the selected measuring distance (z) must be observed.

Case 2 - Continuous Continuation

Glue the Data Matrix code tape up to the gap and cut out the codes in the area of the gap. Continue the code tape at the continuous component.

Advantage: In the case of extremely wide gaps, the Data Matrix code tape can be optimally mounted along the mechanical gap. However, a logical jump occurs in the position value or velocity value within the transition area, because the read head expects the Data Matrix codes in a fixed grid.

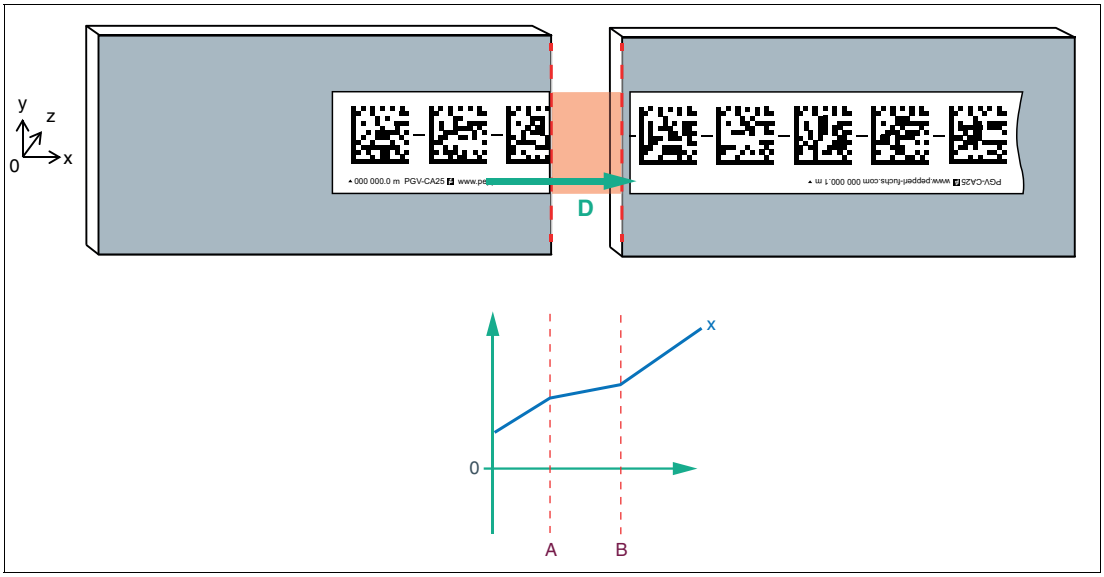

Figure 3.26

The x value is adjusted to the actual distance

Case 3 - Continuous Continuation with Position Jump

Glue the Data Matrix code tape up to the gap/expansion gap and continue the Data Matrix code tape with a position difference of > 1 meter at the continuous component.

Advantage: In the case of extremely wide gaps, the tape can be optimally mounted on mechanical gaps. The position jump results in a transition hysteresis, a defined position change or jump.

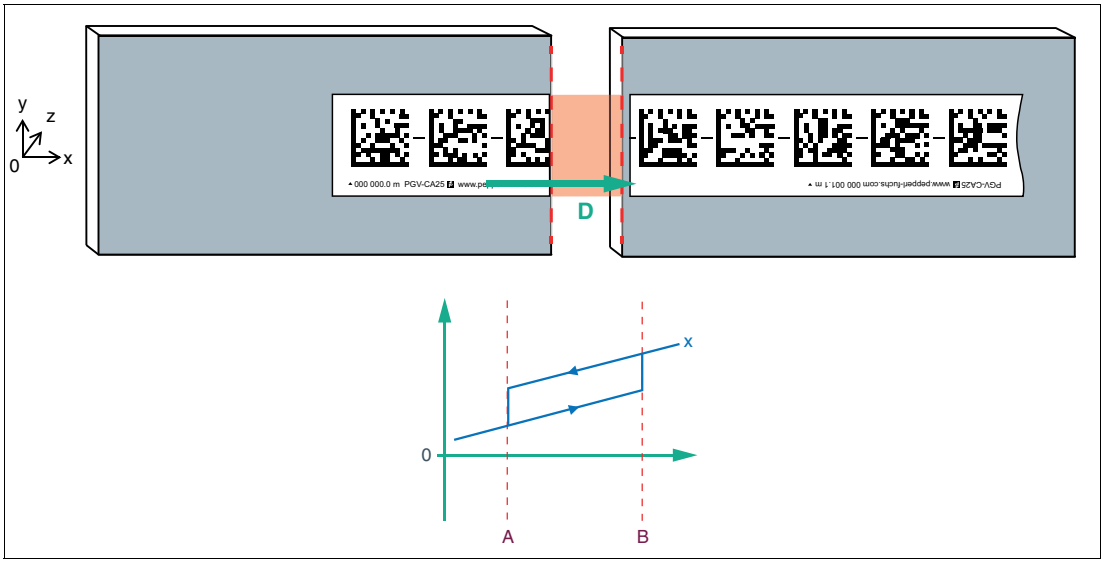

Figure 3.27

The x value remains constant at its historical value and shows a hysteresis of 21 mm. When the center of the image approaches the next code, there is a jump.

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Case 4 - Gap is too Large

For a short period of time, the read head outputs the message "No Position."

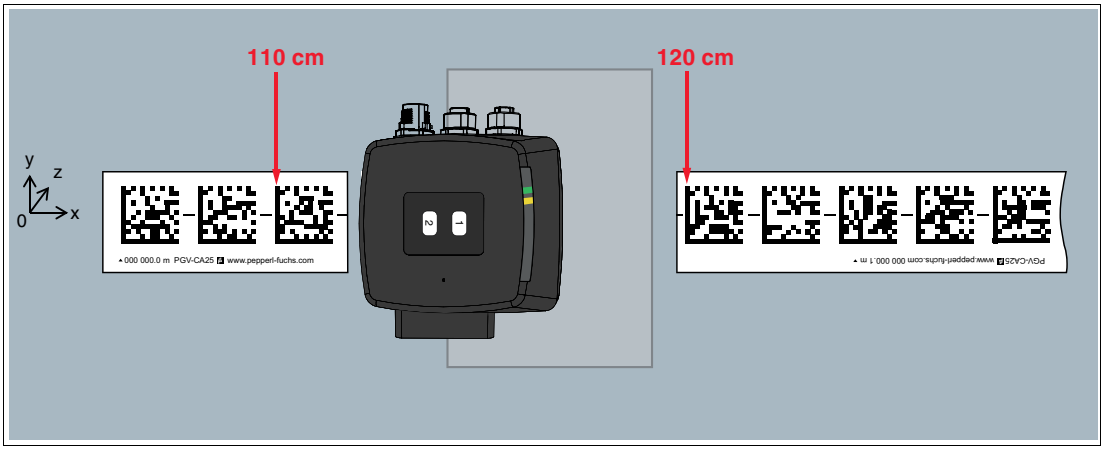


Figure 3.28

y offset

To ensure successful detection of Data Matrix codes on a code tape, the offset **V** between the position codes must not be so large that the actual codes lie outside the reading window.

Note

By transmitting the y position and the angle, lane deviations can be continuously corrected. This may result in a hard steering intervention in case of a y-offset to get the vehicle back in the lane.

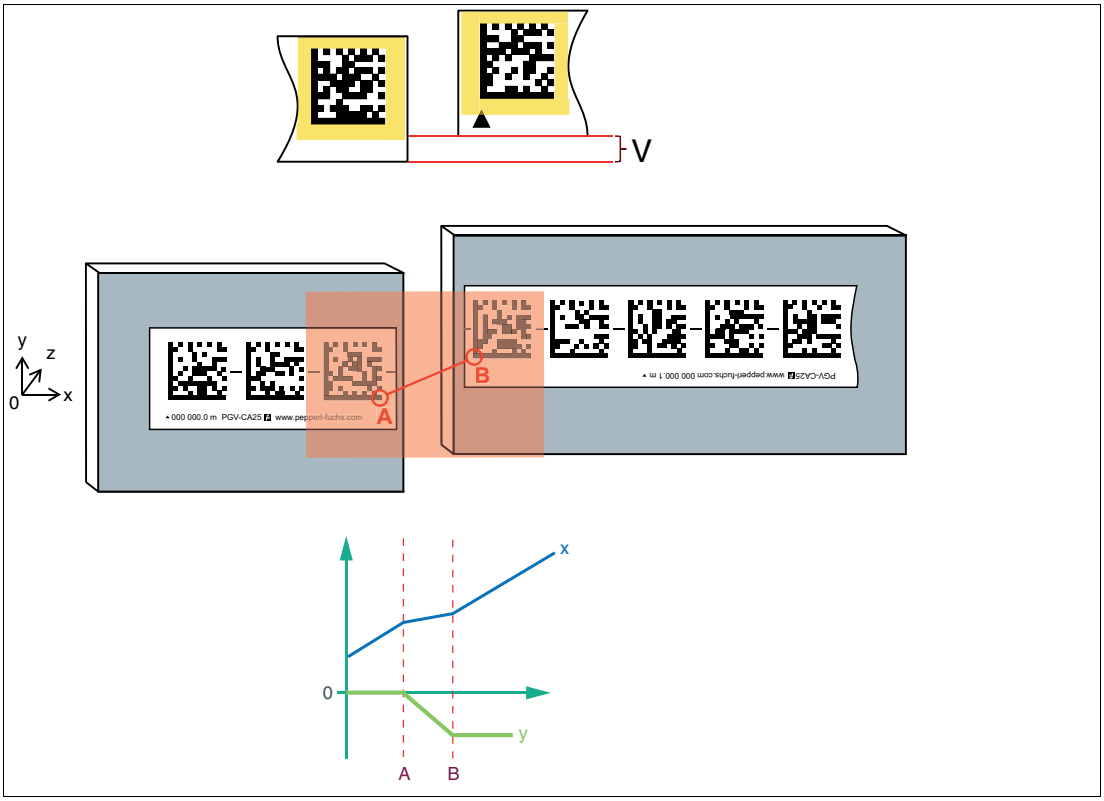


Figure 3.29 Offset

Thermal Expansion of the Surface

Note

Thermal expansion coefficient

The thermal expansion coefficient of the attached code tape depends on the thermal expansion coefficient of the surface.

When planning the system, consider the worst-case scenario that can be caused by thermal expansion of the surface and adjust the Data Matrix code tape to fit the expansion joint accordingly.

One way of reducing the gap between the Data Matrix code tapes in the case of thermal expansion of the surface is to move the butt edges of the Data Matrix code tapes a few millimeters toward the expansion joint. Ensure that the Data Matrix code tapes do not overlap. The quiet zone around the Data Matrix codes of 2 mm must always be observed.

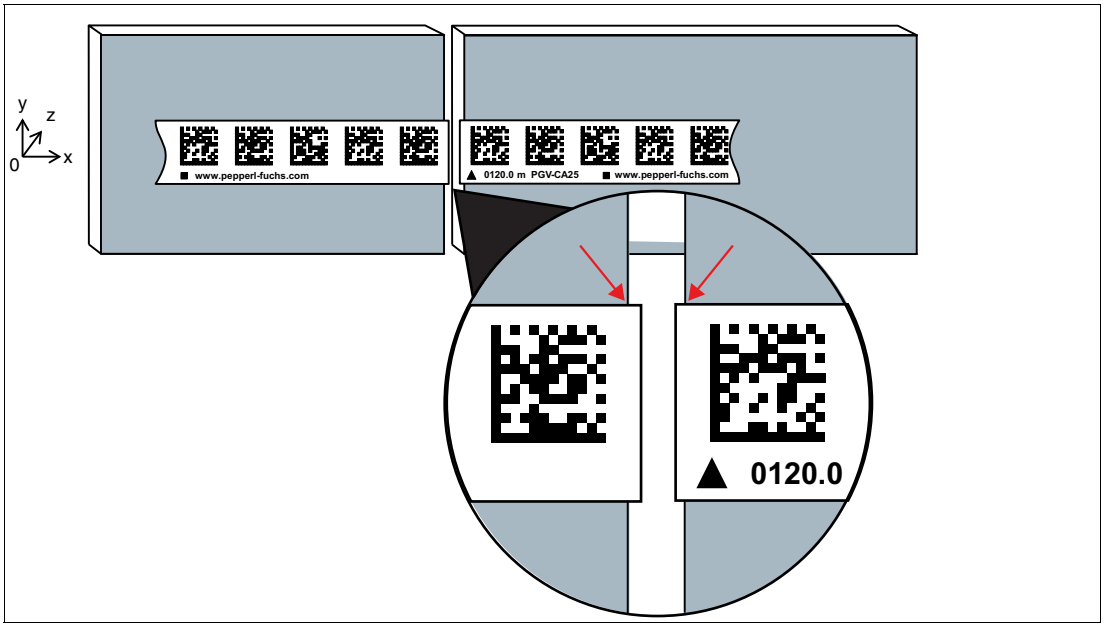


Figure 3.30

3.9 Real-Time Positioning

The read head with timestamp and sync output function ensures extremely accurate synchronization and chronological assignment of image captures and the associated position data. These functions make the read head a reliable component for demanding real-time applications in industrial automation.

The read head is ideal for applications requiring high precision and synchronization, such as logistics and transportation. It ensures that the exact positions of transport vehicles can be captured and controlled in real time, which contributes to efficient and reliable process control.

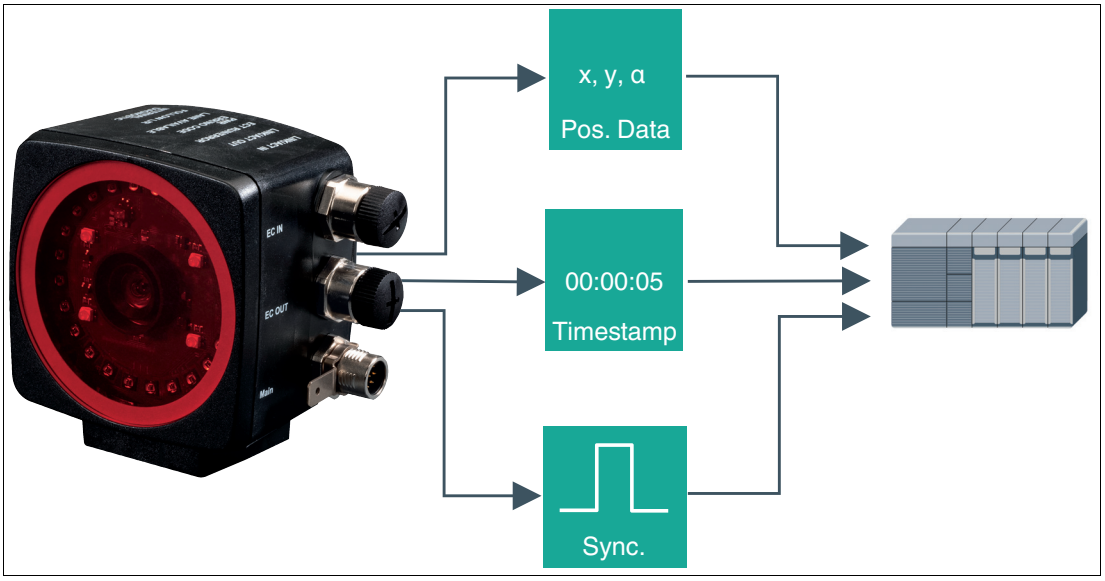


Figure 3.31

Timestamp

The timestamp is the time at which the image is captured, on the basis of which the position values are determined.

- The timestamp is used to determine the exact cycle time between two images.
- The timestamp is a 32-bit counter that continuously counts up to document the exact time of the image capture.
- The time base of the timestamp is an internal 27 MHz timer. This timer is not synchronized with an external source.
- The timestamp is transmitted to the controller together with the position data and allows the cycle time between two image captures to be calculated.

Note

The following formula applies to the calculation of the cycle time between two images captures:

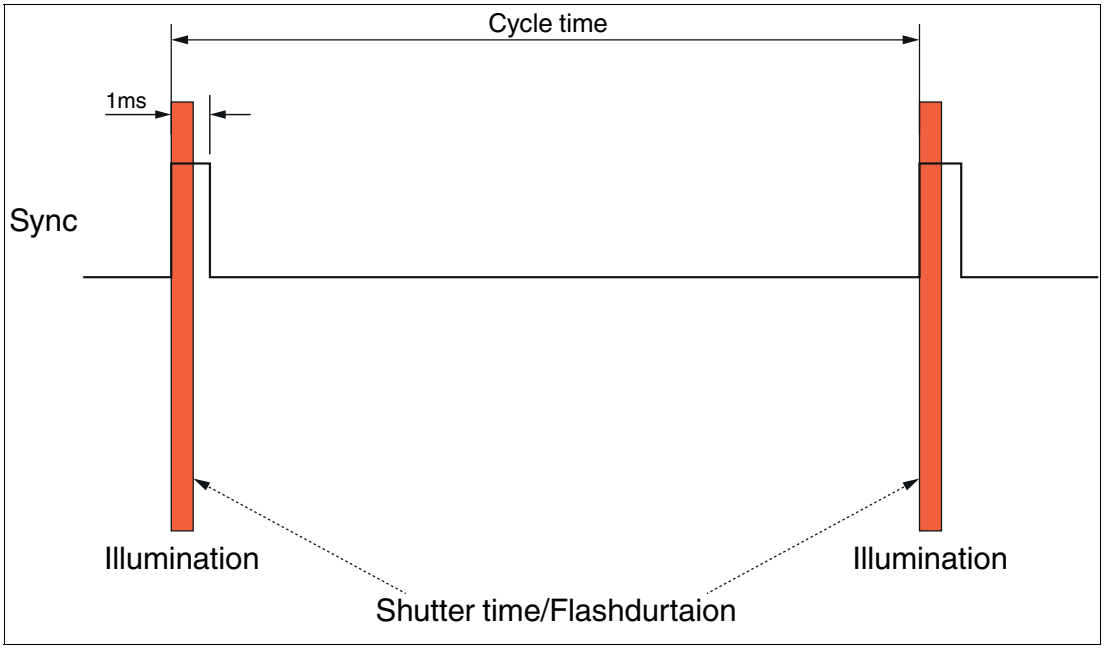
$$\text{Cycle time [s]} = \frac{\text{Timestamp (image) - Timestamp (image - 1)}}{\text{27 MHz}}$$

Synchronization Output (Sync Output)

The read head has two configurable switching outputs. The default setting is recorded on the datasheet.

If the switching output is set to "Sync out," a synchronization pulse will be supplied at the switching output. The pulse is synchronized with image capture. The control signal of the image capture (exposure / shutter speed) is supplied with zero latency at the output and extended to a pulse duration of 1 ms.

The exact time assignment of the position data to the acquisition time can be achieved using this synchronization pulse.



Example of Timestamp and Sync Output

- The read head captures images at a scan rate of 25 frames per second (every 40 ms).
- The latency time required by the read head for image processing and position value calculation is 60 ms.
- With a scan rate of 40 ms and a latency of 60 ms, the position values and the timestamp are output as follows:
  - Initial image capture Image 1 (timestamp + sync pulse) >> After 60 ms, output of position values for Image 1
  - After 40 ms image capture Image 2 (timestamp + sync pulse) >> After 100 ms output of position values for image 2
  - After 80 ms image capture Image 3 (timestamp + sync pulse) >> After 140 ms output of position values for image 3
  - ...

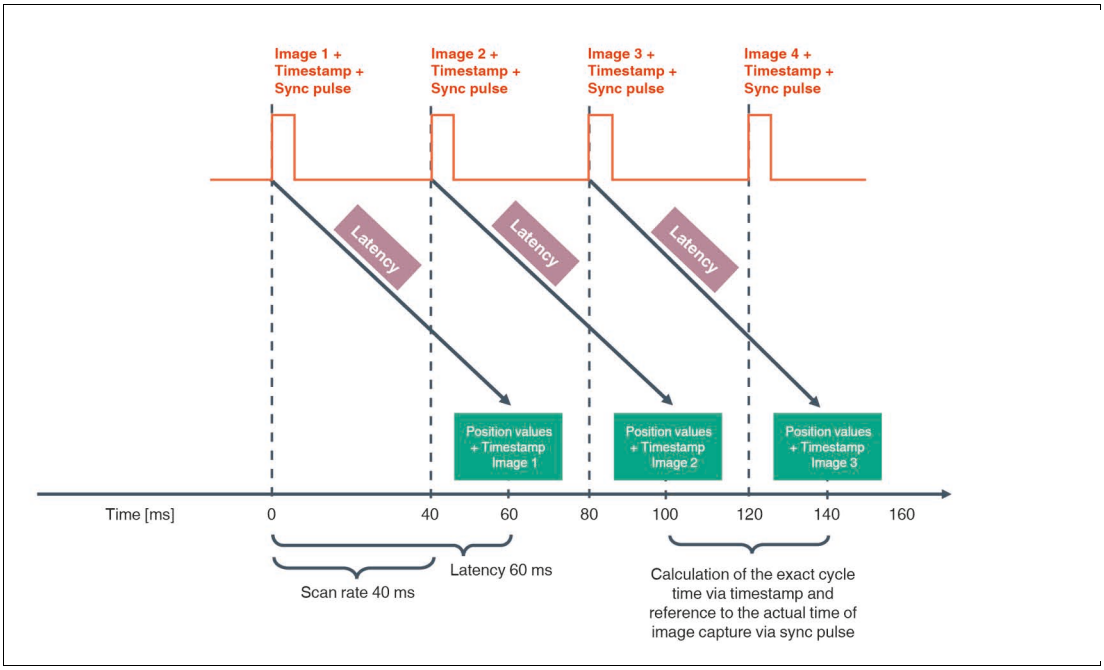


Figure 3.32

3.10 Quality Grades

If you have created a project with your read head in TwinCAT®, you can display the quality grades of the read head.

Quality Grades at a Glance

The permanent monitoring of the quality grades enables an early reaction to damage or contamination of the code tape or the camera during commissioning and during operation. This increases the overall operational safety, and in the case of a fault the problem can be located immediately.

The quality is assessed using a scale of 1 to 6, with 1 being the best reading quality. If the grade is 3 or worse, a check of the camera or distance should be performed. Grade 7 signifies "No position" because no code was detected.

The following examples show the quality grades of the code tape in different states and the evaluation in TwinCAT®.

Number of Codes Detected: 2 and quality grade: 3

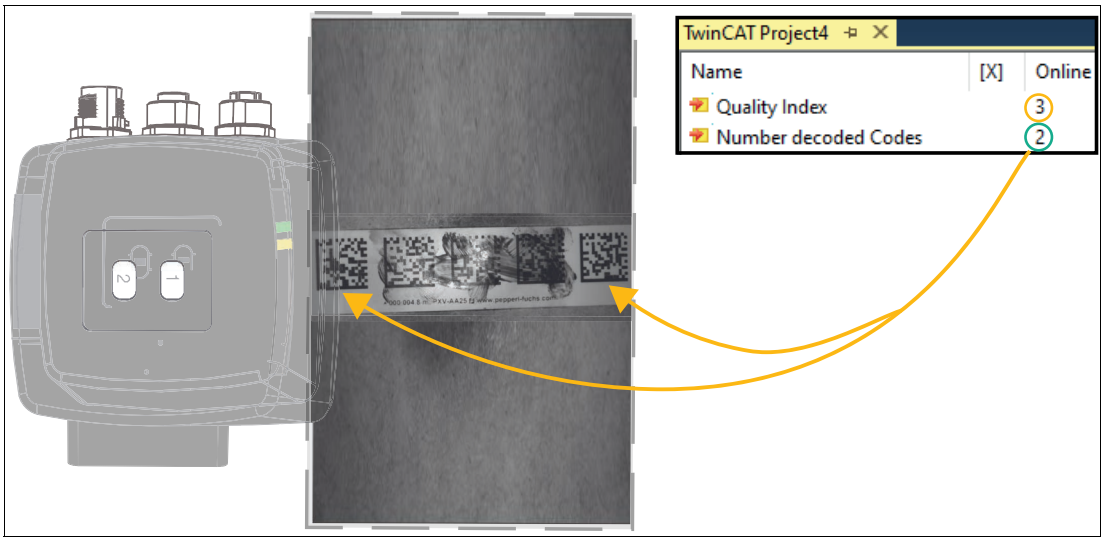


Figure 3.33 Code tape contaminated

Number of Codes Detected: 3 and quality grade: 1

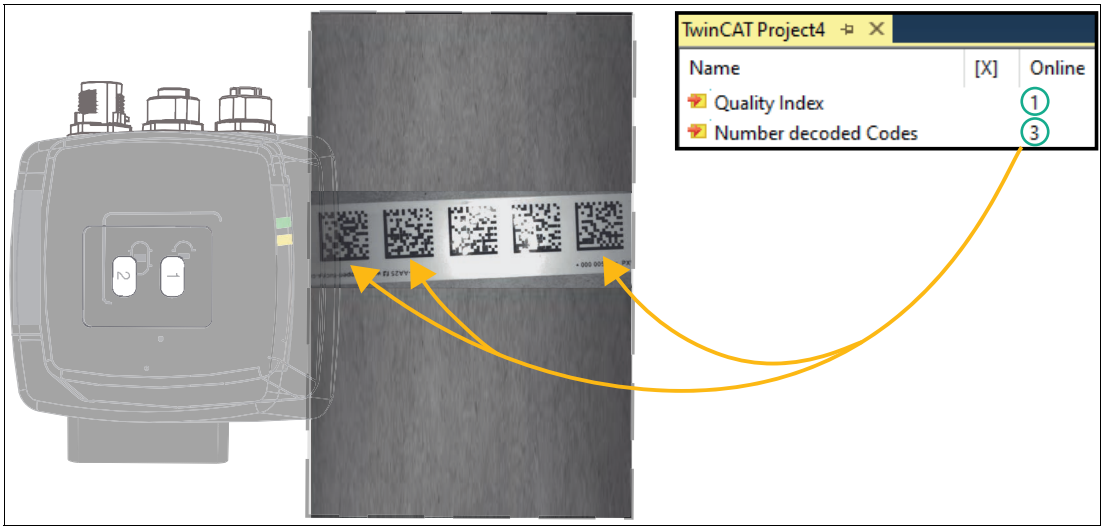


Figure 3.34 Code tape damaged by aggressive cleaning agent

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Number of Codes Detected: 1 and quality grade: 5

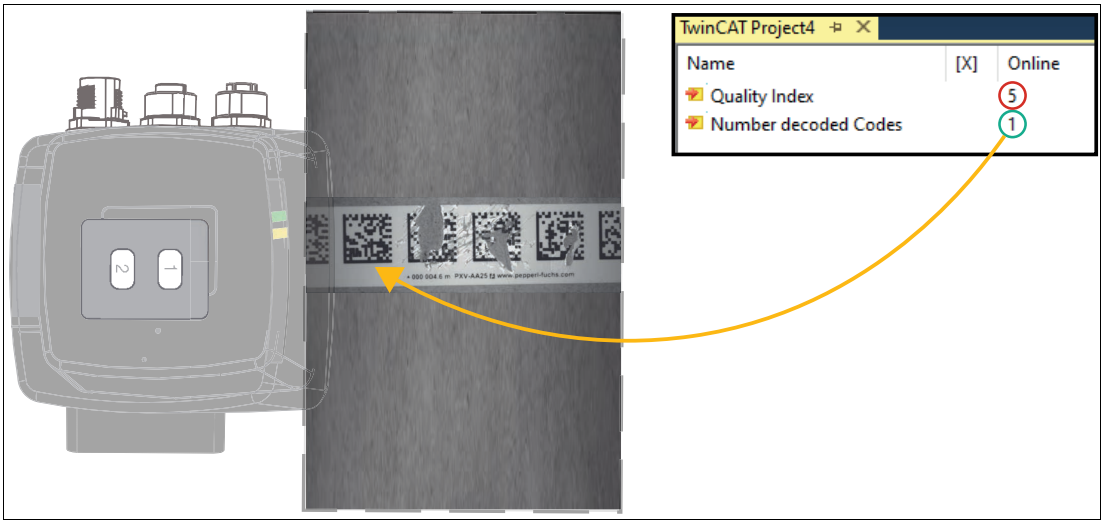


Figure 3.35 Code tape damaged

Note

An evaluation that indicates poor quality as the outcome can be due to a misalignment, an incorrect measuring distance, or because the code tape has been affixed incorrectly. The information in the following chapters must be observed, see chapter 3 and see chapter 4.

Quality Grade for New Application of the Data Matrix Code Tape

Quality grade	Description of the grade	Action
1	Excellent installation	None
2	Good installation	None
3	Installation within tolerance range	Check the code tape for contamination and clean if necessary ().
4	Adequate, but unacceptable	Check the code tape for damage and contamination. Also check the length of the code tape; any potentially non-optimal overlaps and cross-overs are excluded from this. Check the code tape for damage and contamination. The code tape routing must also be checked; unfavorable curve radii and/or inclines and slopes must be ruled out.
5	Incorrect installation	See Grade 4 / Not acceptable
6	Defective installation	See Grade 4 / Not acceptable
7	Operation not possible now nor at a later stage	See Grade 4 / Not acceptable

Quality Grade for Ongoing Operation

Quality grade	Description of the grade	Action
1	Excellent	None
2	Good	None
3	Satisfactory	Keen an eye on positions that are graded ≥ 3 and check them during the next routine inspection; clean them if necessary.
4	Acceptable	Immediately inspect any positions that are graded ≥ 4 for dirt and damage; where necessary, clean or repair them directly.
5	Poor	Immediately inspect any positions that are graded ≥ 5 for dirt and damage; where necessary, clean or repair them directly.
6	Not acceptable	Immediately inspect any positions that are graded ≥ 5 for dirt and damage; where necessary, clean or repair them directly.
7	No operation possible	Immediately inspect any positions that are graded ≥ 5 for dirt and damage; where necessary, clean or repair them directly.

Note

The recommended grades and actions assume that the Data Matrix code tape has been applied in one continuous length. Please note that gaps within the code tape can lead to poorer quality grades.

Note

The quality grades are monitored by the controller and can be called up if necessary to detect any quality deviations.

4 Installation and Commissioning

4.1 Data Matrix Code and Data Matrix Tag

The following description provides general guidance for applying Data Matrix tags or Data Matrix codes. Please note that the exact specifications may vary depending on the application.

Note

Butt edges

If you attach another Data Matrix code tape at the end of a previous Data Matrix code tape, the code pattern of 20 mm must be retained.

Note

Thermal expansion of the code tape

The affixed code tape corresponds to the heat expansion coefficient of the surface with regard to its thermal expansion. Keep this in mind when installing expansion joints, for example.

Note

Installation temperature

Maintain an installation temperature of at least 10 °C.

Note

Suggestion for an Application Device

To facilitate the application of the code tape, we recommend the use of a suitable mechanical application device. The code tape is supplied on a roll and can be cumbersome and time-consuming to apply without a mounting aid. A mechanical application device can make the process more efficient and accurate, and avoid errors when applying.

You can design a mechanical application device for your particular application. This may consistent of a mount or device, for example, that can hold and position the code tape, and a mechanism that aligns the code tape at the desired location. The mounting mechanism can be operated manually or automatically and enables quick, precise, and efficient application of the code tape.

The use of a mechanical application device can reduce the risk of errors and inaccurate positioning of the code tape. In addition, a mechanical application device can help to avoid overstretching or stretching of the code tape, which can occur when applied manually due to excessive force or uneven tension. A well-designed application device can ensure the uniform tension of the code tape during the application process. This contributes to a higher quality and durability of the code tape.

Marking the Code Tape Section

The marker head (PCV-LM25) is available to make it easier to apply the Data Matrix code tape. The marker head is used to indicate the position of the Data Matrix code tape on the traverse path.

1. Apply the marker head in place of the sensor, in the optimal alignment to the Data Matrix code tape.
2. Drive the route with the marker head.
3. Once you have completed the entire route, the Data Matrix code tape can be affixed.

Affixing the Data Matrix Code Tape

The following description explains the basic procedure for affixing the Data Matrix code tape. Depending on where the code tape is mounted, there are certain points to consider. These can be found in other sections of this chapter.

1. Clean the surface to remove greasy, oily, or dusty dirt.
2. Ensure that the surface is dry, clean, and stable.
3. Peel off the protective film at the beginning of the tag or code tape. Place the tag or code tape exactly where you want it, press firmly, and peel off the rest of the protective film.
4. Now glue the tag or code tape in the desired location. Note the following instructions.

Note

When removing the protective film from the code tape, make sure that the code tape is not inadvertently bonded in an undesirable location. If the protective film is removed too far, the code tape may accidentally bond in the wrong position and it may be difficult to remove and reattach the code tape in the right position.

We therefore recommend that you first remove only a small piece of the protective film and carefully attach the code tape to the desired location. If it is positioned correctly, you can further peel off the protective film to fully attach the code tape. This ensures that the code tape is positioned exactly where you want it to be and that the Data Matrix codes can be read reliably.

It is important to ensure that the code tape does not come into contact with dirt or dust particles, since this may affect the adhesion and lead to poor adhesion of the code tape.

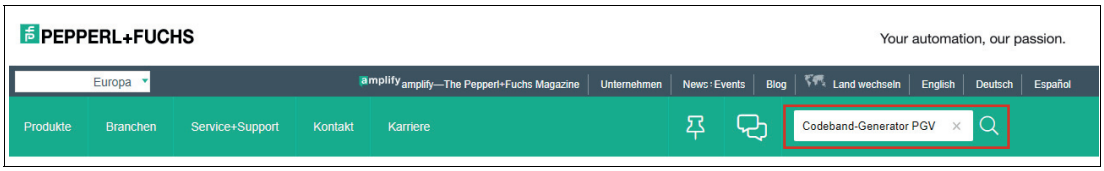
↳ Please note that the adhesive on the Data Matrix tag or code tape takes about 72 hours to harden completely. It is important that this time is observed before the code tape is fully loaded or stressed.

4.2 Replacement Tape

In the event of a repair, the code tape generator is available to you for a short-term interim solution. This provides the option to create and print code tape segments online to replace defective, heavily soiled, or missing pieces.

Note

Printed paper is not a permanent replacement for the rugged original code tapes. The printout must be used only as an emergency solution. The durability of the paper strip is extremely limited depending on the application.



1. Open the **code tape generator** on the homepage www.pepperl-fuchs.com. To do so, enter "Codeband-Generator PGV" [Code Tape Generator PGV] in the search field and click on Search.
2. Follow the instructions on the code tape generator page.
3. Print the pages of the required code tape segments and cut them to size.

   Note

   Adjust the printer setting so that the code size matches the original tape. You can measure the scaling at the top and right of the first page in the document.

4. Stick the replacement tape over the defective area of the existing code tape.

   Note

   When gluing the replacement tape to the code tape, make sure that the replacement tape continues the pattern on the code tape as accurately as possible.

   Tip

   It is recommended that you glue a protective film over the replacement tape to increase the durability of the paper tape.

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4.3 Mounting the Read Head

The mounting and alignment of the read head for detecting Data Matrix codes requires precise fine adjustment of the read head. The PCV-MB1 mounting bracket is suitable for this purpose. It enables flexible and precise adjustment of the read head.

The slots in the mounting bracket allow the read head to be moved in the Y and Z axes to achieve the most accurate alignment possible with the Data Matrix code tape.

Before mounting the read head, it must be ensured that the guide of the moving system part is designed in such a way that:

- The read distance is always maintained, otherwise the depth of field is no longer sufficient to ensure safe position detection (see chapter 3.7.1).
- The read head moves in the Y direction in the setpoint range, otherwise a warning message is issued above a defined threshold value, or no position is detected (see chapter 3.7.2).

Attaching Mounting Brackets to the AGTS

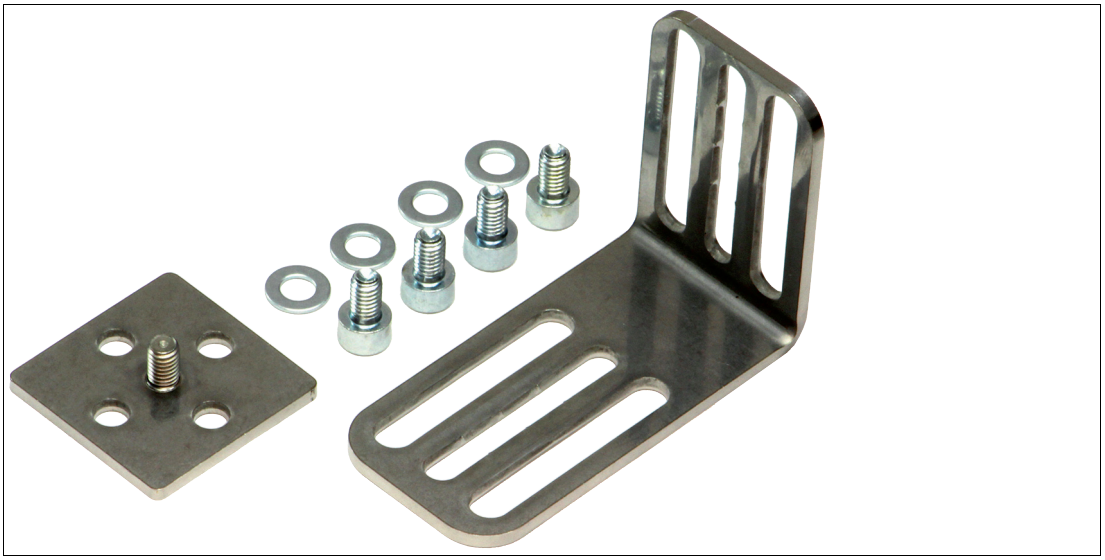

Figure 4.1 Mounting bracket (PCV-MB1)

1. Position the mounting bracket in the direction of the Data Matrix code tape so that the read head can be precisely adjusted afterward.
2. Use the three slots to mount the mounting bracket. Screw the mounting bracket onto the moving part of the system using three screws.

Note

Influence on the Position Values!

It is important to check that the mounting bracket of the read head is firmly secured to ensure stable and safe mounting of the read head.

A loose or loosely fastened mounting bracket can cause the read head to be misaligned or move during operation, which can result in incorrect position values.

To check that the mounting bracket is firmly seated, carry out a visual inspection of the fasteners, such as the screws, to ensure that they are tight and secure. It may be helpful to observe the read head during operation to ensure that it does not wobble or move.

Mounting the Read Head on the Mounting Bracket

Before installing the read head, ensure that a stable and secure mounting fixture is provided. Mount the read head so that the optics of the read head with ring light and camera module point toward the Data Matrix code tape.

Caution!

Damage to the reader due to wrong mounting accessory

Using longer screws can damage the reader.

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

Caution!

Damage to the reader due to inadequate attachment

If the reader is not sufficiently well and securely attached according to the requirements of the mechanical load due to the application, it can come loose and be damaged. Tightening the screws to a higher tightening torque can damage the reader.

Depending on the local installation conditions, the plant designer or commissioning engineer are responsible or the following:
tightening torque of the mounting screws: determining the minimum tightening torque for attachment according to the plant requirements.
Do not exceed the maximum tightening torque of 9 Nm.
Ensure that the attachment is in accordance with the mechanical load of the application.
Prevent the unwanted loosening of connections, e.g., by using thread-locking fluid.

3. Place the read head on the terminal block and position it in the middle. Insert the 4 mounting screws from below through the slots of the mounting bracket and through the terminal block. Tighten the screws so that the read head can still be moved on the terminal block.

Note

The screws should not be tightened until the read head is precisely aligned.

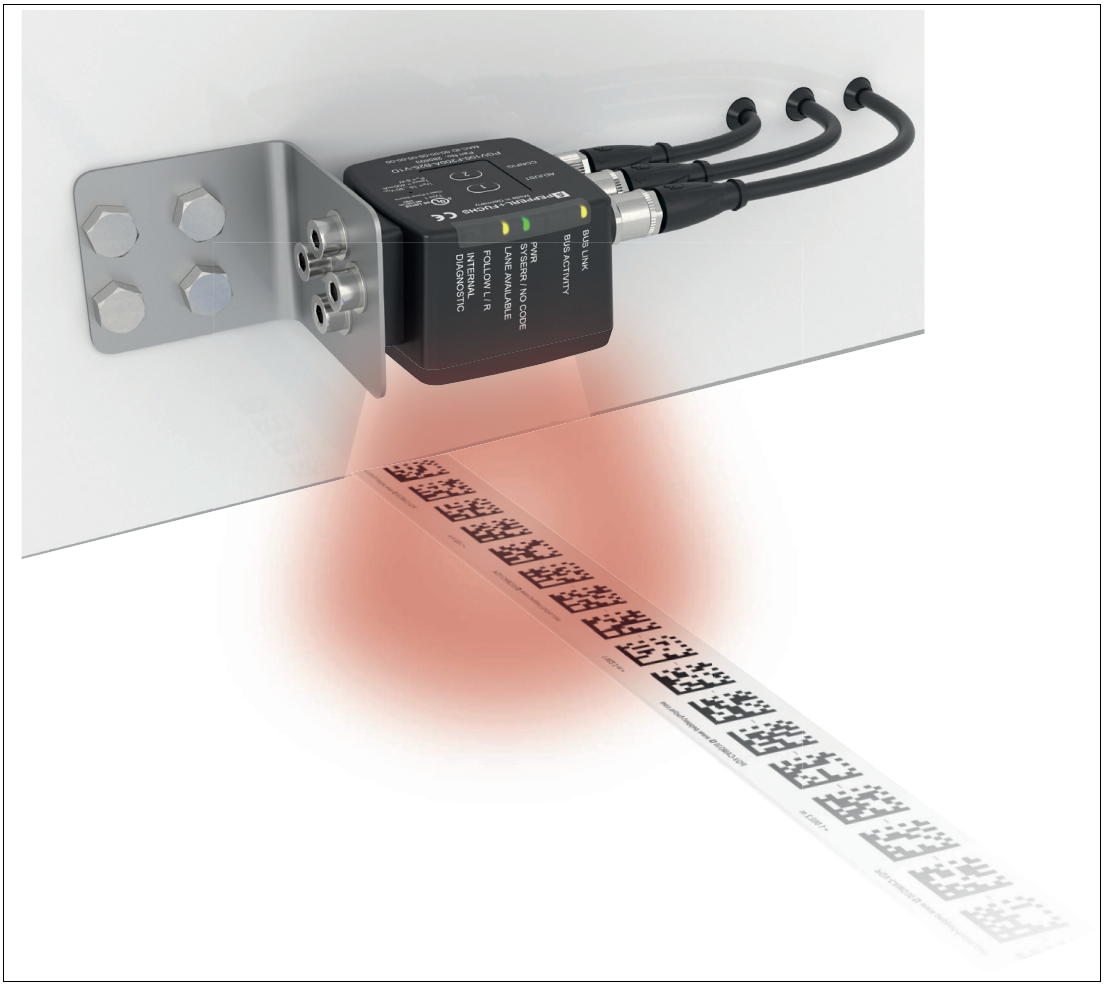

Figure 4.2 Schematic diagram for mounting the read head

Note

A guide pin is located in the center of the terminal block. This ensures that the read head is guided through the slots.

4.4 Aligning the Read Head

Since the vehicle follows the lane and compensates for deviations in the Y direction by steering movements, the read head does not have to be aligned exactly with the lane. However, some systems require uniform alignment of all read heads to ensure that all vehicles are positioned equally. In these cases, additional fine-tuning steps are required.

Several tools are available for aligning the read head with the Data Matrix code tape:

- Mechanical alignment using the alignment aid. This enables rough adjustment in the Y and Z axis.
- Vision Configurator for fine-tuning with position data or image capture.
- The integrated alignment aid via the "ADJUST" operating button 1 on the read head: This enables rough adjustment in the Y and Z axis.

Rough Alignment of the Read Head

The alignment guide and the electronic alignment aid are suitable for this purpose. A rough alignment is carried out along the Z axis and the Y axis.

Aligning the Read Head with an Electronic Alignment Aid

The read head has an integrated alignment aid, which enables easy alignment of the read head in the y and z direction to the Data Matrix code tape. The alignment aid can only be activated within 10 minutes of switching on the read head.

1. Press the "ADJUST" button 1 on the read head for at least 2 seconds to activate the integrated alignment aid.

   ↳ If the read head has recognized the Data Matrix code tape, LED 4 flashes green. If the read head has not recognized the Data Matrix code tape, LED 4 flashes red, .

2. Slowly move the read head in the direction (z axis) of the Data Matrix code tape until yellow LED 6 flashes simultaneously with green LED 4.

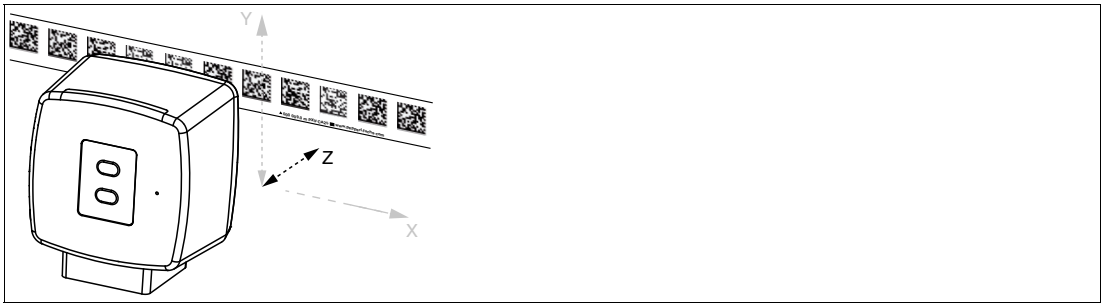

Figure 4.3 Distance z

Note

Z Orientation:

- Distance between camera and Data Matrix code tape too small: yellow LED 6 lights up
- Distance between camera and Data Matrix code tape too large: yellow LED 6 goes out
- Distance between camera and Data Matrix code tape within the target range: yellow LED 6 flashes simultaneously with green LED 4

3. Slowly move the read head in the vertical direction (Y axis) to the Data Matrix code tape until yellow LED 5 flashes simultaneously with green LED 4.

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Figure 4.4 Distance y

Note

Y Orientation:

- The optical axis of the read head is too low in relation to the center of the code tape: yellow LED 5 lights up.
- The optical axis of the read head is too high in relation to the center of the code tape: yellow LED 5 goes out
- Alignment of the read head in the target range: yellow LED 4 flashes simultaneously with the green LED 4

4. Terminate the alignment aid for the read head by briefly pressing the "ADJUST" button 1.

↳ The read head now switches to normal operation.

Alignment Using an Alignment Guide

If you have the option of attaching the alignment guide to the read heads in your application, you can use the alignment guide (PCV-AG100) to set the distance between the read head and the Data Matrix code tape, and to align the optical axis of the read head with the center of the Data Matrix code (dashed line). Note that the PCV-AG100 alignment guide is designed for a read distance of 100 mm.

The zero line Y = 0 is calibrated identically for all read heads with regard to the alignment guide. You can therefore determine the zero line with the help of the alignment guide when changing the read head, for example.

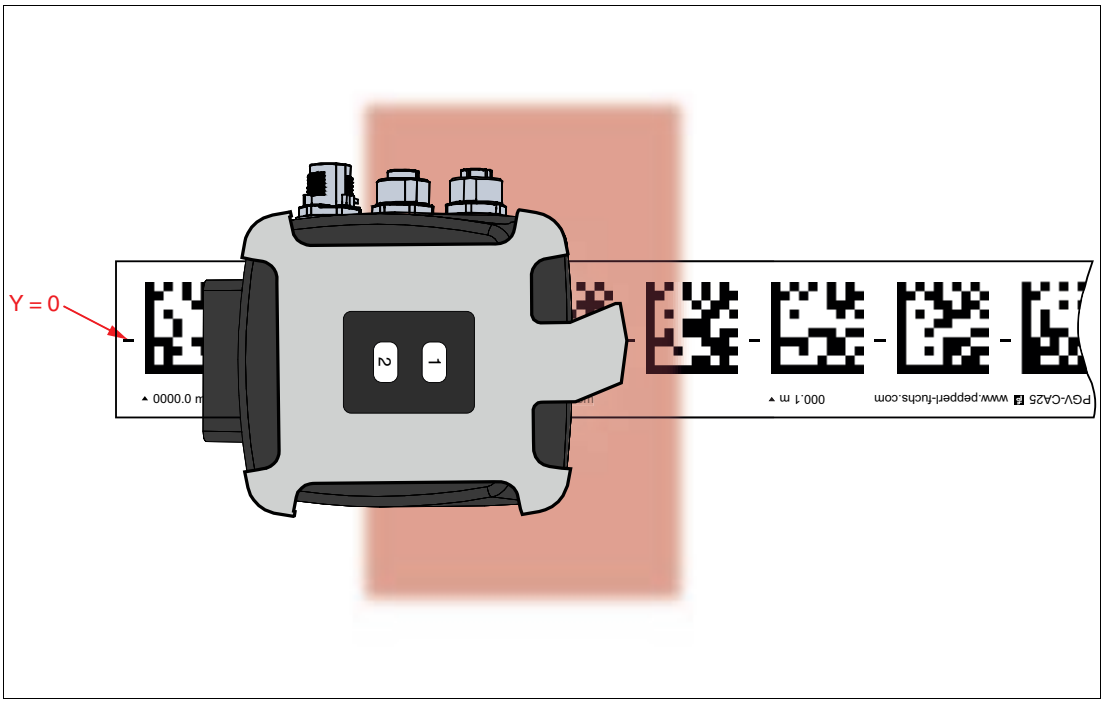

Figure 4.5 Display example

Fine-Tuning the Read Head

To ensure that all vehicles are aligned equally, a system-specific alignment procedure is required. The following steps are for guidance only.

1. Before fine-tuning the read head, make sure that the vehicles are mechanically positioned as evenly as possible. Floor markings, for example, are suitable for this purpose.
2. First, follow the rough alignment steps described above. This ensures a sufficient distance in the z-direction and minimizes deviations due to tilting.
3. Now align all read heads with a defined X and Y value. In the Vision Configurator, you can view the current position data of the read heads under the **Position View** tab (1) (). If required, you can also query the position data via the EtherCAT interface.

Note

To use the Vision Configurator, the read head must first be configured via TwinCAT® so that EoE is activated to establish a connection to the Vision Configurator. To do so, proceed as follows see "Activating EoE" on page 72.

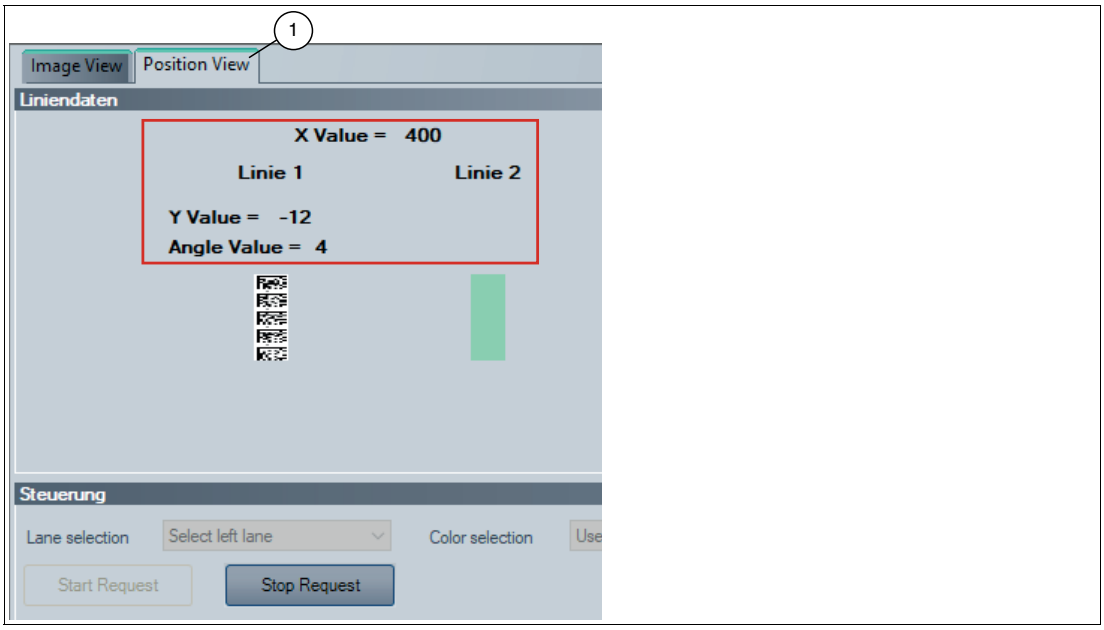

Figure 4.6 Position view

In addition, you can open the currently captured image under the **Image view** tab (1). To do this, click on **Get image** (2) in the toolbar.

Here you can display the current image of the read head via the "Image View" (1) image display. This allows you to visually recognize and check the alignment of the read head with the Data Matrix code tape.

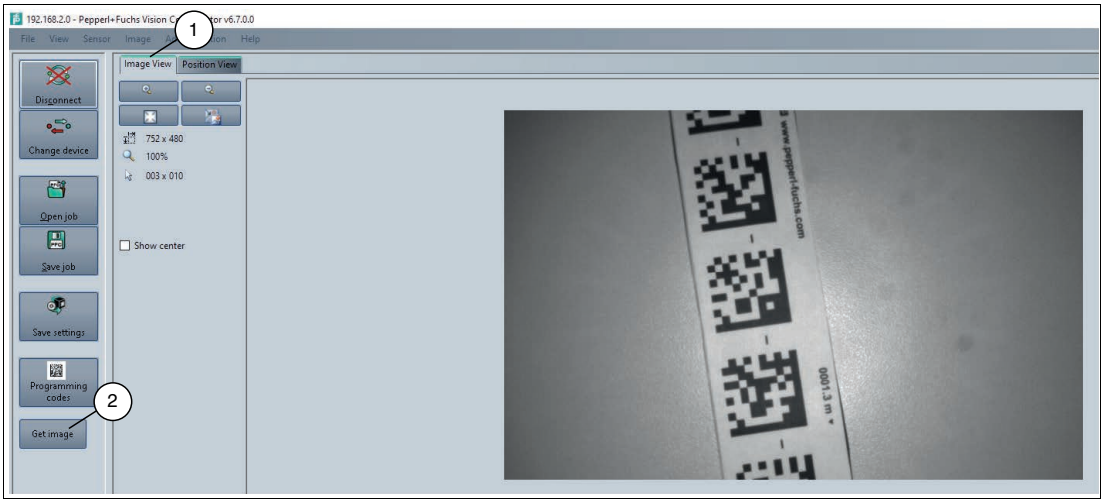

Figure 4.7 Image view

4.5 Electrical Connection

The electrical connection of the read head is established via connector plugs on the side of the housing. The read head is connected to the field environment via the "Main" connector along with "EC IN" and "EC OUT" for the EtherCAT 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.

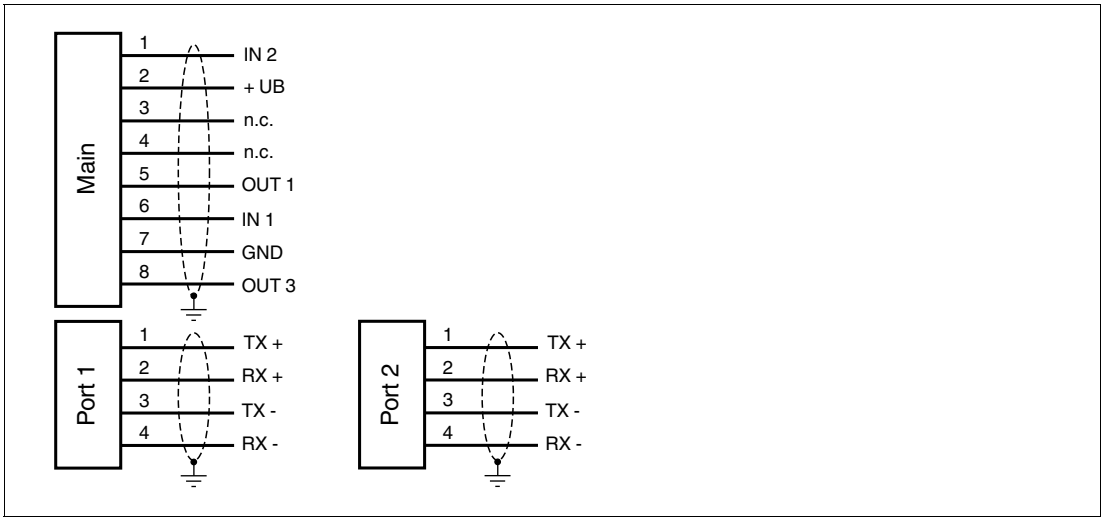

Figure 4.8 Plug Assignment

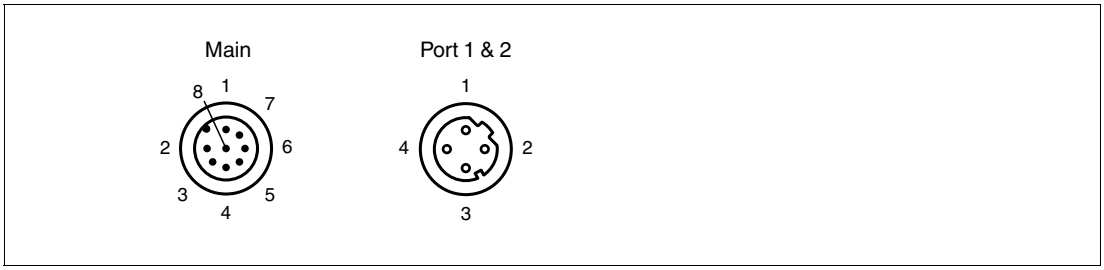

Figure 4.9 Pinout

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Inputs/outputs and power supply

Connection for inputs/outputs and power supply	
Connection	**Power Connector plug, M12, 8-pin, A-coded**
1	Input 2
2	Operating voltage +U_B
3	Not used
4	Not used
5	Sync out
6	Illumination control
7	Ground
8	Output 3

EtherCAT IN and OUT

EtherCAT connection	
Connection	**EC IN, EC OUT Connector socket, M12, 4-pin, D-coded**
1	Tx +
2	Rx +
3	Tx-
4	Rx -

Shielding Connection Lines

The shielding of cables is required to suppress electromagnetic interference. Establishing a low-resistance or low-impedance connection with the protective conductor or equipotential bonding circuit is an especially 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 Vision Sensor. The grounding terminal included in the scope of delivery enables easy integration into 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 be noted:

- Use metal cable clips that cover large areas of the shield.
- Place the cable shield onto the potential equalization rail immediately on entering the switch cabinet.
- Direct the protective grounding connections to a common point in a star configuration.
- The conductor cross section used for grounding should be as large as possible.

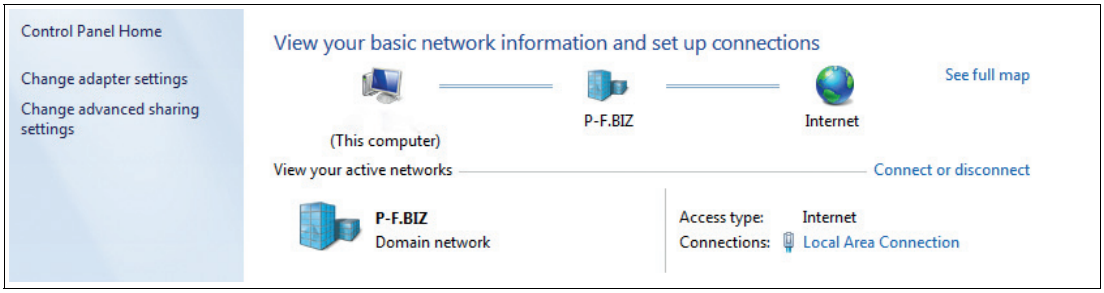
4.6 Setting up Windows Network Communication between the Read Head and a PC/Laptop

The read head has a fixed IP address **192.168.2.2** when connected via EoE (Ethernet over EtherCAT). To enable communication within the network, the network settings of your PC/laptop must be synchronized with the read head and may need to be adjusted.

Setting the IP Address

The following section describes how to check the network connection settings of your Windows PC and adapt them accordingly. The images in this description were created using Windows 10. The description below applies to later versions of Windows.

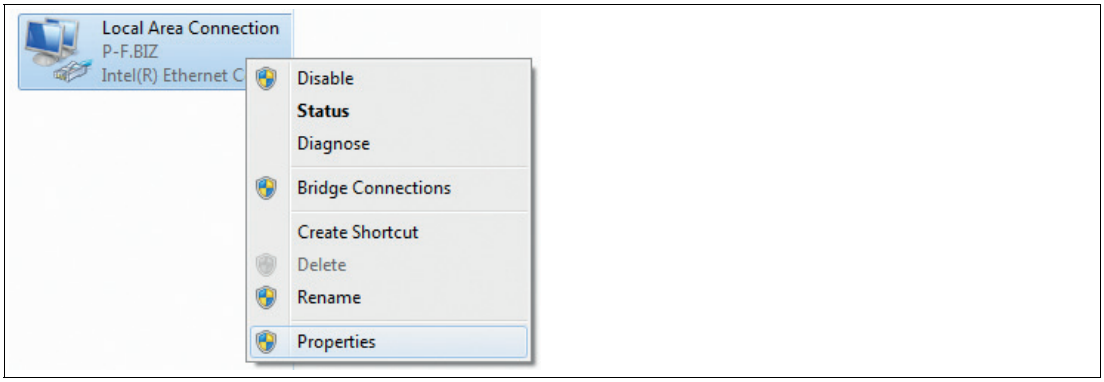
1. Click on the Windows **"Start"** button.
2. Select **"Control Panel > Network and Sharing Center."**
3. Now click on **"Change adapter settings."**



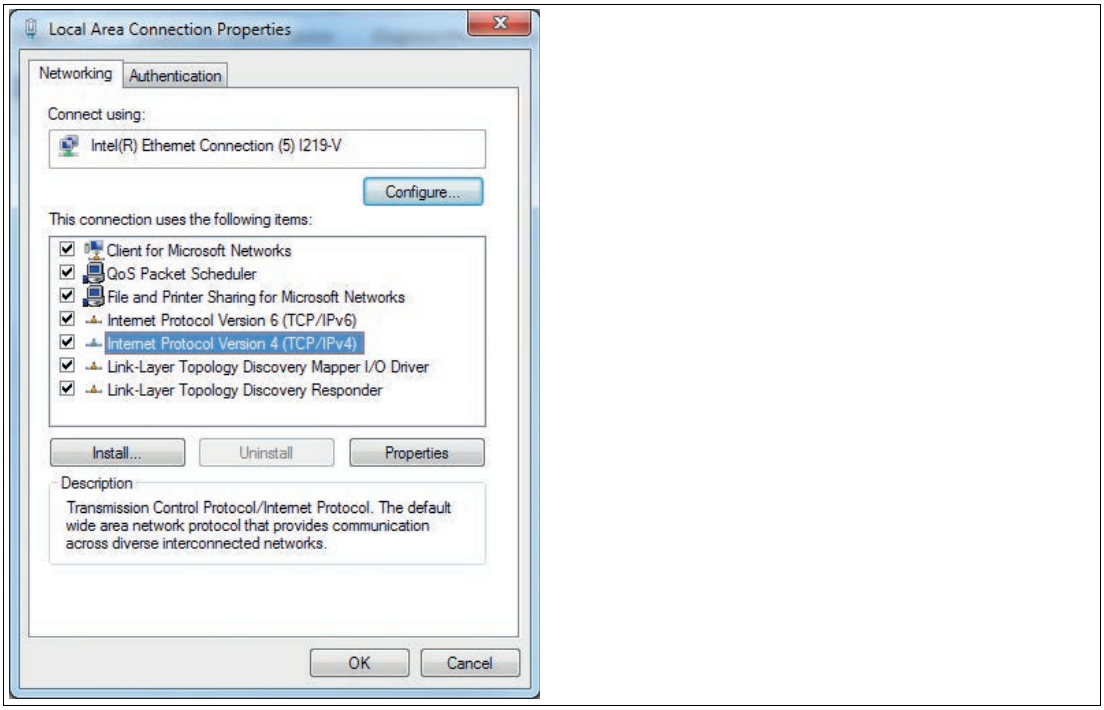
Note

Changes to the network settings of the PC/laptop require advanced user rights. If necessary, consult with your administrator.

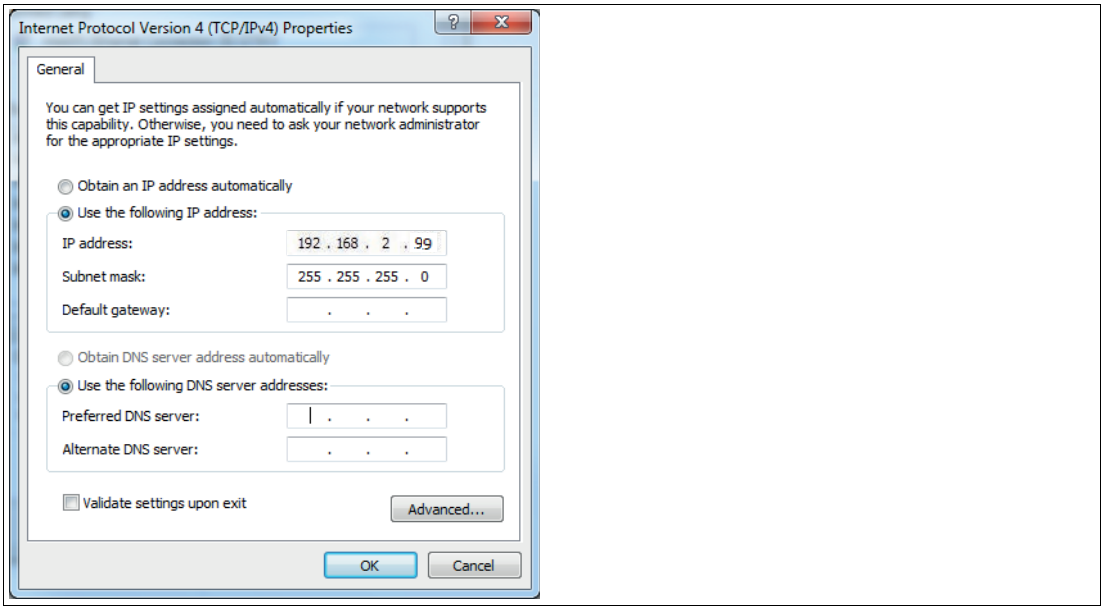
4. Select the required connection and right-click on your selection. In the selection window, select **Properties.**



5. Double-click on **"Internet Protocol Version 4 (TCP/IPv4)."**



↳ The **Properties** window for the TCP/IP protocol opens.



6. Select the **"General"** tab.
7. Select the input function **"Use the following IP address."**
8. Enter the IP address of the read head, but only the first three segments of the IP address. The last segment must be different from the read head's IP address.
9. In this example, enter the following IP address and subnet mask:
   - **IP address: 192.168.2.99**
   - **Subnet mask: 255.255.255.0**
10. Click on **OK** and click on **OK** in the next dialog.

    ↳ This completes the network configuration. The read head is ready for use.

4.7 Configuration with TwinCAT®

The configuration of a read head using the "TwinCAT®" project planning and development environment from Beckhoff Automation GmbH is described below as an example.

Offline and Online Read Head Configuration

There are two options for configuring the EtherCAT® read head:

- **Offline configuration** allows the read head configuration to be prepared in advance of plant construction, e.g., on a laptop as a programming system.
- **Online configuration** is preferably carried out by scanning the existing network if the controller is already connected to the EtherCAT® system and all components of the EtherCAT® network are ready for operation.

Sample online configuration

The online configuration is described in more detail below.

All available nodes are automatically integrated into the EtherCAT® network by the control system.

Creating a New Project in TwinCAT® 3

To connect your read head to the controller, you must create a new project in TwinCAT® 3.

1. Start TwinCAT® 3 on your PC.
2. On the start page, select the option "New TwinCAT Project..."
3. Select "TwinCAT XAE Project (XML format)," enter a project name, and confirm your selection with "OK."

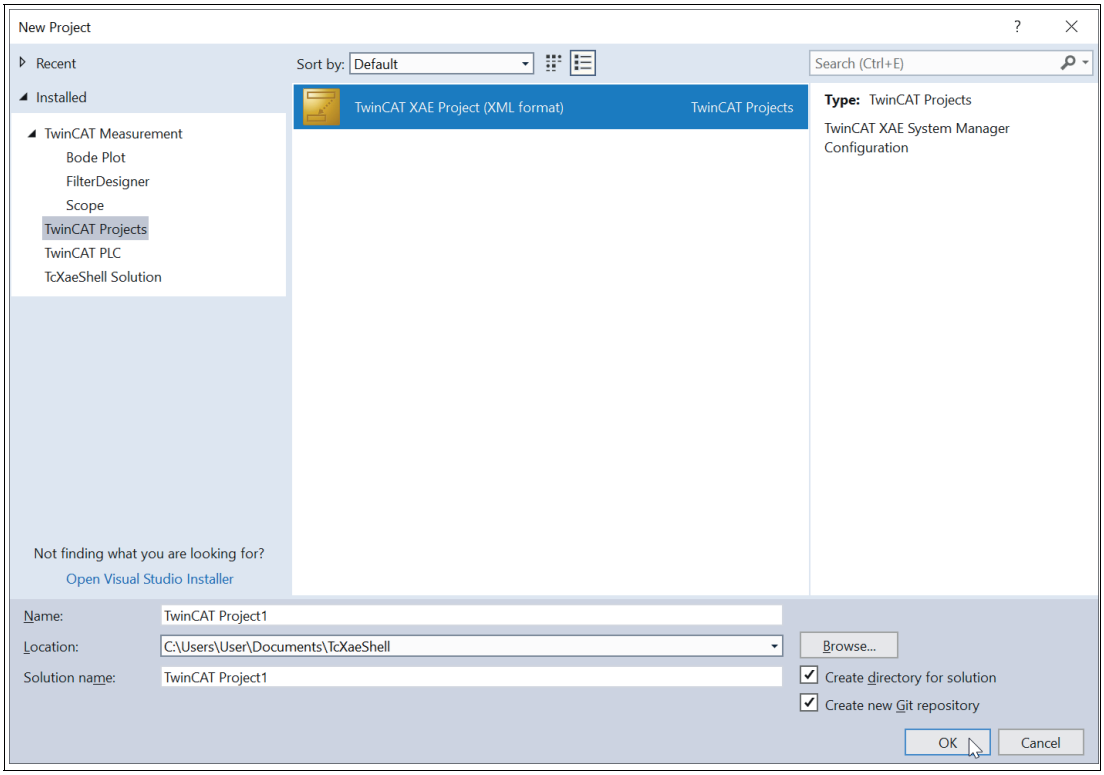


Figure 4.10 Creating a New Project

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Note

It is always possible to use TwinCAT® "locally" or "remotely." If the TwinCAT® system including the user interface is installed on the respective controller (local), TwinCAT® can be used "locally." In this example, TwinCAT® is used locally.

Integrate the controller in TwinCAT® 3

1. Install the ESI file of the module family in TwinCat®. In TwinCAT® 3, the ESI file is normally inserted in the installation folder `C:\TwinCAT\3.1\Config\Io\EtherCAT®`.

   ↳ After you restart TwinCAT®, the modules will be available in the hardware catalog.

2. Start TwinCat and open a new project.

   Note

   After the project has been created, communication with the controller must first be set up.

3. Select the "SYSTEM" option in the "Solution Explorer" and click on the "Choose Target" button.

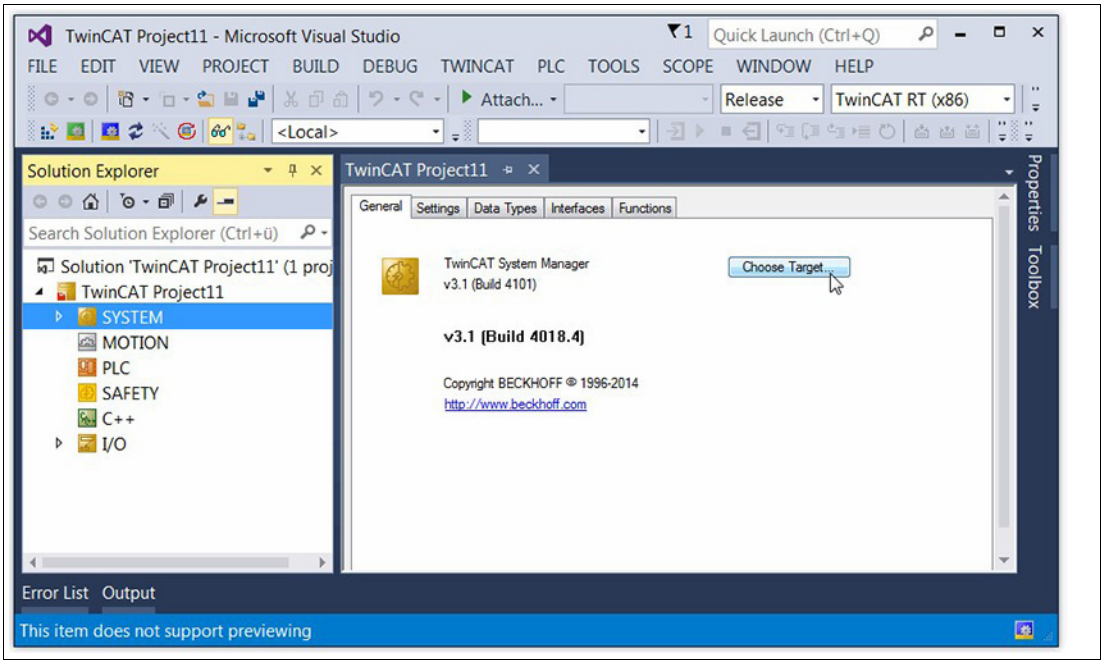

Figure 4.11

4. Click on the "Search (Ethernet)" button in the "Choose Target" menu.
5. Perform a broadcast search to view the available devices and select the desired device.

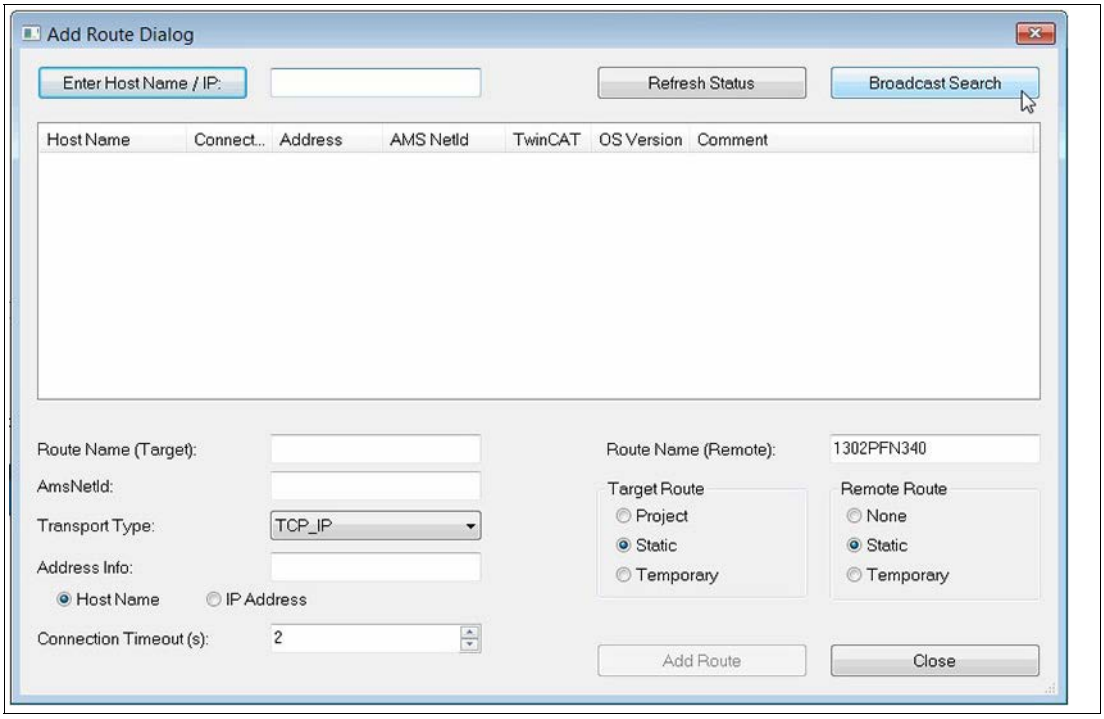

Figure 4.12

6. Configure the IP address for the selected device in the "Address Info" area.
7. Add a communication route to the device by clicking on the "Add Route" button and confirm without entering a password.
8. Save the connection settings and confirm the selection.
9. In the left-hand working area of "Solution Explorer", switch to the option "I/O."
10. Right-click on "Devices" and select the "Add New Item..." option.

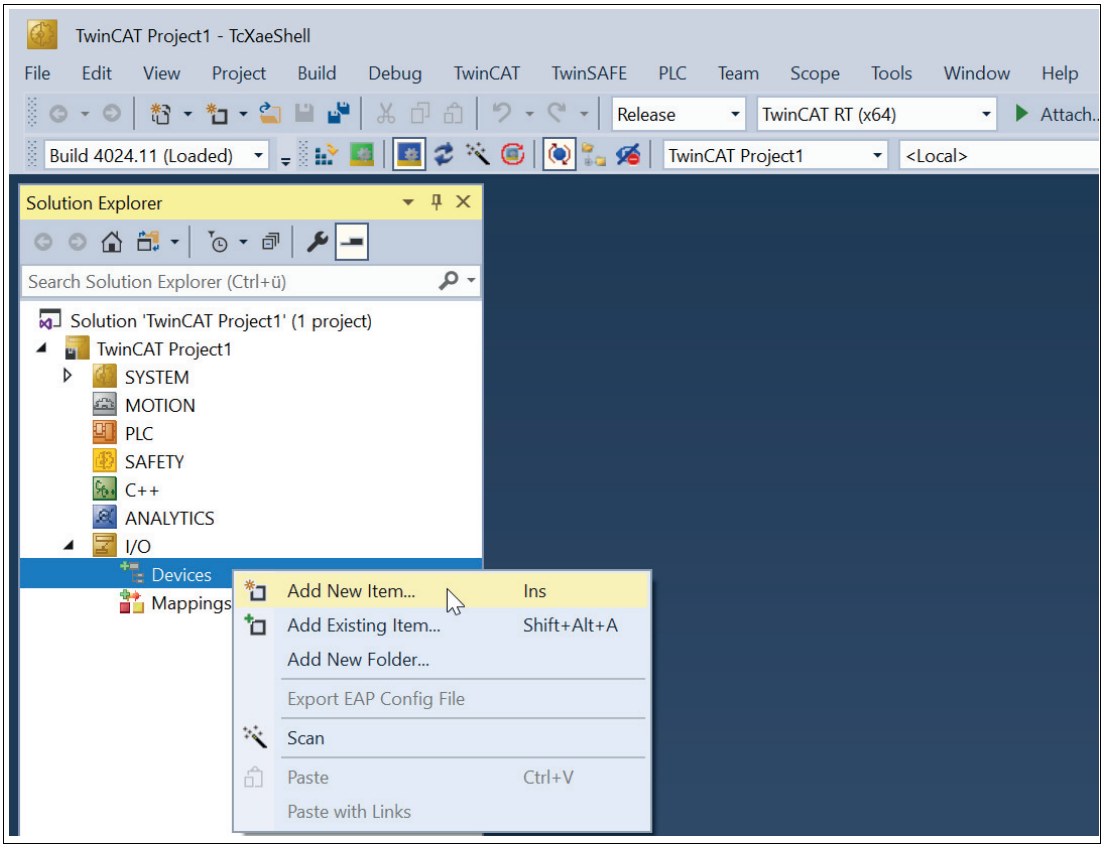

Figure 4.13

↳ The "Insert Device" selection window opens.

11. Select "EtherCAT® Master" and confirm with "OK."

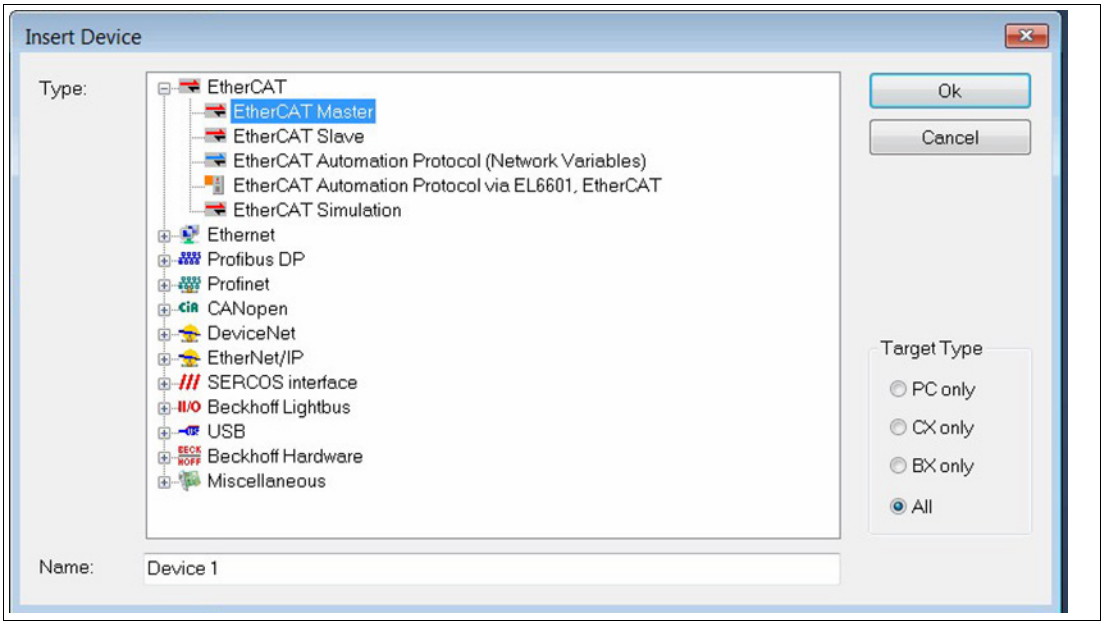

Figure 4.14

↳ The EtherCAT® controller is created in the "Solution Explorer" project tree with the designation "Device 1 (EtherCAT®)."

12. In the "Solution Explorer" project tree, select the controller with the designation "Device 1 (EtherCAT®)" with a left mouse click.

↳ The properties page opens on the right side of the window.

13. Click the "Adapter" tab, followed by "Search..." to select the port for your controller.

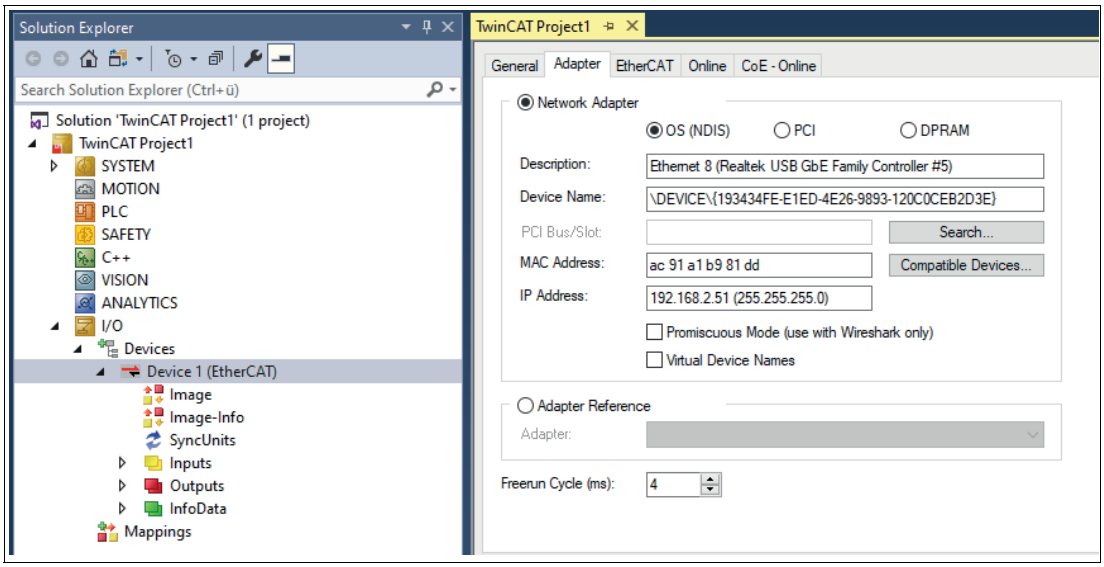

Figure 4.15

14. In the "Device Found At" dialog, select the port for your controller; in this example, the "Ethernet (TwinCAT-Intel PCI Ethernet adapter (Gigabit))" is used.

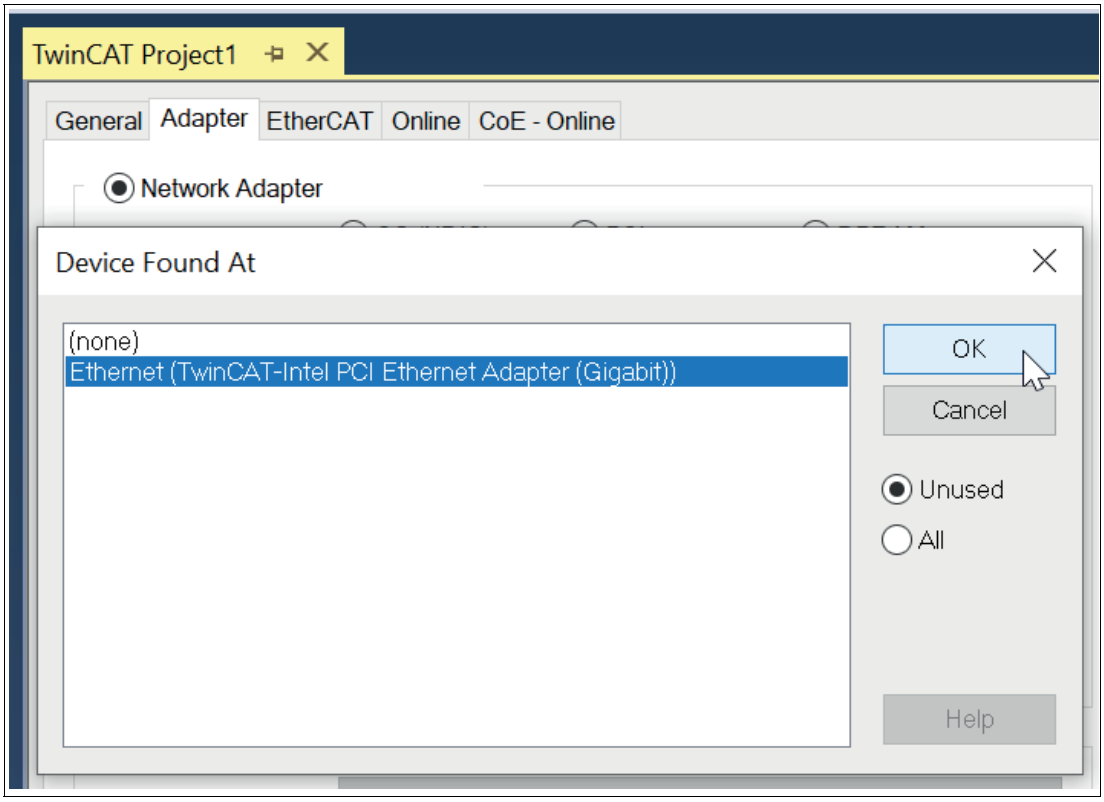

Figure 4.16

15. Click on the "OK" button to confirm the selection.

16. If you have not already done so, select the network adapter and install the driver for EtherCAT real-time communication.

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17. Click on the "Adapter" tab and then on "Compatible Devices ..." to select and install the EtherCAT driver. Follow the further instructions within the software to install the driver.

Adding the Read Head to the Project

1. To add the read head to the controller, right-click on "Device 1 (EtherCAT®)" in the project tree. Activate the "Scan" function with the left mouse button.

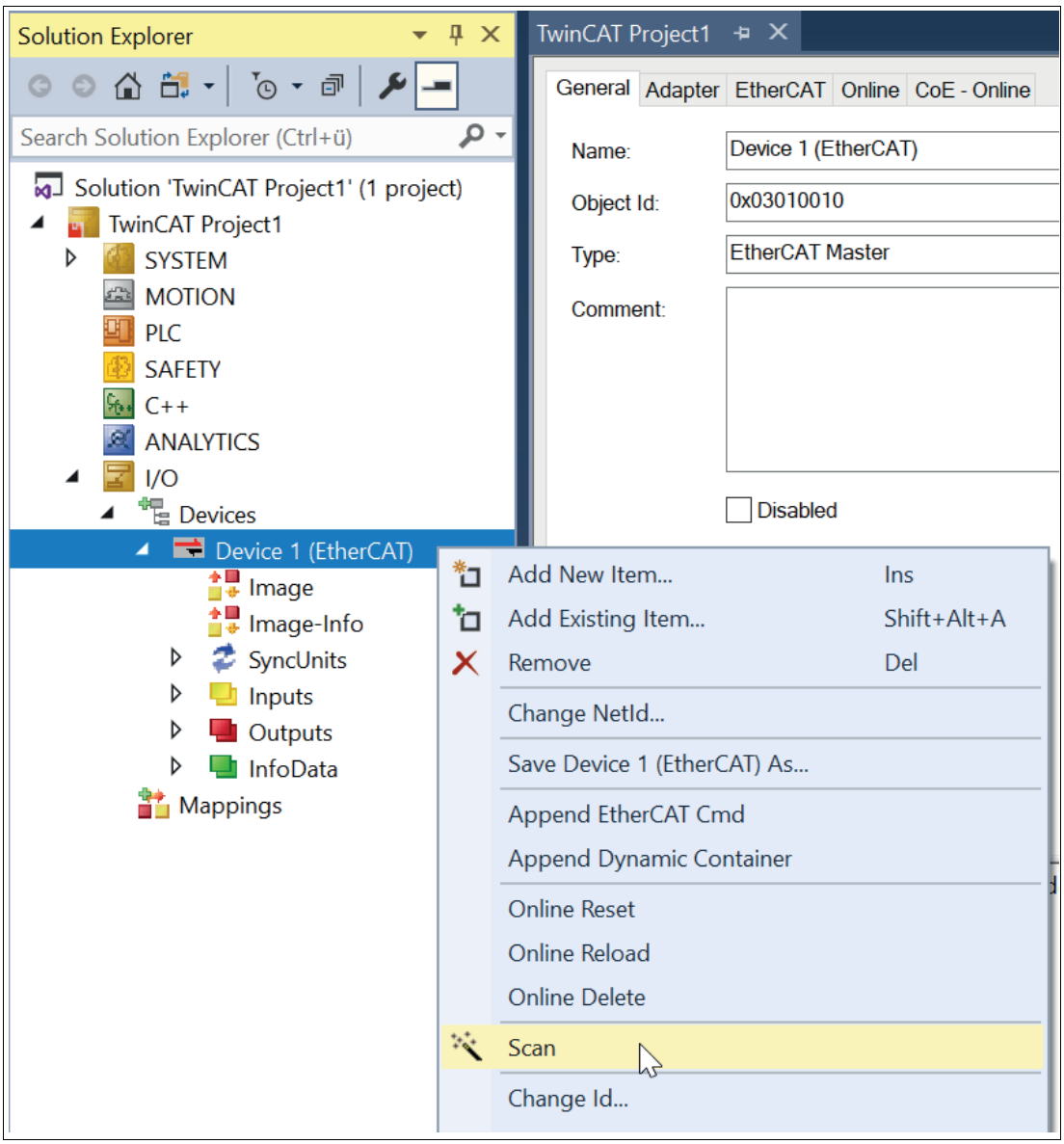

Figure 4.17

↳ All EtherCAT® nodes are read in and automatically added to the I/O configuration. The PGV-F200 read head appears in the project tree below the EtherCAT® controller as Box 1 (PGV F-200).

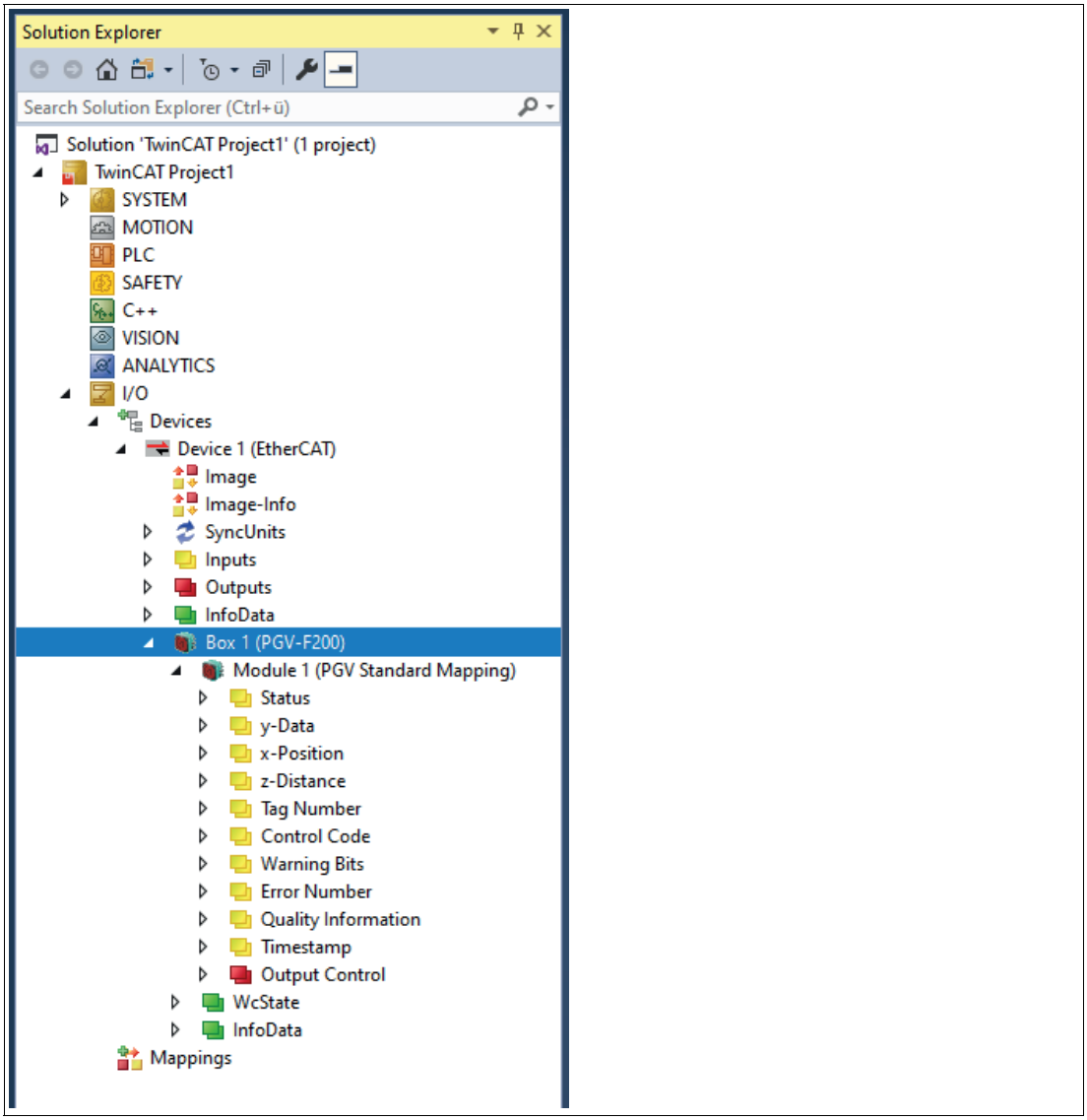

Figure 4.18

2. Click on the "Box 1 (PGV-F200)" entry with the left mouse button.

   ↳ The menu "TwinCAT Project 1" is displayed.

3. To configure the process data, go to the "Process Data" (1) tab.

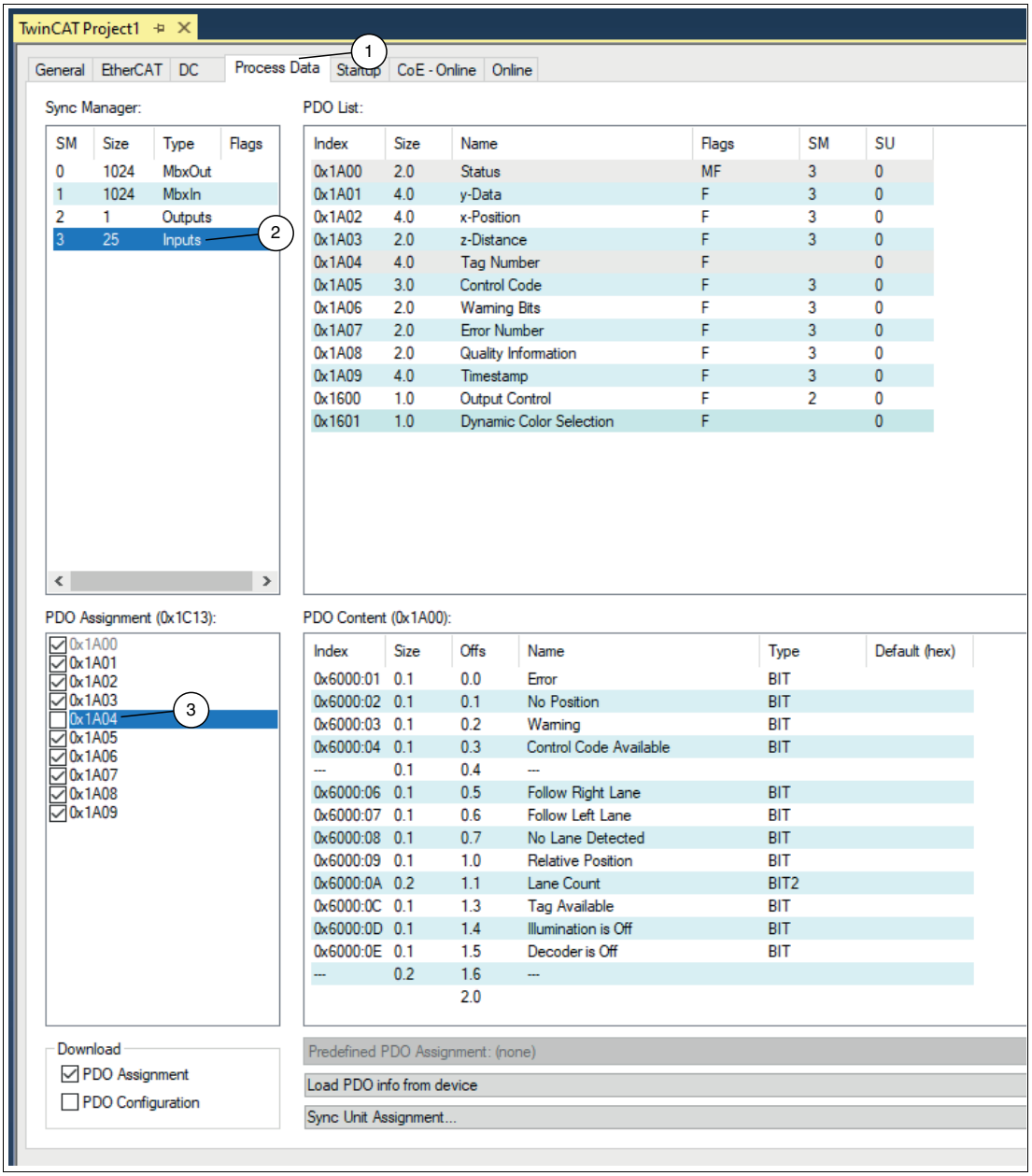

Figure 4.19

4. In the "Sync Manager" section, click on the "Inputs" (2) option and select your input PDOs in the "PDO Assignment" area.
5. For example, disable the checkbox "0x1A04" (3) if no tag number should be transmitted to the EtherCAT® controller.
6. To set the TwinCAT system manager to "Config Mode", restart TwinCAT. To do this, click the "Restart TwinCAT (Config Mode)" button (1). Click "OK" to confirm the dialog (2).

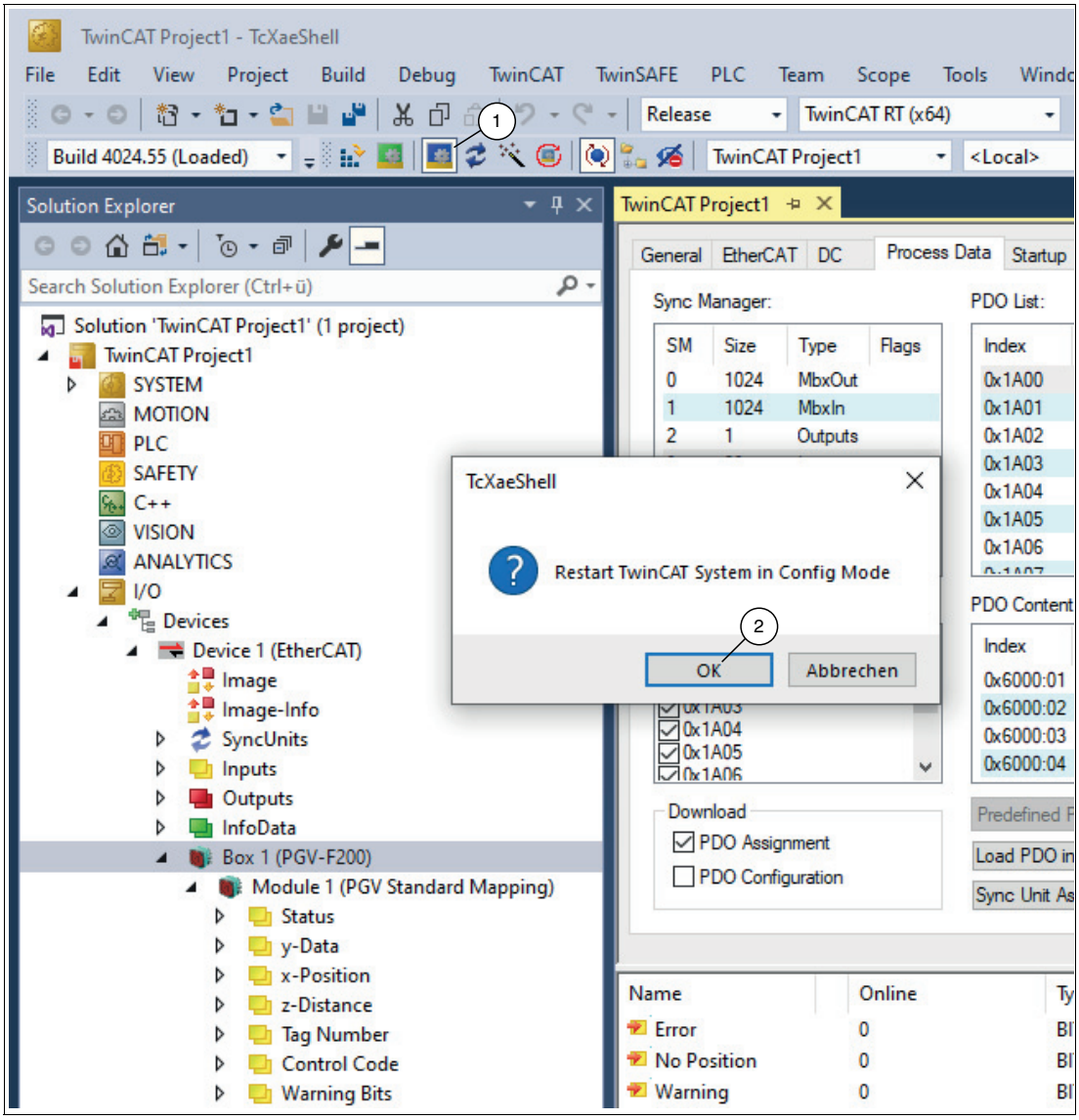

Figure 4.20

7. Confirm the message "Load I/O Devices" with "OK."

   ↳ The message "Activate Free Run" appears.

8. Confirm the dialog with "Yes" to allow the processing of input data within the "Config Mode."

9. The read head is in operating mode, but does not yet output any data (ERR LED lights up red). Select one of the two "Lane" (1) lanes by setting either the right or the left lane to 1 (1). By default, both lanes are set to 0. Once one of the two lanes is set to 1, everything works as expected.

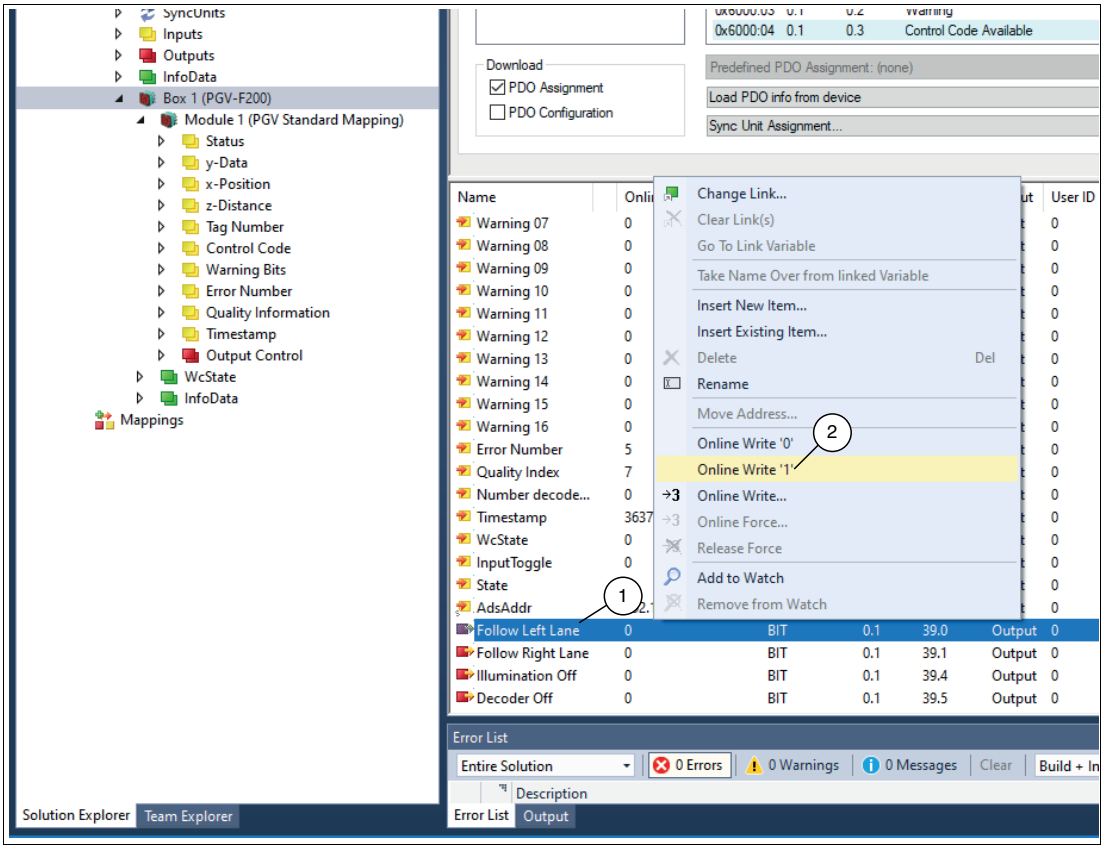

Figure 4.21

10. Go to the "Online" tab (1) and click on the "Pre-Op" button (2).

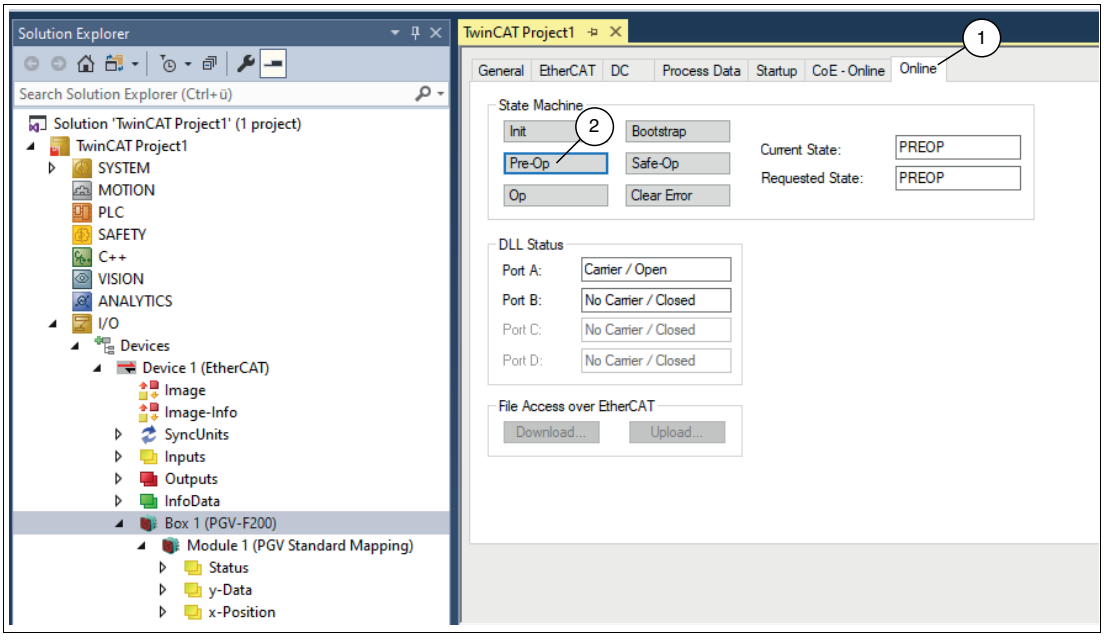

Figure 4.22

↳ The read head is in the "Pre-Operational" state.

Activating EoE

In general, the EtherCAT read head cannot be connected directly to the Vision Configurator. First, the reading head must be configured via TwinCAT in such a way that EoE is possible.

1. In the "Solution Explorer", select the "Device (EtherCAT)" **controller** (1) in the left work area and click on "EtherCAT (2) > Advanced Settings..." in the right work area. (3).

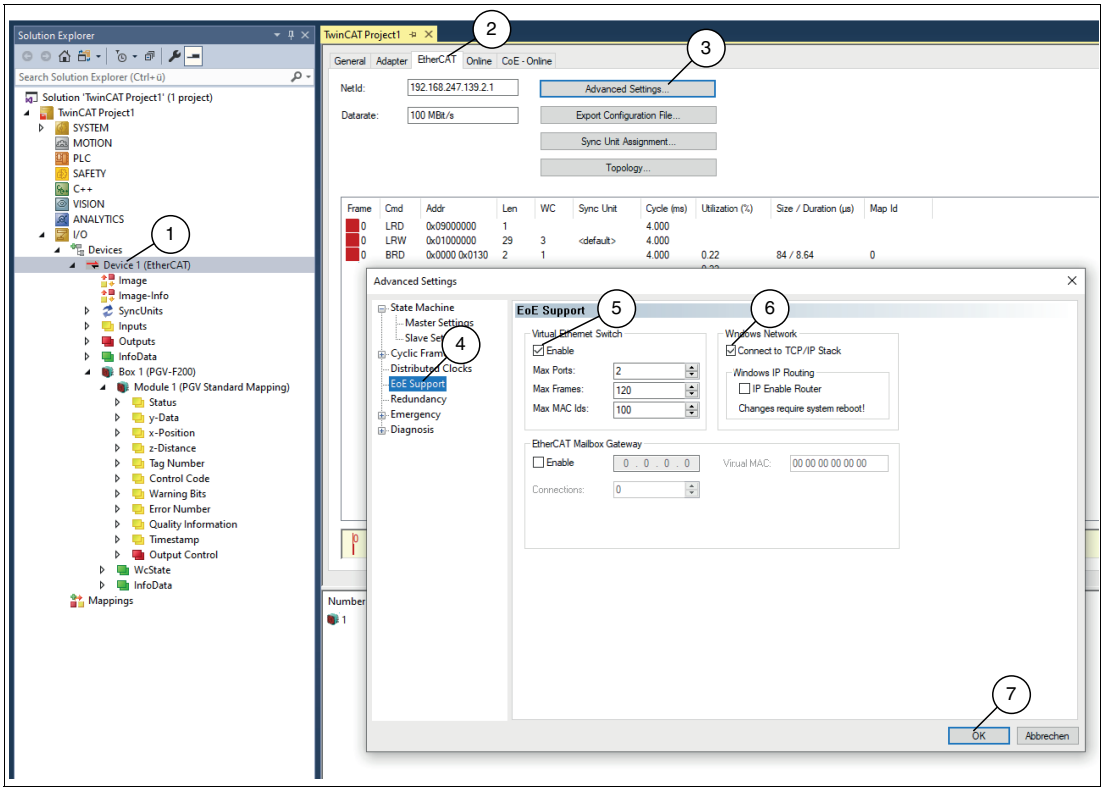

Figure 4.23

↳ The "EoE Support" selection window opens.

2. Enable the control panel with the following settings, "Virtual Ethernet Switch" - "Enable" (5) and "Windows Network" - "Connect to TCP/IP Stack"(6).
3. Click "OK" (7) to confirm your selection.
4. In the "Solution Explorer", select the "Box 1 (PGV-F200)" **read head** (1) in the left work area and click on "EtherCAT > Advanced Settings..." in the right work area. (2).

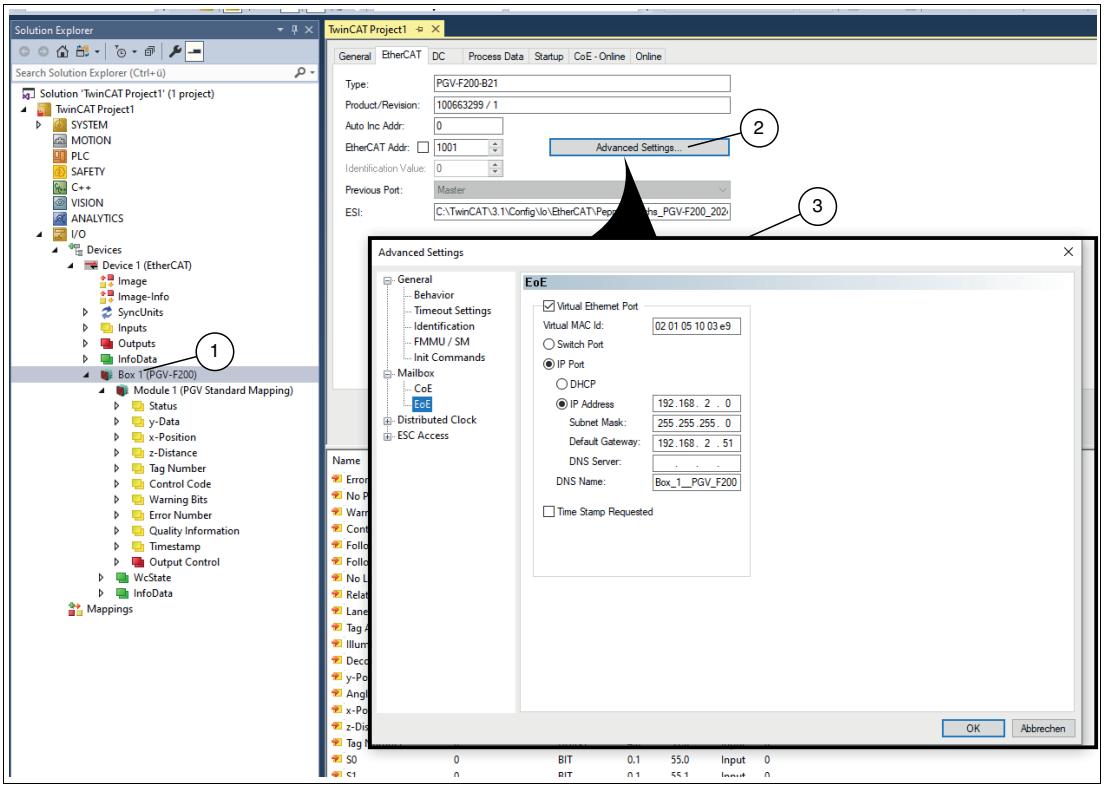

Figure 4.24

↳ The "Advanced Settings" selection window (3) opens.

5. Navigate to "Mailbox > EoE."

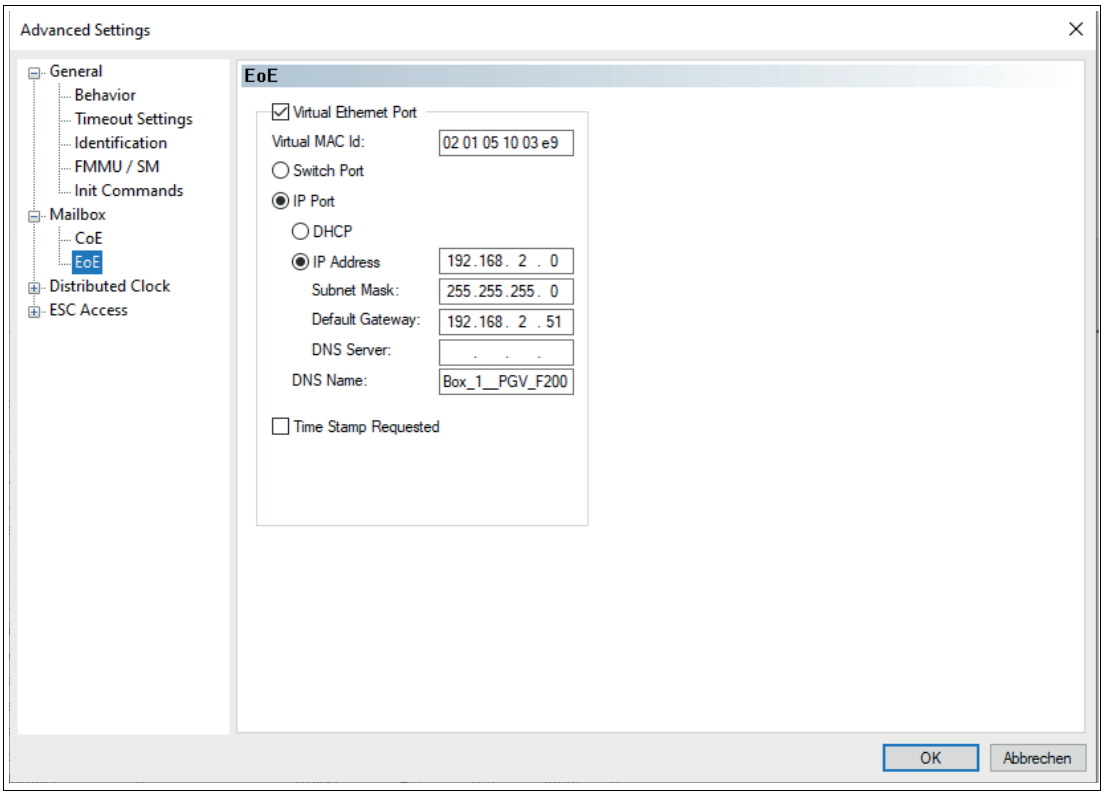

Figure 4.25

6. Enable the "Virtual Ethernet Port" option.

Note

MAC Addresses

Each read head has a unique MAC ID that is assigned by the manufacturer. The MAC ID cannot be changed by the user.

This MAC ID has no function for EtherCAT®. For EoE (Ethernet over EtherCAT®), the read head is assigned a virtual MAC address.

7. Activate "IP Port" and "IP Address."
8. Enter the IP address and subnet mask. Make sure that the IP addresses of the read head and the controller are in the same subnet.
9. Select the "Activate Configuration" symbol in the toolbar.

   ↳ TwinCAT® is started in configuration mode.
10. Confirm the message that the new configuration will be activated and old configurations will be overwritten.
11. Confirm the message that a reboot is in run mode.

    ↳ The TwinCAT system is now in run mode and the corresponding symbol is active. The blue symbol to the right of the run mode symbol allows you to switch back to configuration mode.
12. Restart to update the IP address.

Vision Configurator - Auto Detect

The **Auto detect (TCP/IP only)** function is available in Vision Configurator. This function allows you to view all connected TCP/IP Ethernet devices. In the output window, you can display the device you are looking for.

Auto Detect

1. Select the "Auto detect (TCP/IP only)" function (1).

↳ If a read head is detected, the following output window appears with the corresponding read head (2).

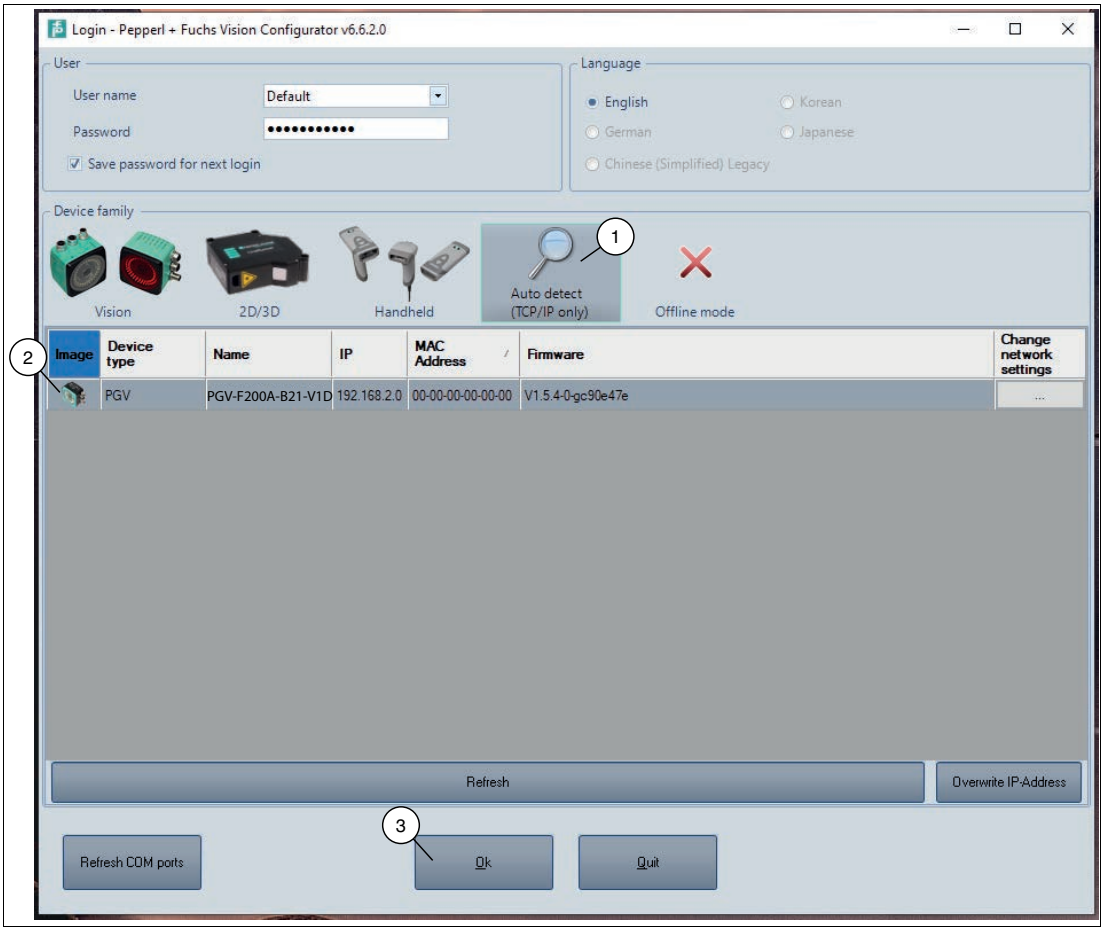

Figure 4.26 Auto Detect

2. Select your read head (2).
3. Click on "OK" (3) to confirm the entry.

↳ A connection to the Vision Configurator is established. More information on the Vision Configurator can be found at the following link, see chapter 6.

Note

If you are having trouble connecting via "Auto Detect", you can use the alternative connection method, see chapter 6.

5 Operation and Communication

5.1 EtherCAT® Communication Methods

Ethernet over EtherCAT® - EoE

In an EtherCAT® network, only communication via the EtherCAT® protocol is permitted. Any Ethernet-based communication that is not EtherCAT® (e.g., TCP/IP, UDP/IP, etc.) is tunneled through the EtherCAT®-SubDevice using the EtherCAT® EoE protocol. This includes protocols such as HTTP, FTP, Telnet, etc. It is a mailbox channel that does not interfere with the cyclic real-time process data exchange.

The Ethernet-over-EtherCAT® protocol allows all Ethernet traffic to be transported within an EtherCAT® network segment. Ethernet devices are connected to the EtherCAT® network segment via switch ports. The Ethernet frames are tunneled through EtherCAT® in a similar way to how Internet protocols (TCP/IP, HTTP etc.) are tunneled through Ethernet frames, but these are embedded in EtherCAT® frames. This keeps the EtherCAT® network completely transparent for these protocols.

The EoE-enabled SubDevice device embeds the EoE telegrams. The real-time properties of the network remain unaffected, as sending and processing takes place via acyclical mailbox traffic, which has a significantly lower priority compared to cyclical process data exchange.

Since the EoE MainDevice acts as a Layer 2 switch, it sends telegrams via EoE to the MAC addresses of the EoE nodes.

CANopen over EtherCAT® - CoE

For the CANopen over EtherCAT® (CoE) protocol supported by the read head, most objects are supported for the communication layer according to the CIA's DS301 CANopen standard by EtherCAT®. These are mostly objects for setting up communication between the control unit and the bus node.

The EtherCAT® protocol uses two different types of transfer to transfer the device and user protocols, such as the CoE protocol. These two transfer types are the mailbox telegram protocol for transmitting acyclic data and the process data telegram protocol for transmitting cyclic data.

For the CoE protocol, these two transfer types are used for the different types of CANopen transfer. They are used as follows:

- **Mailbox Telegram Protocol:**
  This transfer type is used to transfer the service data objects (SDO) defined under CANopen. Service data objects control the parameter data exchange, e.g., the acyclic execution of the preset function. They are transmitted in EtherCAT® in SDO frames.

- **Process Data Telegram Protocol:**
  This transfer type is used to transfer the process data objects (PDO) defined under CANopen. Process data objects manage the process data exchange, e.g., the cyclic transfer of the position value. They are transmitted in EtherCAT® in PDO frames.

Device Description File—ESI File

With EtherCAT®, all process data and the parameters are described in objects. The compilation of all the process data and parameters (the object directory) is stored in an EtherCAT® description file (ESI file, EtherCAT® SubDevice Information File).

This ESI file contains all objects with index, subindex, name, data type, data access, and the value range with minima, maxima, and default value. The ESI file describes the complete functionality of the device. It is possible to adapt the communication between the device and the control via these objects.

Downloading and Installing the ESI File

You can find the relevant ESI file in the **Commissioning** section of the product detail page for the device. To access the product detail page for the device, go to http://www.pepperl-fuchs.com and use the search function to search by the product description or the item number.

Install the ESI file using your controller manufacturer's configuration software. For TwinCAT®, the ESI file must normally be copied into the installation folder. After installation, the object data of the ESI file is available in the hardware catalog.

Booting up the Read Head in the EtherCAT System

When a read head is booted up in an EtherCAT system, several statuses are run through to ensure correct integration and communication in the network. The exact states may vary depending on the EtherCAT implementation and specification, but here are some typical states that are run through during the boot process:

INIT

The read head is switched on or restarted. The read head is first initialized and is in the "INIT" state. In this state, direct communication between the MainDevice and the read head via the application layer is not possible. The read head is gradually transferred to the "OPERATIONAL" state via the EtherCAT-MainDevice.

During the transition from INIT to PRE-OPERATIONAL, the EtherCAT-SubDevice checks whether the mailbox has been initialized correctly.

PRE-OPERATIONAL

In the PRE-OPERATIONAL state, application-specific initializations and device-specific parameters are exchanged between the MainDevice and the read head. In this state, configuration is initially only possible via Service Data Objects (SDOs). Mailbox communication is possible.

During the transition from PRE-OPERATIONAL to SAFE-OPERATIONAL, the EtherCAT-SubDevice checks the configuration of the read head and compares it with the requirements of the EtherCAT-MainDevice.

SAFE OPERATIONAL

The device is ready for EtherCAT communication, but does not yet participate in the regular cyclical process data exchange. It is in a safe state to verify integration.

OPERATIONAL

The device is in full operating state and actively participates in the cyclical process data exchange in the EtherCAT network.

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Data Transmission by the SyncManager

The PDOs and SDOs are read from the EtherCAT telegram by the SyncManager (Receive Parameter) or inserted into the EtherCAT telegram (Transmit Parameter). Four sync channels are available for data transmission.

SyncManager channel	Function
0	Transfer of service data from the EtherCAT telegram to the mailbox (Receive SDO)
1	Transfer of service data from the mailbox to the EtherCAT telegram (Transmit SDO)
2	Transfer of process data from the EtherCAT telegram (Receive PDO)
3	Transfer of process data in the EtherCAT telegram (Transmit PDO)

The SyncManager objects 0x1C12 and 0x1C13 are available for process data transfer ().

Note

Monitoring Read and Write Access

The SyncManager protects the memory for data exchange between EtherCAT-MainDevice and EtherCAT-SubDevice from simultaneous access. This prevents another memory area from being overwritten while a memory area is being read, therefore preventing the read data from being inconsistent.

PDO (Process Data Object)

PDOs contain process data for controlling and monitoring the read head behavior. The PDOs are distinguished from the read head into receive and send PDOs.

- Receive PDO (RxPDO): is received from a read head and contains, for example, control data
- Transmit PDO (TxPDO): is sent from a read head and contains, for example, monitoring data

SDO (Service Data Object)

The SDO reads and writes parameters to the object directory. The SDO accesses the object directory via the 16-bit index and the 8-bit subindex.

5.2 Object Directory

Communication Objects

Index (hex) box	Object name	Access	Link
Default objects			
0x1000	Device type	ro	See "0x1000 Device Type" on page 80
0x1008	Manufacturer Device Name	ro	See "0x1008 Manufacturer Device Name" on page 80
0x1009	Manufacturer Hardware Version	ro	See "0x1009 Manufacturer Hardware Version" on page 80
0x100A	Manufacturer Software Version	ro	See "0x100A Manufacturer Software Version" on page 80
0x1018	Device ID (Identify Object)	ro	See "0x1018 Identify Object" on page 81
0x1C00	Sync manager Communication type (Sync Manager Communication Type)	ro	See "0x1C00 SyncManager Communication Type" on page 81
0x1C12	RxPDO assignment (Sync Manager RxPDO Assignment)	rw	See "0x1C12 SyncManager RxPDO Assignment" on page 81
0x1C13	TxPDO assignment (Sync Manager TxPDO Assignment)	rw	See "0x1C13 SyncManager TxPDO Assignment" on page 81
0x1C32	Sync Manager Output Parameter	-	See "0x1C32 SyncManager Output Parameter" on page 84
0x1C33	Sync Manager Input Parameter	-	See "0x1C33 SyncManager Input Parameter" on page 84
Profile-specific objects			
0xF000	Modular device profile	ro	See "0xF000 Modular Device Profile" on page 84
Manufacturer-specific objects			
0x3000	Pepperl+Fuchs Serial Number	ro	See "0x3000 Pepperl+Fuchs Serial Number" on page 84

For the tables below, the following applies:

ro (= **r**ead **o**nly) means read-only access

rw (= **r**ead **w**rite) means reading and writing permitted

0x1000 Device Type

This object contains information about the device type.

Index	Subindex	Object name	Access	Default	Description
0x1000	0x00	Device Type	ro	0x000013898 (5001_{dec})	Specifies the device type

0x1008 Manufacturer Device Name

This object specifies the manufacturer-specific device name.

Index	Subindex	Object name	Access	Default	Description
0x1008	0x00	Manufacturer Device Name	ro	-	Device name

0x1009 Manufacturer Hardware Version

This object specifies the status of the hardware version of the read head.

Index	Subindex	Object name	Access	Default	Description
0x1009	0x00	Manufacturer Hardware Version	ro	-	Hardware version

0x100A Manufacturer Software Version

This object specifies the current status of the software version.

Index	Subindex	Object name	Access	Default	Description
0x100A	0x00	Manufacturer Software Version	ro	-	Software version

0x1018 Identify Object

This object provides general information about the device. Keep these values available for service requests.

Index	Subindex	Object name	Access	Default	Description
0x1018	0x01	Vendor ID	ro	0x000000AD (173_{dec})	Manufacturer identification number
	0x02	Product code	ro	0x06000003 (100663299_{dec})	Product identification number
	0x03	Revision Number	ro	0x00000001 (1_{dec})	Version Number
	0x04	Serial number	ro	Each read head has its own serial number	Serial number

0x1C00 SyncManager Communication Type

This object displays the assignment of the four sync channels.

Index	Subindex	Object name	Access	Default	Description
0x1C00	0x01	Subindex 001	ro	0x01 (1_{dec})	Channel 1: Mailbox write permission
	0x02	Subindex 002	ro	0x02 (2_{dec})	Channel 2: Mailbox read permission
	0x03	Subindex 003	ro	0x03 (3_{dec})	Channel 3: Process data write authorization (outputs)
	0x04	Subindex 004	ro	0x04 (4_{dec})	Channel 3: Process data read authorization (inputs)

0x1C12 SyncManager RxPDO Assignment

The output process data of the read head has the following assignment to an RxPDO object.

Index	Subindex	Object name	Access	Default	Description
0x1C12	0x01	SubIndex 001	rw	0x1600 (5632_{dec})	Assignment of output process data to RxPDO object
	0x02	Subindex 002	rw	0x1601 (5633_{dec})	Assignment of output process data to RxPDO object

0x1C13 SyncManager TxPDO Assignment

Object 1C13h can be used to configure a PDO for the sync channel. The sync channel is permanently intended for sending transmit PDOs (read head for control). In this object, the number of PDOs assigned to this sync channel must be set under sub-index 0.

The object number of the PDO to be assigned to the channel is entered in subindices 1 to 10. Only the object numbers of the previously configured transmit PDOs can be used here (0x1A00 bis 0x1A09).

Index	Subindex	Object name	Access	Default	Description
0x1C13	0x01	SubIndex 001	rw	0x1A00 (6656_{dec})	First assigned TxPDO (contains the index of the corresponding TxPDO mapping object)
	0x02	SubIndex 002	rw	0x1A01 (6657_{dec})	Second assigned TxPDO (contains the index of the corresponding TxPDO mapping object)
	0x03	SubIndex 003	rw	0x1A02 (6658_{dec})	Third assigned TxPDO (contains the index of the corresponding TxPDO mapping object)
	0x04	SubIndex 004	rw	0x1A03 (6659_{dec})	Fourth assigned TxPDO (contains the index of the corresponding TxPDO mapping object)
	0x05	SubIndex 005	rw	0x1A04 (6660_{dec})	Fifth assigned TxPDO (contains the index of the corresponding TxPDO mapping object)
	0x06	SubIndex 006	rw	0x1A05 (6661_{dec})	Sixth assigned TxPDO (contains the index of the corresponding TxPDO mapping object)
	0x07	SubIndex 007	rw	0x1A06 (6662_{dec})	Seventh assigned TxPDO (contains the index of the corresponding TxPDO mapping object)
	0x08	SubIndex 008	rw	0x1A07 (6663_{dec})	Eighth assigned TxPDO (contains the index of the corresponding TxPDO mapping object)
	0x09	SubIndex 009	rw	0x1A08 (6664_{dec})	Ninth assigned TxPDO (contains the index of the corresponding TxPDO mapping object)
	0x0A	SubIndex 010	rw	0x1A09 (6665_{dec})	Tenth assigned TxPDO (contains the index of the corresponding TxPDO mapping object)

0x1C32 SyncManager Output Parameter

This object shows the synchronization parameters of the outputs.

Index	Subindex	Object name	Access	Default	Description
0x1C32	0x01	Synchronization Type	ro	0x0000 (0_{dec})	Current synchronization mode
	0x02	Synchronization Types Supported	ro	0x0001 (1_{dec})	Supported synchronization modes

0x1C33 SyncManager Input Parameter

This object shows the synchronization parameters of the inputs.

Index	Subindex	Object name	Access	Default	Description
0x1C32	0x01	Synchronization Type	ro	0x0000 (0_{dec})	Current synchronization mode
	0x02	Synchronization Types Supported	ro	0x0001 (1_{dec})	Supported synchronization modes

0xF000 Modular Device Profile

This object contains all the information necessary to interpret the module objects.

Index	Subindex	Object name	Access	Default	Description
0xF000	0x01	Module index distance	ro	0x0010 (16_{dec})	Index distance of the objects of the individual channels
	0x02	Maximum number of modules	ro	0x0001 (1_{dec})	Number of channels. Only one active channel is supported

0x3000 Pepperl+Fuchs Serial Number

Pepperl+Fuchs standard serial number.

Index	Subindex	Object name	Access	Default	Description
0x3000	0x00	Pepperl+Fuchs serial number	ro	-	Pepperl+Fuchs serial number

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5.3 Process Data Objects (PDOs)

PDO Frame

The process data objects (PDOs) are used for the cyclic transfer of process data between the controller and read head. They must be configured by the controller in the "Pre-Operational" state before the read head is operated. They are transmitted in PDO frames.

To transfer a PDO via the EtherCAT®-CoE protocol, the transmit and receive PDOs (TxPDOs and RxPDOs) must be assigned to a transfer channel of the sync manager in addition to the PDO configuration (PDO mapping). The data exchange of PDOs for the read head takes place exclusively via the EtherCAT® process data telegram protocol.

PDO Mapping

PDO mapping is used to assign the application objects (real-time process data) from the object directory to the process data objects. All mapping objects are predefined and only read access is permitted.

Overview

	Index	Designation	Data size	Link
The input PDOs ("input" from the EtherCAT Main-Device view) are located here	0x1A00	Status	2	See "0x1A00 Status" on page 86
	0x1A01	Y-Data	4	See "0x1A01 Y Position Data" on page 86
	0x1A02	X Position	4	See "0x1A02 X Position Data" on page 86
	0x1A03	Z Distance	2	See "0x1A03 Z Distance" on page 87
	0x1A04	Tag Number	4	See "0x1A04 Tag Number" on page 87
	0x1A05	Control Code	3	See "0x1A05 Data Matrix Control Code" on page 87
	0x1A06	Warning Bits	2	See "0x1A06 Warning Bits" on page 88
	0x1A07	Error Number	2	See "0x1A07 Error Number" on page 88
	0x1A08	Quality Information	2	See "0x1A08 Quality Information" on page 89
	0x1A09	Timestamp	4	See "0x1A09 Timestamp" on page 89
The output PDOs ("output" from the EtherCAT Main-Device view) are located here	0x1600	Output control	1	See "0x1600 Output Control" on page 89

0x1A00 Status

Index	Subindex	Object name	Data type	Data size	Offset	Description
0x6000	0x01	Error	BIT	0.1	0.0	Error message, see **Error Codes**
	0x02	No position	BIT	0.1	0.1	No absolute position
	0x03	Warning	BIT	0.1	0.2	Warnings present; see **Warning Module**
	0x04	Control Code Available	BIT	0.1	0.3	Control code recognized
	0x06	Follow Right Lane	BIT	0.1	0.5	Right lane is followed
	0x07	Follow Left Lane	BIT	0.1	0.6	Left lane is followed
	0x08	No Lane Detected	BIT	0.1	0.7	Has no function in the case of this read head.
	0x09	Relative Position	BIT	0.1	1.0	Relative Position
	0x0A	Lane Count	BIT2	0.2	1.1	Number of lanes detected
	0x1C	Tag Available	BIT	0.1	1.3	Data Matrix tag present
	0x1D	Illumination is Off	BIT	0.1	1.4	Illumination is switched off
	0x1E	Decoder is Off	BIT	0.1	1.5	Decoder is switched off

0x1A01 Y Position Data

Index	Subindex	Object name	Data Type	Data size	Offset	Description
0x6001	0x01	y position	INT16	2.0	0.0	Y position
	0x02	Angle	UINT16	2.0	0.2	Angle

0x1A02 X Position Data

Index	Subindex	Object name	Data Type	Data size	Offset	Description
0x6002	0x01	x position	DINT	4.0	0.0	X position

0x1A03 Z Distance

Index	Subindex	Object name	Data Type	Data size	Offset	Description
0x6003	0x01	z distance	UINT	2.0	0.0	Z distance

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0x1A04 Tag Number

Index	Subindex	Object name	Data Type	Data size	Offset	Descrip-tion
0x6004	0x01	Tag Number	UDINT	4.0	0.0	Tag number

0x1A05 Data Matrix Control Code

Index	Subindex	Object name	Data Type	Data size	Offset	Description
0x6005	0x01	S0	BIT	0.1	0.0	Position of a Data Matrix control code relative to the Data Matrix code tape
	0x02	S1	BIT	0.1	0.1	
	0x03	O0	BIT	0.1	0.2	Alignment of the Data Matrix control code in the reading window
	0x04	O1	BIT	0.1	0.3	
	0x05	Control Code Number	UINT	2.0	1.0	Number of the Data Matrix control code

0x1A06 Warning Bits

Index	Subindex	Object name	Data Type	Data size	Offset	Description
0x6006	0x01	Warning 01	BIT	0.1	0.0	A code with con-tent that does not belong to the PCV read head was found.
	0x02	Warning 02	BIT	0.1	0.1	Read head too close to code tape
	0x03	Warning 03	BIT	0.1	0.2	Read head too far from code tape
	0x04	Warning 04	BIT	0.1	0.3	Reserved
	0x05	Warning 05	BIT	0.1	0.4	Reserved
	0x06	Warning 06	BIT	0.1	0.5	The reader is rotated or tilted in relation to the code tape
	0x07	Warning 07	BIT	0.1	0.6	Reserved
	0x08	Warning 08	BIT	0.1	0.7	Reserved
	0x09	Warning 09	BIT	0.1	1.0	Reserved
	0x0A	Warning 10	BIT	0.1	1.1	Reserved
	0x0B	Warning 11	BIT	0.1	1.2	Reserved
	0x0C	Warning 12	BIT	0.1	1.3	Reserved
	0x0D	Warning 13	BIT	0.1	1.4	Reserved
	0x0E	Warning 14	BIT	0.1	1.5	Reserved
	0x0F	Warning 15	BIT	0.1	1.6	Reserved
	0x10	Warning 16	BIT	0.1	1.7	Reserved

0x1A07 Error Number

Index	Subindex	Object name	Data Type	Data size	Offset	Description
0x6007	0x01	Error Number	UINT	2.0	0.0	Error number

Error codes

Error code	Description	Priority
2	No clear position can be determined, e.g., difference between codes is too great, code distance incorrect	4
5	No direction decision available	2
> 1000	Internal error	1

0x1A08 Quality Information

Index	Subindex	Object name	Data Type	Data size	Offset	Description
0x6008	0x01	Quality Index	USINT	1.0	0.0	Quality grade of the scene being viewed
	0x02	Number decoded Codes	USINT	1.0	1.0	Number of decoded codes

0x1A09 Timestamp

Index	Subindex	Object name	Data Type	Data size	Offset	Description
0x6009	0x01	Timestamp	UDINT	4.0	0.0	Timestamp

For more information about the timestamp, .

0x1600 Output Control

Index	Subindex	Object name	Data type	Data size	Offset	Description
0x7000	0x01	Follow Left Lane	BIT	0.1	0.0	Follow left-hand lane
	0x02	Follow Right Lane	BIT	0.1	0.1	Follow right-hand lane
	0x05	Illumination Off	BIT	0.1	0.4	Switch off illumination
	0x06	Decoder Off	BIT	0.1	0.5	Switch off decoder Switches off the Data Matrix decoder. Any further positioning targets will not be detected. • Absolute Data Matrix code tapes • Data Matrix repair tape • Data Matrix control codes • Data Matrix Tags

5.4 Configuration Parameters

The configuration data is used to set the basic parameters of the read head. This data can be defined via the controller and serves as an initial configuration that is loaded when the read head is started. Unlike the process data, the configuration data cannot be changed during operation.

Overview

Index	Designation	Access	Default	Value range	Description
0x8002	Input source selector	rw	Protocol (1)	Hardware (0) Protocol (1)	Selecting the source of the input data
0x8003	Resolution settings	rw			
0x8003:01	X position resolution	rw	1 mm (1)	0.1 mm (0) 1 mm (1) 10 mm (2)	Multiplier for the length in the direction of the X coordinate
0x8003:02	Y position resolution	rw	1 mm (1)	0.1 mm (0) 1 mm (1) 10 mm (2)	Multiplier for the length in the direction of the Y coordinate
0x8003:03	Angular resolution	rw	360	360 3600	Multiplier for the angle value is set to 1° (360)
0x8004	Horizontal offset	rw	0	-2147483648 ... 2147483647	Offset in the direction of the X coordinate in mm * X position resolution
0x8005	Vertical offset	rw	0	-32768 ... 32767	Offset in the direction of the Y coordinate in mm * Y position resolution
0x8006	Angle offset	rw	0	-16383 ... 16383	Offset of the viewing direction in ° * angular resolution
0x8007	No position behavior	rw			
0x8007:01	Behavior if x-position data is missing	rw	special value (1)	last valid value (0) special value (1)	Behavior with missing X-position data
0x8007:02	Specified value for missing x-position data	rw	0	-2147483648 ... 2147483647	Specified value for missing X position data in mm * X position resolution
0x8007:03	Behavior if y-position data is missing	rw	special value (1)	last valid value (0) special value (1)	Behavior with missing y-position data
0x8007:04	Specified value for missing y-position data	rw	0	-2147483648 ... 2147483647	Specified value for missing Y position data in mm * Y position resolution
0x8007:05	Behavior if angle data is missing	rw	special value (1)	last valid value (0) special value (1)	Behavior with missing angle data
0x8007:06	Specified value for missing angle data	rw	0	0– 65535	Specified value for missing angle data in ° * angular resolution

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5.5 Firmware Update via the "File Access over EtherCAT®" (FoE) protocol

This chapter describes the firmware update for the read head. The read head supports "File Access over EtherCAT®" (FoE). This makes it possible to load the firmware onto the read head via the EtherCAT® controller, provided that it supports this function.

A firmware update should only be carried out after consultation with Pepperl+Fuchs Support.

Note

The current firmware version can be downloaded from our website: www.pepperl-fuchs.com. Simply enter the product name or item number in the Product/Keyword field and click "Search." Select your product from the list of search results. Click on the information you require in the product information list, for example, Software. A list of all available downloads is displayed.

Perform the firmware update via TwinCAT

Proceed as follows with the configuration software TwinCAT 3.x:

1. Download the new firmware locally to your computer.
2. Double-click on "Box 1 (PGV-F200)" in the project tree.

   ↳ The menu "TwinCAT Project 1" is displayed.
3. Click the "Online" tab (1).

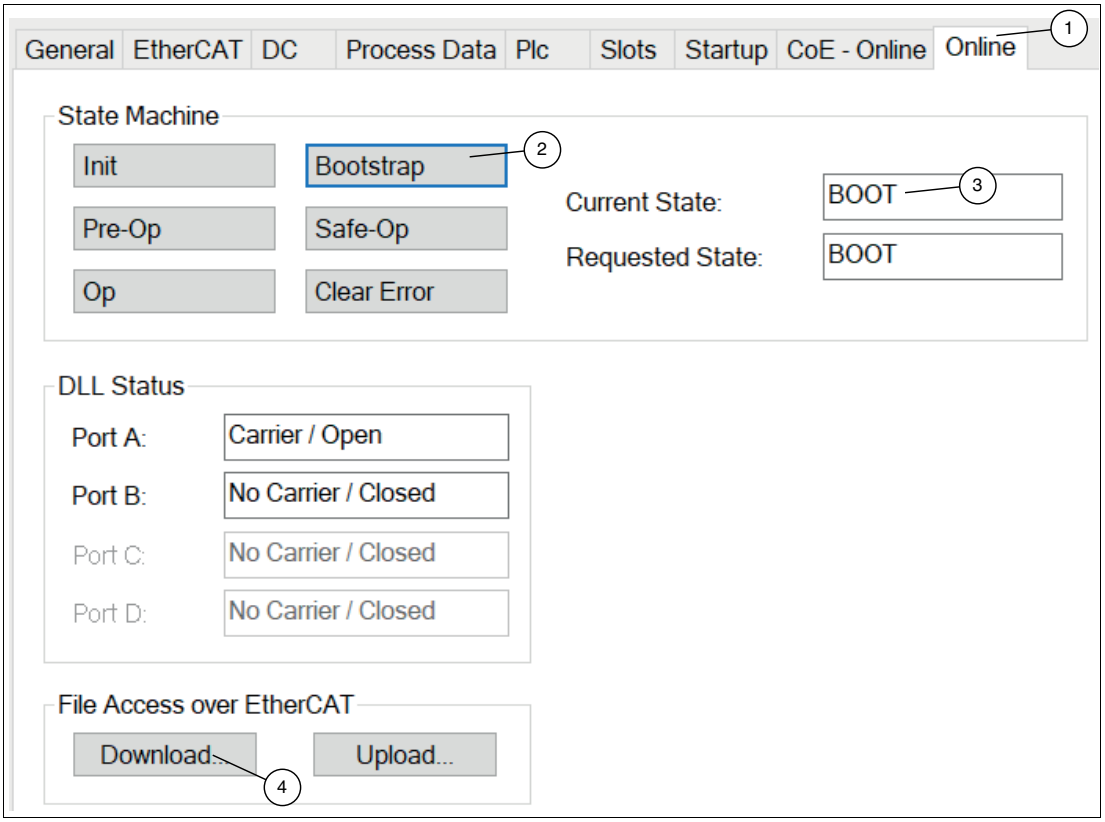


Figure 5.1 State Machine—Bootstrap

↳ The "State Machine" menu opens.

4. Click the "Bootstrap" button (2).

   ↳ The read head changes to the "BOOT" status (3).

5. To download the new firmware from the directory, click the "Download" button (4).

   ↳ A new window opens in which you can search for your firmware file. All of the "efw" files (EtherCAT® Firmware) are displayed.

6. Select your firmware file and click "Open" to confirm your selection.

   ↳ The "Edit FoE Name" window opens.

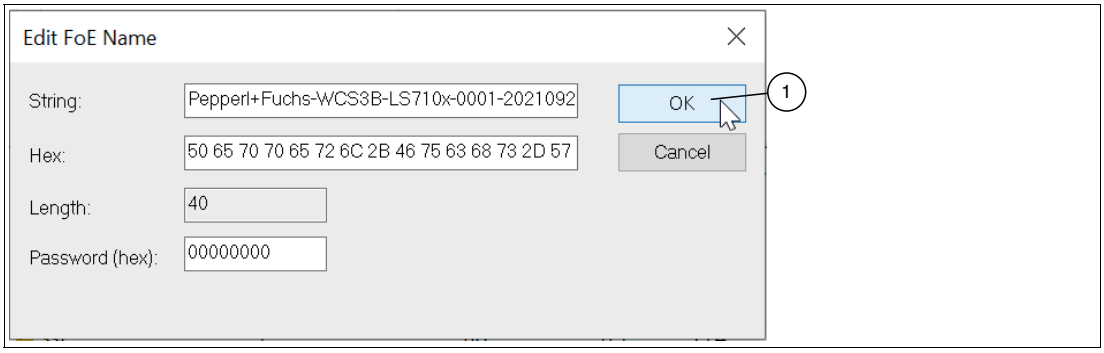


Figure 5.2 Edit the FoE name

7. Confirm the "Edit FoE Name" window with "OK" (1).

   ↳ The download starts and the firmware file is loaded into the flash memory of the read head. The TwinCAT configuration software displays the download of the firmware file with a progress bar at the bottom of the screen.

8. Click the "Init" button (1).

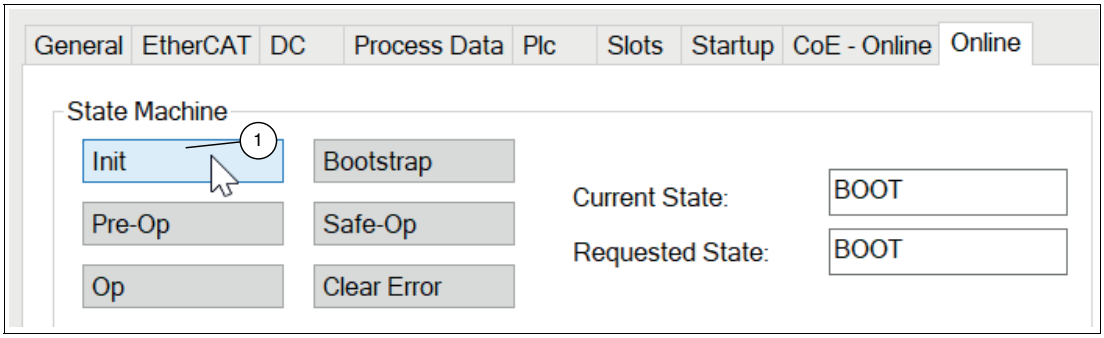


Figure 5.3 State Machine—Init

↳ The update is in progress. When the update is complete, the read head switches to the normal operating mode.

6 Vision Configurator

Vision Configurator enables the read head to be operated using a user-friendly interface. The standard functions include establishing a connection to the read head, the parameterization of operating parameters, saving data sets, visualizing the camera capture of the read head, and error diagnosis.

Note

The latest version of the Vision Configurator software can be found online at https://www.pepperl-fuchs.com. The Vision Configurator manual outlines the properties of the operating software for multiple devices. You can access this manual from our website.

Note

In general, the EtherCAT read head cannot be connected directly to the Vision Configurator. First, the read head must be configured via TwinCAT in such a way that EoE is possible (see chapter 4.7).

6.1 Installing Vision Configurator

Installing Vision Configurator

The following describes how to obtain the installation file from the Pepperl+Fuchs homepage and install it.

1. Go to the Pepperl+Fuchs homepage at http://www.pepperl-fuchs.com and enter the product designation or item number in the search function. You can find the Vision Configurator software in the **Software** section of the device's product detail page.
2. Save the installation file locally.
3. Start the exe file.
4. Follow the instructions for the installation process.

   ↳ After installation, several image processing functions are available in the Windows Start menu under **"Start > All programs > Vision Configurator."**

6.2 Connecting the Read Head to the PC

Connecting the Read Head to the PC

The read head is connected to the PC as follows:

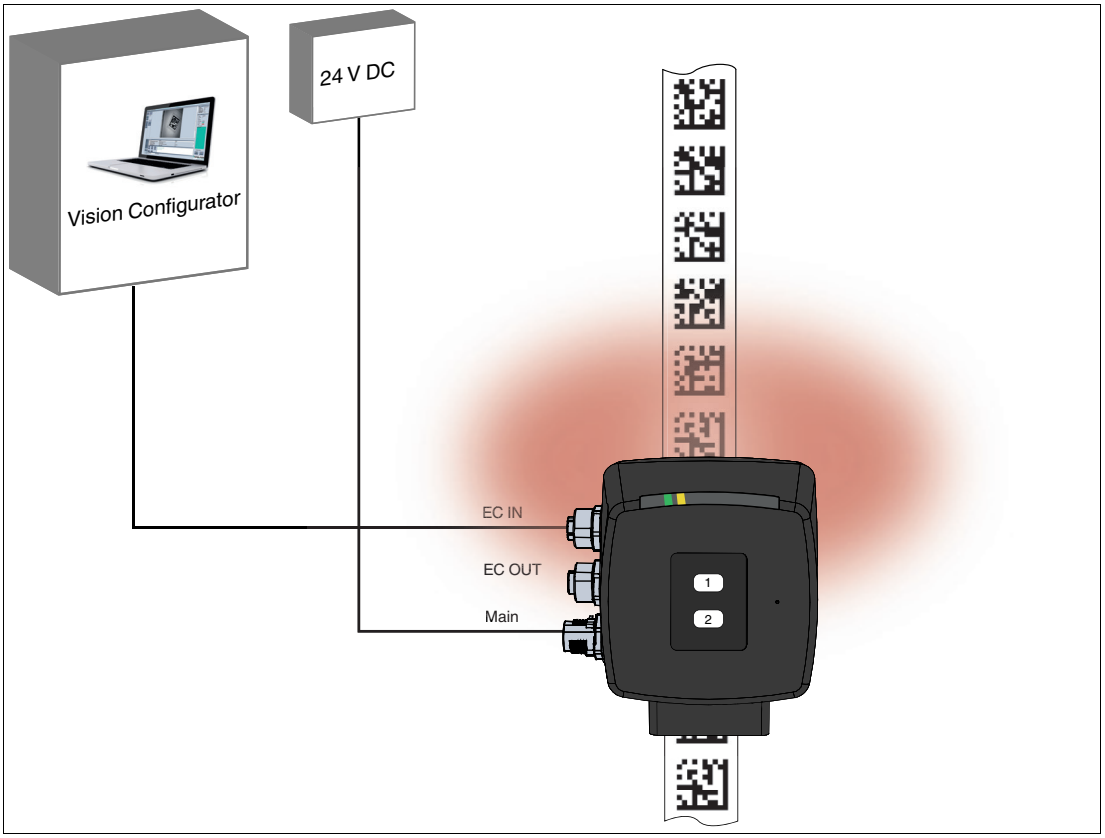


Figure 6.1

1. Connect the read head to a voltage supply (24 V DC).
2. Establish an Ethernet connection between the PC system and read head.

Note

Suitable Cables

For reliable operation, we recommend using the cables included in the accessories ().

Do not use cables that are not intended for the read head or that are damaged. This can lead to malfunctions.

6.3 Getting Started

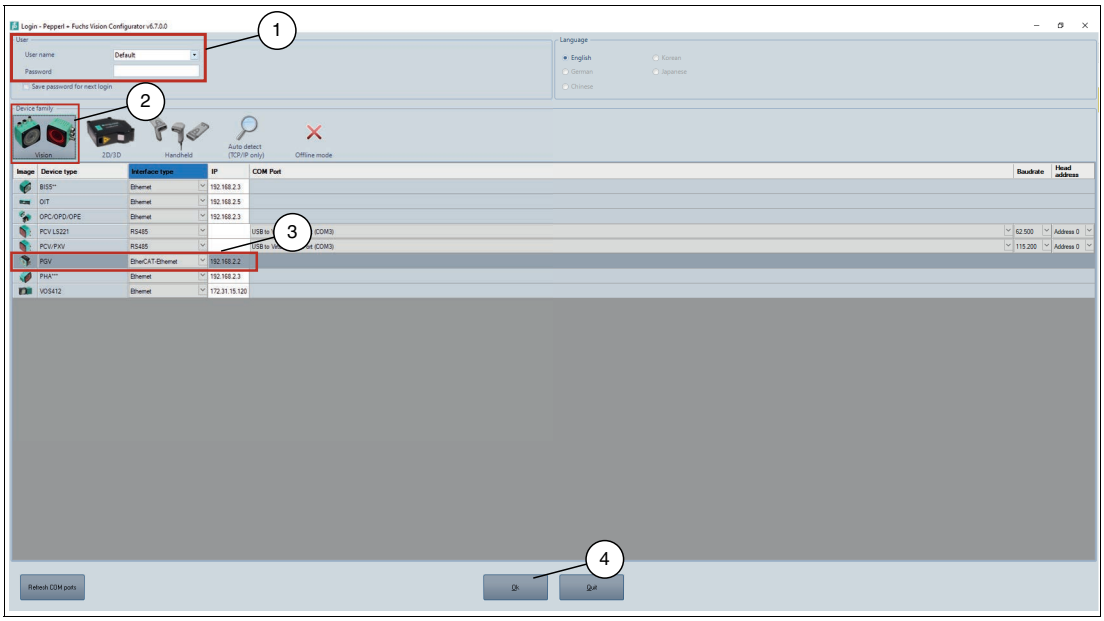


Figure 6.2

Selecting Users (1)

1. Select the required user from the **User name** drop-down list.
2. Enter the appropriate password in the **Password** input field.
3. If you want to save the password for the next time you log in, select the **Save password for next login** check box.

User Roles and Rights

Note

On delivery, the following user roles are predefined in **User name** in the **User** screen with various authorizations.

User Rights and Password

User rights	Description	Password
Default	View all information Sensor configuration Create users at same level or below	No password required
User	View all information Sensor configuration Create users at same level or below	User
Admin	View all information Sensor configuration Create and delete users	PF
PFAdmin	Access only for Pepperl+Fuchs service personnel	-

Selecting a Device Family (2)

The device family is selected in the **Device family** screen as follows:

1. Left-click on the "Vision" device family.

↳ A list of the available sensor types is displayed.

Selecting the Sensor Type (3)

1. Left-click on the "PGV" device family.

↳ The selected sensor type is highlighted in dark gray.

Selecting the Connection Type (3)

The connection type is selected in the **Interface type** screen as follows:

1. Select "EtherCAT-Ethernet" from the **Interface type** drop-down list.

Entering the IP Address (3)

The IP address required to establish the connection is set in the **IP** screen.

1. Enter the IP address 192.168.2.2.
2. Click "OK" (4) to confirm your selection.

6.4 Application Window Structure

The application screen opens after you log in.

Note

The number of menu items depends on the selected sensor; not all menu items will be available. Only those menu items required to configure the sensor will be displayed.

Figure 6.3 The application screen

The software is designed to be similar to most Windows applications.

1	Title bar	• Displays the name of the connected sensor • Displays the software designation • Contains the **Minimize/Maximize/Close** buttons
2	Menu bar	• Displays all the menus in the program • Provides an overview and helps with navigation
3	**Device data** screen	• Displays data for the connected sensor
4	**Device output** screen	• displays the read results
5	Status bar	• Displays status information about the application
6	Configuration Window	• Contains the sensor-specific parameters that you can set
7	Toolbar	• Contains icon buttons as an extension to the menu
8	Toolbar	The toolbar is located on the left side under the **Image View** tab. The toolbar contains several useful functions that are used to further process recorded images.

9	Image Display	• Displays images or diagrams
10	Tab	• Used for layout and arrangement of information • The tab in the foreground is the active one • A varying number of tabs can be displayed depending on which sensor is connected • Typical tabs are: "Image View"—shows images from the sensor that may contain additional information "Result View"—shows measurement data or statistics "Diagram View"—shows a diagram of the measurement data

6.5 Menu Bar

The menu bar contains a list of menu items. The functionality depends on the type of sensor that is connected and the permissions of the user logged in.

Figure 6.4 Menu Bar

6.5.1 *File* Menu

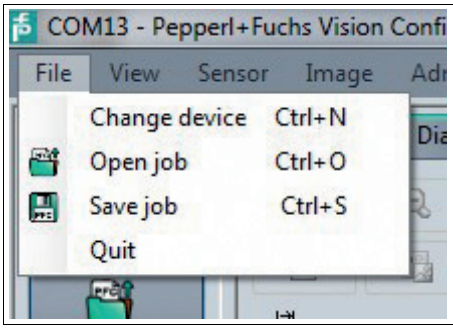


Figure 6.5 **File** Menu

Change device	Disconnects the read head and returns to the Login window. For example, a new device can be selected here.
Open job	A read head configuration stored on the PC is loaded. Note: Configuration is overwritten by the controller.
Save job	The read head settings made are stored on a data carrier (PC, USB stick, etc.).
Quit	Terminates the program.

Table 6.1 **File** Menu

6.5.2 *View* Menu

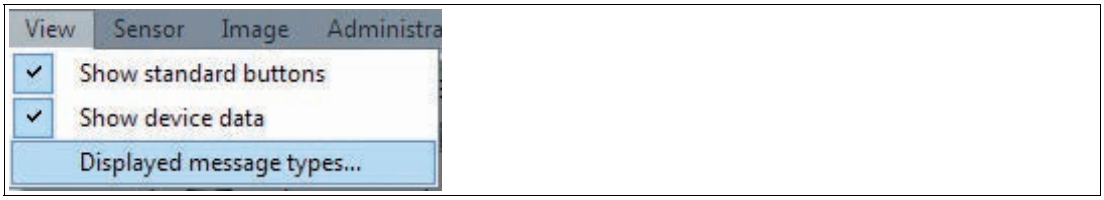


Figure 6.6 **View** menu

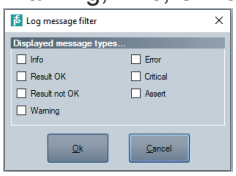
Show standard buttons	Show and hide the buttons in the toolbar ().
Show device data	Show and hide the device data in the display window (see chapter 6.7).
Displayed message types...	Opens a selection window in which the following display windows can be activated or deactivated: Info, Result OK, Result not OK, Warning, Erro, Critical, and Assert. 

Table 6.2 **View** menu

6.5.3 *Sensor* menu

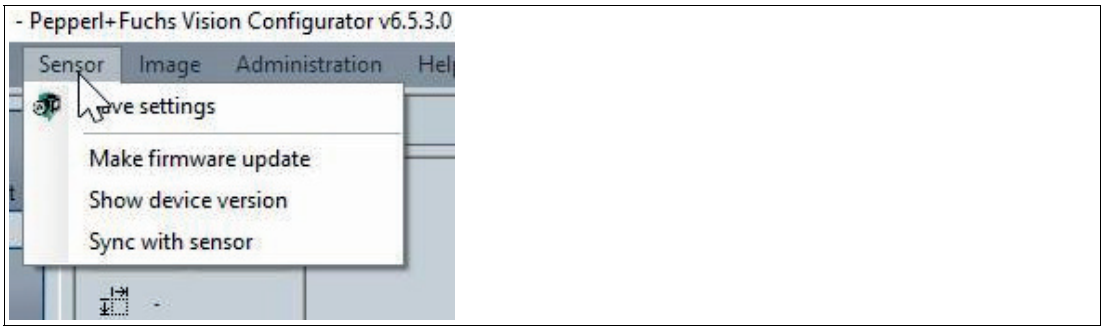


Figure 6.7 **Sensor** menu

Save settings	Saves the settings to the sensor
Make firmware update	Performs a firmware update. This command should only be used by experienced users.
Show device version	Displays the device version
Sync with sensor	Synchronization with the sensor

Table 6.3 **Sensor** menu

Note

Firmware Update

Restart the read head after the firmware update.

6.5.4 *Image* Menu

Figure 6.8 **Image** menu

Open image folder	Opens the folder in which images are currently saved
Save image	Saves the image currently displayed on the PC
Copy image to clipboard	Loads an image file to the clipboard
Show graphic	Switches display data sent from the sensor on and off in the image.

Table 6.4 **Image** menu

6.5.5 *Administration* Menu

Figure 6.9 **Administration** menu

User administration	Opens a window that shows all currently created users at the same authorization level or lower. New users at the same authorization level or lower can be created and deleted here. In addition, a user password can be reset to the default password for the relevant user level.
Change password	Changes the current user's password.
Change user	The login screen opens and a different user and/or sensor can be selected.
Load XML file...	Loads XML data from a computer.
Create reader programming code	Creates a reader programming code

Table 6.5 **Administration** menu

6.5.6 *Help* Menu

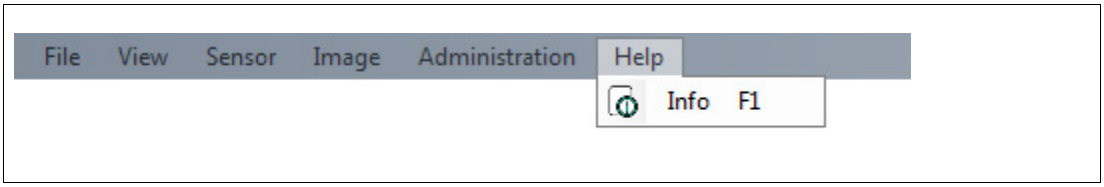


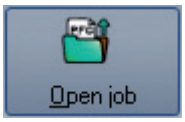
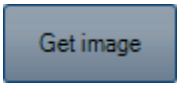
Figure 6.10 **Help** menu

Info	Displays information about Vision Configurator.

Table 6.6 **Help** menu

6.6 Toolbar

The toolbar can be used to select various functions.

	Selecting the Connect button establishes a connection between the PC and the read head.
	The connection between the PC and the read head is disconnected.
	A read head configuration stored on the PC is loaded. Note: Configuration is overwritten by the controller.
	The read head settings made are stored on a data carrier (PC, USB stick, etc.).
	All settings made are saved on the actual read head.
	You will be taken to the "Control Codes" menu. Here you can generate and print different control codes for the parameterization of your device.
	The read head records an image. The image can be displayed straight away in "Image View."

6.7 Device Data

The connected device type (Device type) and the firmware version (Firmware) are displayed in the Device data area.

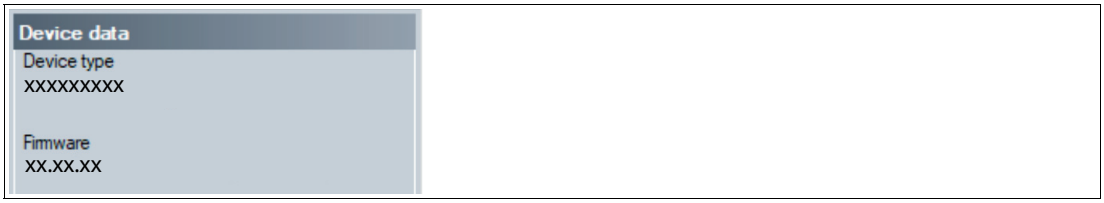


Figure 6.11 Device data

6.8 Image Display

The image display [Image View] (1) allows you to view the current capture of the read head. As an example, you can move the read head into difficult mounting positions, and display the capture. This allows you to detect the alignment of the read head with the Data Matrix code and readjust it.

You can open the currently captured image under the **Image view** tab. To do this, click on **Get image** in the toolbar.

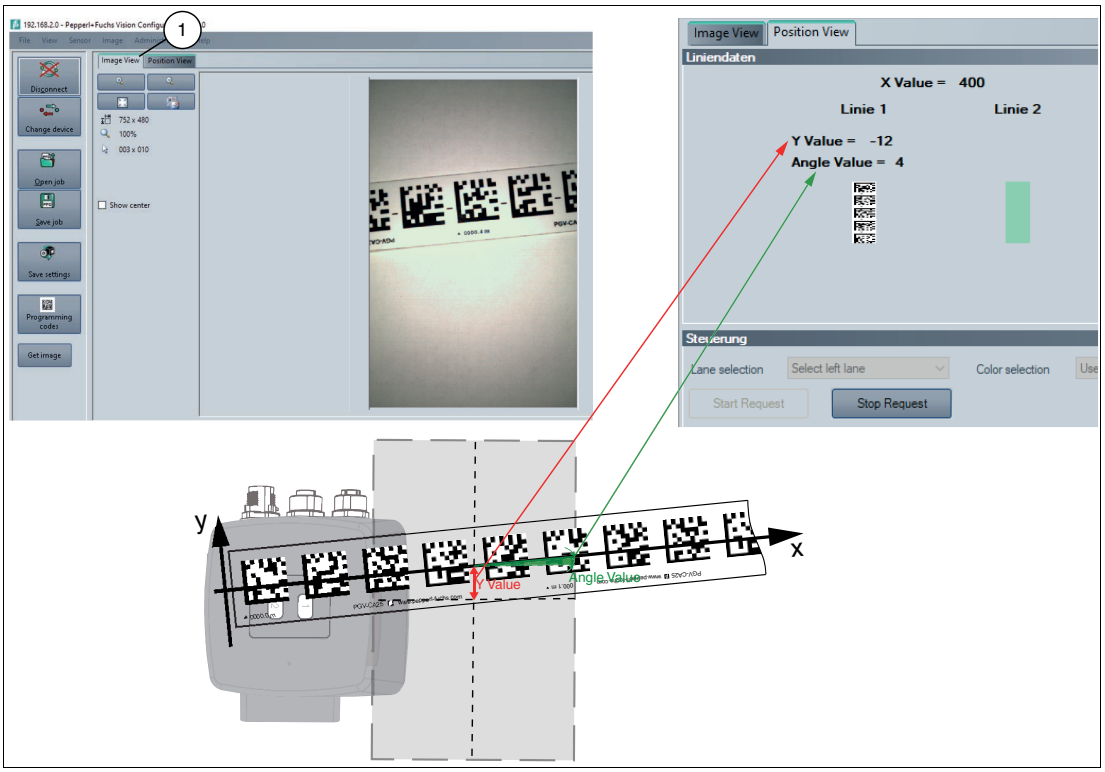


Figure 6.12

Right-clicking on the captured image opens the following context menu:

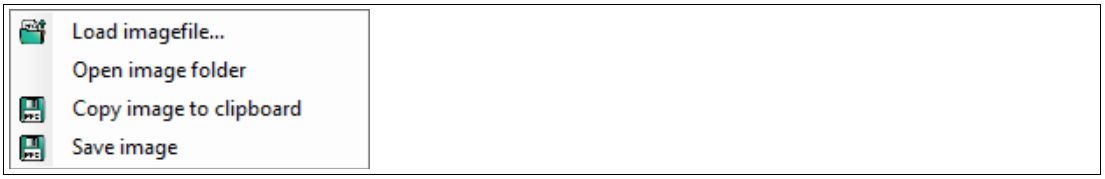


Figure 6.13 Image View context menu screen

Designation	Function
Load image file...	Loads a sensor image. You can select the sensor image.
Open image folder	Opens the storage location
Copy image to clipboard	Copies image to the clipboard
Save image	Saves the displayed sensor image

Toolbar

The toolbar is located on the left side under the **Image View** tab. The toolbar contains several useful functions that are used to further process recorded images. The following functions are available.

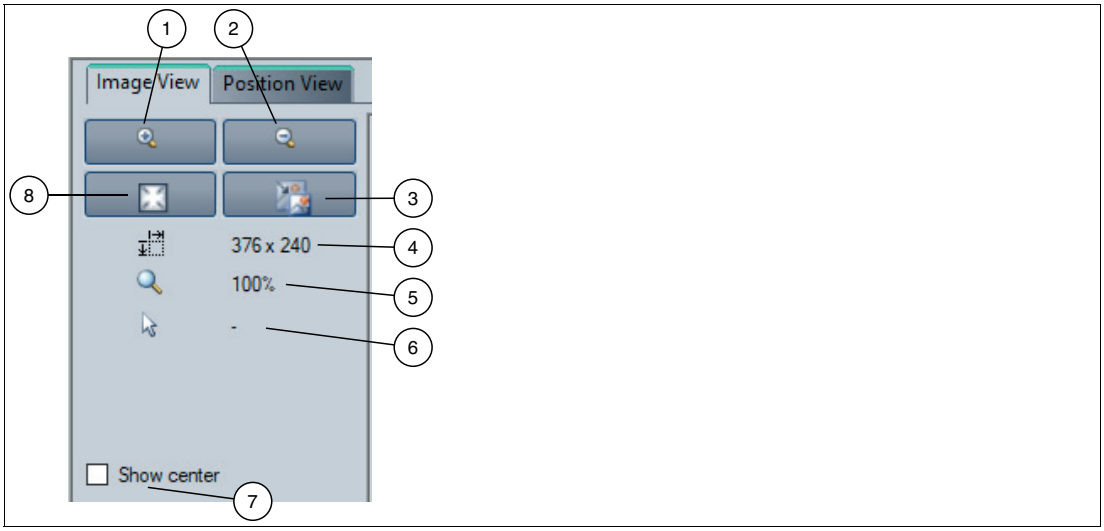


Figure 6.14 Toolbar

Item	Designation	Function
1	Magnifier +	Zoom into the image.
2	Magnifier -	Zoom out of the image.
3	Original size	Display image in original size.
4	Size details	Image size information box (length and width in pixels)
5	Zoom factor	Current zoom factor in percent (zoom factor 100 % is original image size)
6	Position details	Position of the cursor within the image
7	Show center	Display center
8	Fit to window	Adjusts the image display in relation to the size of the image display area.

6.9 Position View

The "Position View" (1) can be used to display the recorded absolute X position, the Y offset, the angle value, and various status values. The display is started with the "Start request" button and stopped with the "Stop request" button.

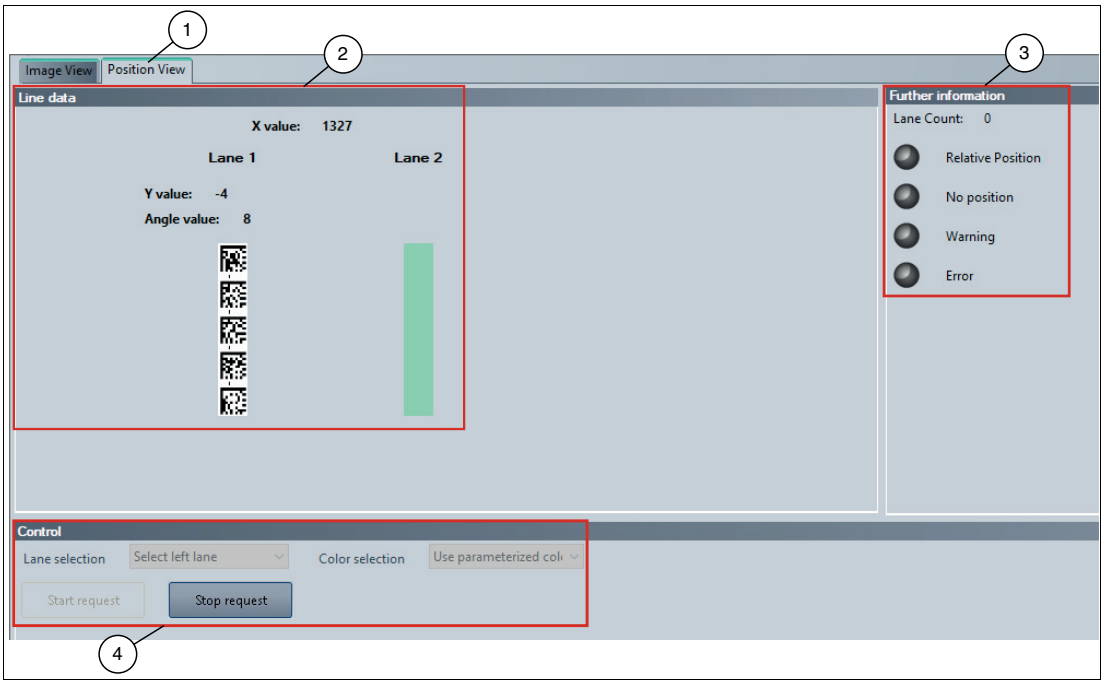


Figure 6.15

1 Position view

2 Position data [line data]

3 Status information [more information]

4 Has no function in the case of this read head version

Position Data [Line Data]

The display of the position information is launched with the "Start request" button.

Display	Description
X value	X position in mm
Y value	X position in mm
Angle value	Scaled angle of the code relative to the read head
Lane 1	The position information of the Data Matrix code tape is displayed.
Lane 2	No function

Example for "Angle Value"

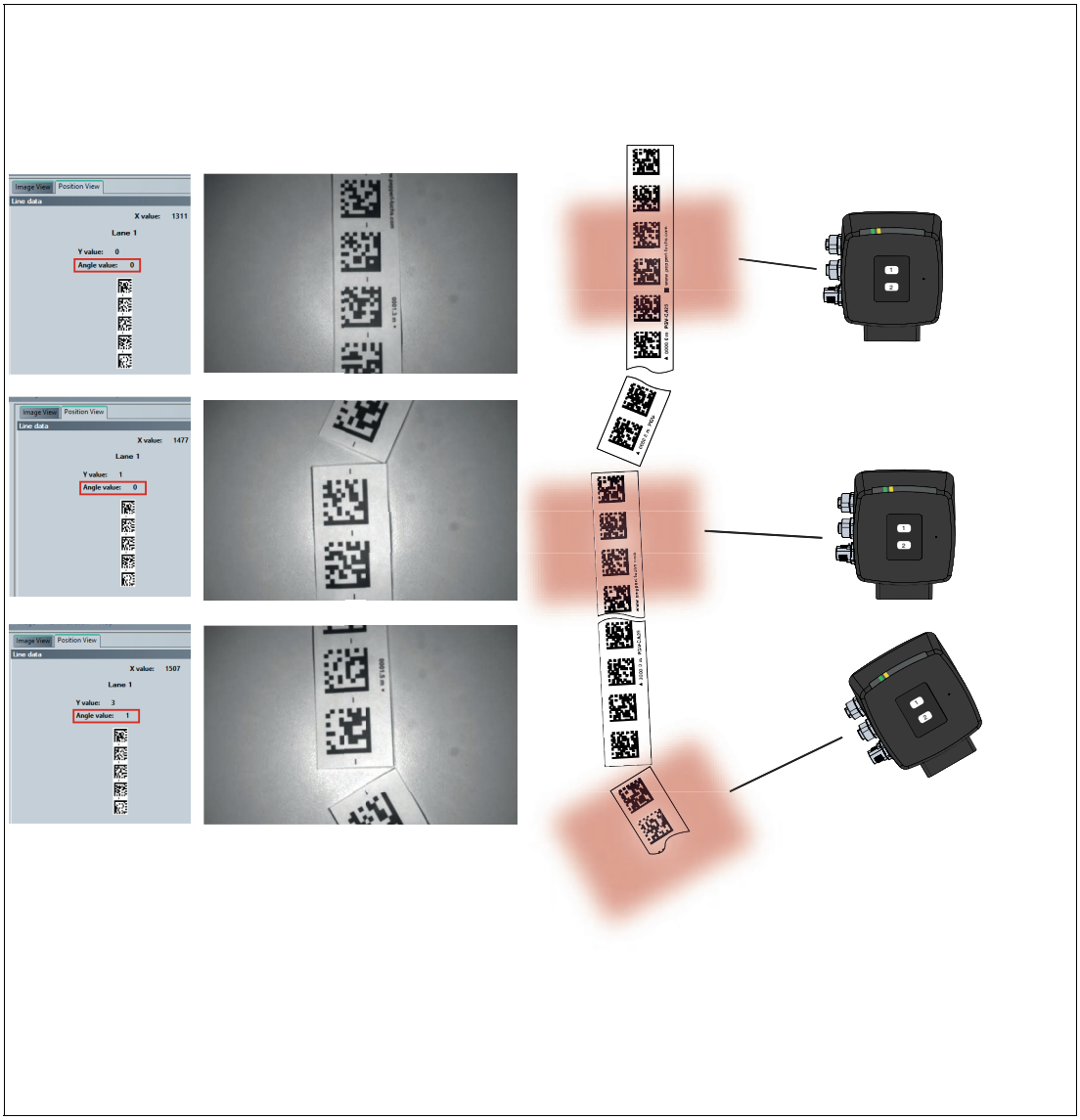


Figure 6.16 Example of an angle value

Status information [more information]

Message	Description
Lane Count	The lane count indicates the number of Data Matrix lanes found in the reading window.
Relative Position	Relative Position
No position	No absolute position
Warning	Warning message, code reading is restricted. Additional information about the codes can be found in the "Warning Messages" table ().
Error	Error message

6.10 Configuration Window

Various parameters are specified in the configuration window. The individual parameters depend on the current authorization level and are therefore not always all visible. Some features are available in different versions only. Depending on the parameters set, some fields will be grayed out.

Note

Note that the parameters set in the Vision Configurator are overwritten by the settings in the EtherCAT software. Carefully check and configure the EtherCAT settings to ensure that the read head performs the desired functions.

6.10.1 Sensor Information tab

The **Sensor information** tab contains the **Information** menu item. The **Information** menu item allows you to view more detailed information on the sensor.

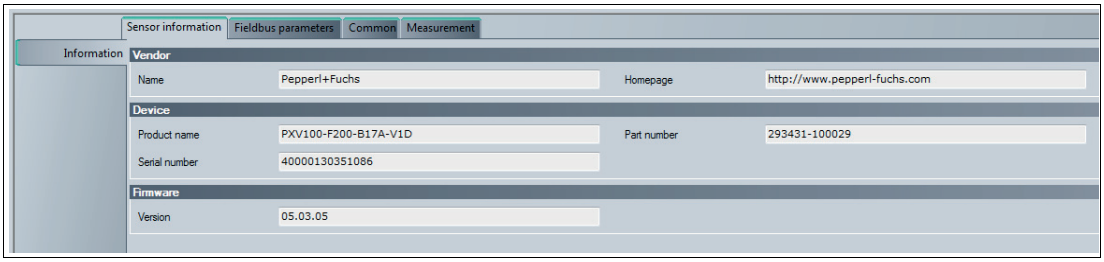


Figure 6.17 Sensor Information tab

Vendor	Name	Manufacturer
	Homepage	Manufacturer homepage
Device	Product name	Product name
	Serial number	Serial number
	Part number	Item number
Firmware	Version	Firmware version

6.10.2 Common Tab

Two menu items are available under the **Common** tab. The purpose of this section is to present the menu items in more detail.

Input/Output Menu Item

This section contains editable parameters for configuring the digital inputs, digital outputs, and read head inputs/outputs.

Inputs always have the input function (cannot be changed).

Outputs always have the output function (cannot be changed).

- **Input/output**
  Identifies the connection as an input or output.
  "Input" identifies the connection as an input.
  "Output" identifies the connection as an output.
- **Function**
  Assigns a function to the connection. The possible functions depend on whether the connection is an input or output.

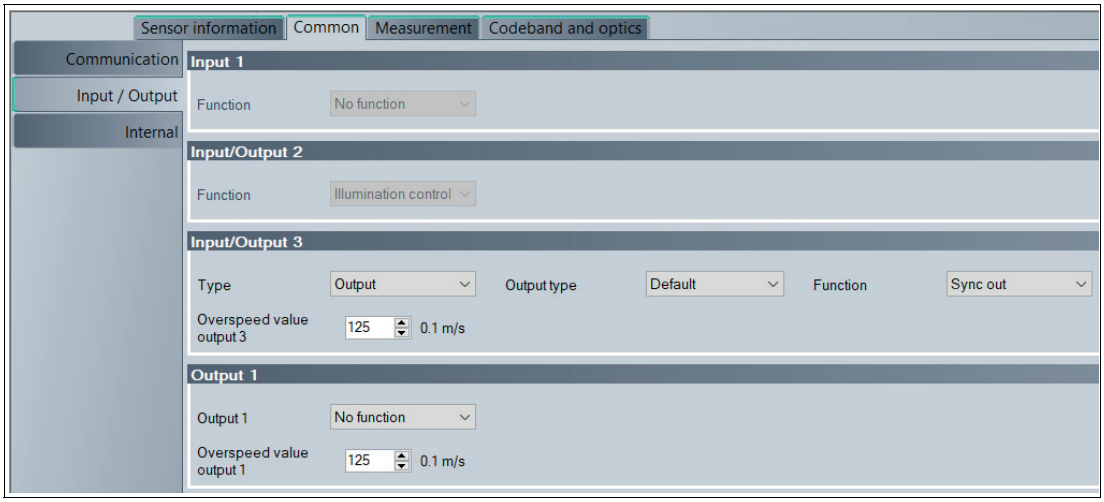


Figure 6.18

Input 1

Grayed out, no function

Input/Output 2

Grayed out, no function

Input/Output 3

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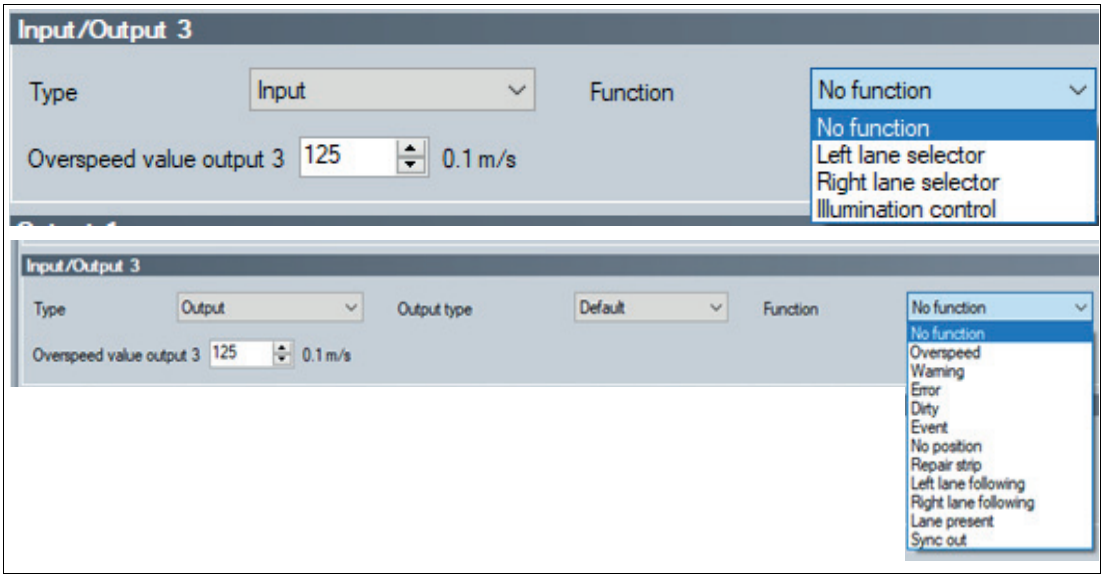

Figure 6.19

Designation		Function
Type	Output 3	The connection is identified as an output
	Input 3	The connection is identified as an input
Input - Function	No function	The "No function" setting deactivates the input or output.
	Left lane selector	The read head follows the left lane.
	Right lane selector	The read head follows the right lane.
	Illumination control	If one of the two inputs and outputs is configured as an input and the "Illumination control" function is activated, it means as follows: • If the input is not set, theread head captures an image as usual and simultaneously triggers the flash to illuminate the scene. • If the input is set, no flash is triggered during image capture. This option can be used to save energy, for example, as the sensor does not have to supply any values in this case. In addition, repeated flashes can be perceived as disruptive.

Designation		Function
Output - Function	No function	The "No function" setting deactivates the input or output.
	Overspeed	"Overspeed" activates the output if the speed is exceeded.
	Warning	"Warning" activates the output if a warning occurs.
	Error	"Error" activates the output if the error bit is set.
	Dirty	"Dirty" activates the output if there is a critical level of contamination on the read head or code tape.
	Event	Option is not used.
	No position	"No position" activates the output if the position cannot be determined (e.g., no code tape in the field of view of the read head)
	Repair strip	Repair strip (this function is only available for PCV read heads)
	Left lane following	Follow left-hand lane
	Right lane following	Follow right-hand lane
	Lane present	The first lane that appears in the reading window is assumed as the direction of travel.
	Sync out	The read head has two configurable switching outputs. If the corresponding switching output is set to "Snyc out," a synchronous pulse is provided at the switching output.
Overspeed value output 3	Overspeed value output 3	Determines the speed above which an overspeed message should be displayed. If one of the outputs is configured to "Overspeed," this is activated when the speed is exceeded.

Output 1

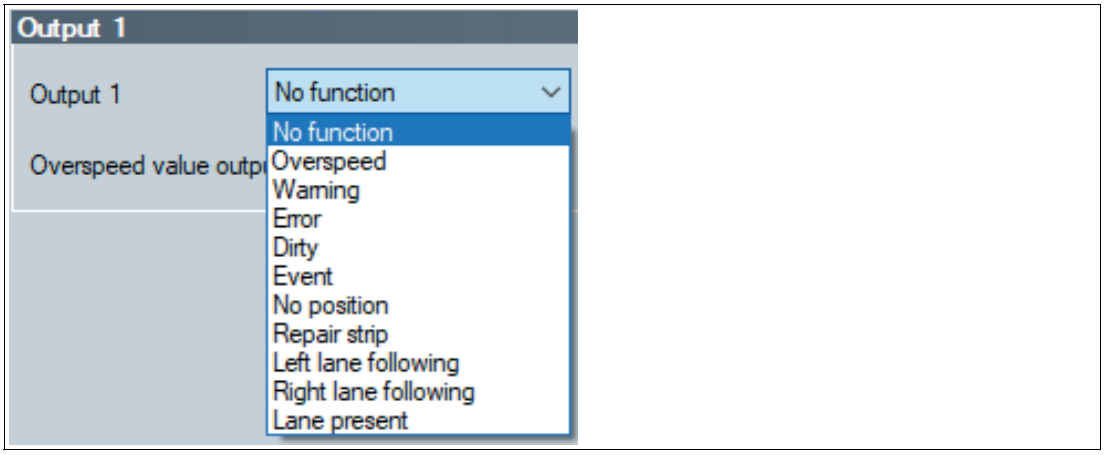

Figure 6.20

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Designation		Function
Type	Output 1	The connection is identified as an output
Function	No function	The "No function" setting deactivates the input or output.
	Overspeed	"Overspeed" activates the output if the speed is exceeded.
	Warning	"Warning" activates the output if a warning occurs.
	Error	"Error" activates the output if the error bit is set.
	Dirty	"Dirty" activates the output if there is a critical level of contamination on the read head or code tape.
	Event	Option is not used.
	No position	"No position" activates the output if the position cannot be determined (e.g., no code tape in the field of view of the read head)
	Repair strip	Repair strip (this function is only available for PCV read heads)
	Left lane following	Follow left-hand lane
	Right lane following	Follow right-hand lane
	Lane present	The first lane that appears in the reading window is assumed as the direction of travel.
Overspeed value output 1	Overspeed value output 1	Determines the speed above which an overspeed message should be displayed. If one of the outputs is configured to "Overspeed," this is activated when the speed is exceeded.

Internal Menu Item

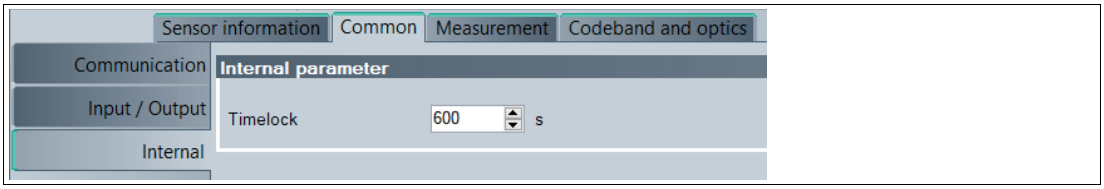

Figure 6.21

Internal parameter

Designation	Function
Timelock	Defines after what time without parameterization activity the time lock of the read head is locked. Entered in seconds as an integer value. 0 means that this functionality is inactive and the read head can always be parameterized.

6.10.3 Measurement Tab

Two menu items are available in the **Measurement** tab. The purpose of this section is to present the menu items in more detail.

Resolution/offset

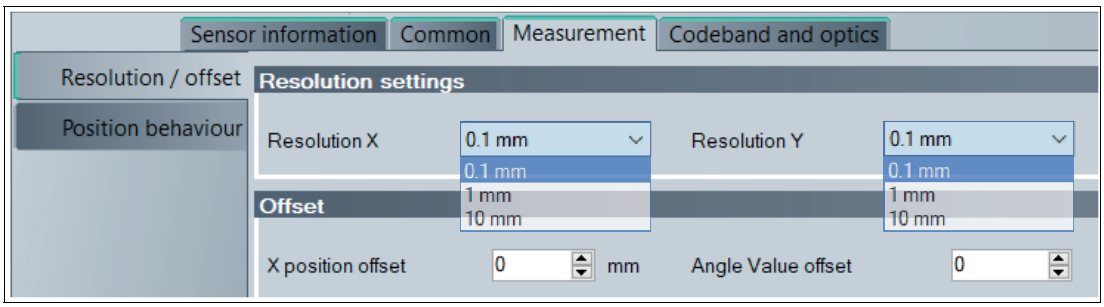

Figure 6.22

Resolution settings

Designation	Function
Resolution X	Multiplier for the length in the direction of the X coordinate • 0.1 mm • 1 mm • 10 mm
Resolution Y	Multiplier for the length in the direction of the Y coordinate • 0.1 mm • 1 mm • 10 mm
Resolution angle (Color tape 1° fixed)	Multiplier for the angle output • 1°

Offset

Designation	Function
x position offset	Offset in the direction of the x coordinate
Angle Value offset	Angle offset

Position behavior

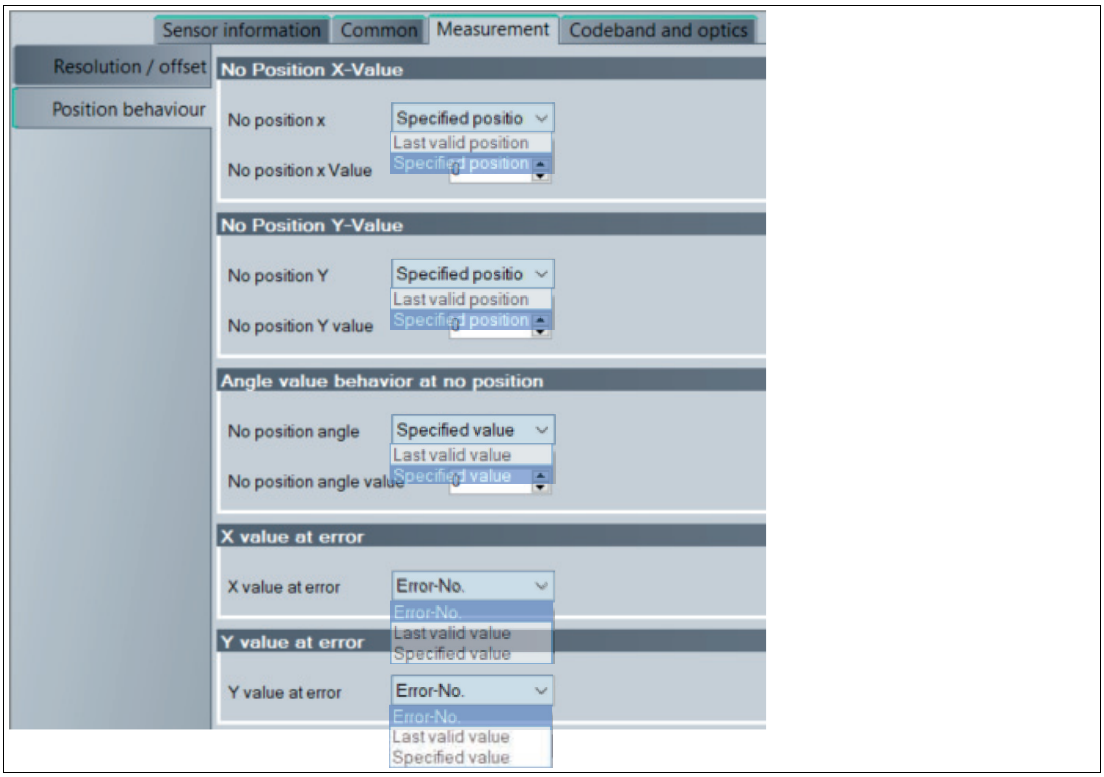

Figure 6.23

No Position X-Value

Defines the x value if no Data Matrix code tape is visible.

No position x

Designation	Function
Last valid position	The last valid x position is output with "Last valid position."
Specified position	"Specified position" outputs a defined x position value.

No position x value

No Position Y-Value

Defines the y value if no Data Matrix code tape is visible.

No position Y

Designation	Function
Last valid position	The last valid y position is output with "Last valid position."
Specified position	"Specified position" outputs a defined y position value.

No position y value

Angle value behavior at no position

Defines the angle output when a position is no longer detected.

No position angle

Designation	Function
Last valid value	The last valid position angle is output with "Last valid value."
Specified value	"Specified value" outputs a specified angle value.

No position angle value

X value at error

Defines the output value when an error occurs in the x direction.

X value at error

Designation	Function
Error-No.	"Error-No." displays the error code.
Last valid value	The last valid x position is output with "Last valid value."
Specified value	"Specified value" outputs a specified x position value.

Y value at error

Defines the output value when an error occurs in the y direction.

Y value at error

Designation	Function
Error-No.	"Error-No." displays the error code.
Last valid value	The last valid y position is output with "Last valid value."
Specified value	"Specified value" outputs a specified y position value.

6.10.4 Code Tape and Optics Tab

One menu item is available under the **Code tape and optics** tab. This section explains the menu item in more detail.

Code Tape

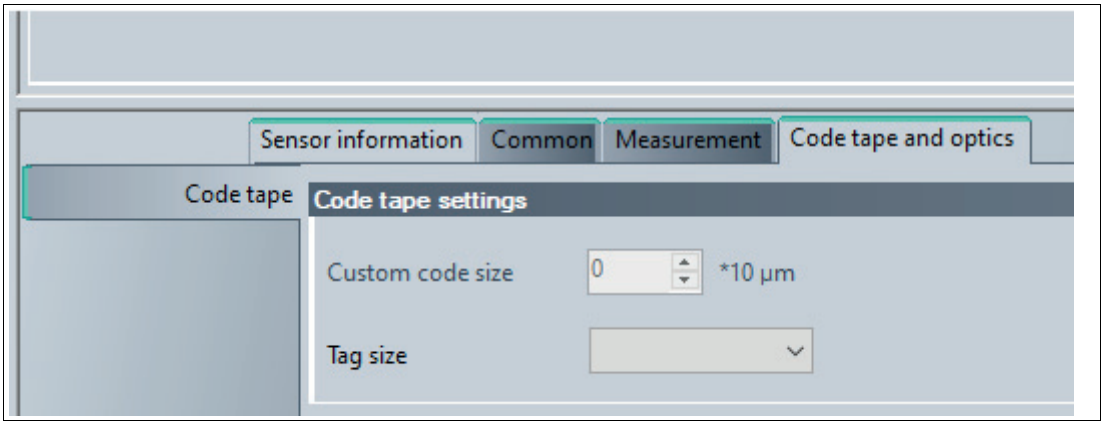

Figure 6.24

Code Tape Settings

Designation	Function
Custom code size	User-defined code size
Tag size	Size of the Data Matrix tag

7 Maintenance

Caution!

Device may become hot during prolonged operation

After a long operation time, the metal surfaces (plug) and the housing of the sensor have an elevated temperature relative to the environment.

This must be taken into account during service work. Let the device cool down before operating.

If the read head is faulty, it must be replaced with a new device. The read head may not be repaired.

No position values can be determined wherever sections of the Data Matrix code tape are dirty or destroyed.

Note

Replacing Damaged or Destroyed Data Matrix Code Tape

The operator is responsible for replacing dirty or destroyed sections of Data Matrix code tape with original Data Matrix code tape. Replacement sections can be obtained from Pepperl+Fuchs.

Note

Replacing the Read Head

If there is a defect, always replace the read head with an original device.

Note

Reference Run

For example, no reference run is required after a replacement, as all read heads are aligned identically with each other.

Note

Prior to Use of a Replacement Device

In the event of replacement, the plant operator is responsible for setting the PROFINET name according to the old device.

7.1 Maintenance

The device is maintenance-free.

7.2 Testing

The device does not need to be tested. To ensure adequate availability, we recommend regularly examining the read head and the Data Matrix code tape for mechanical damage and removing contamination.

A regular proof test is not required since the minimum interval for a proof test is longer than the useful lifetime. If the device is subjected to sources of potential mechanical damage or vibration in the plant, we recommend regularly inspecting the device with regard to the integrity of the housing (water ingress) and the right fastening (loose mounting screws).

7.3 Cleaning

Caution!

Material damage due to improper cleaning

Treating surfaces with the wrong cleaning agents and liquids can damage the surface and therefore disrupt the function of the read head or make the Data Matrix codes illegible.

Cleaning the Read Head

Check that the components are securely mounted and that optical surfaces are clean.

Regularly clean the surface of the read head lens. The cleaning interval depends on the ambient conditions and the climate within the plant.

Use a soft, lint-free cloth to clean the surfaces. We recommend cleaning the code tape with cotton or microfiber cloths.

Cleaning the Data Matrix Code Tape

The surface of the Data Matrix code tape consists of a polyester film with a special matt surface for diffuse reflection. The use of incorrect cleaning agents, or constant brushing can lead to the risk of the matt surface of the Data Matrix code tape being polished smooth. If the Data Matrix code tape has a shiny surface, this impairs detection of the codes by the read head. To avoid polishing the surface, do not apply strong pressure when cleaning the Data Matrix code tape.

Only use a non-aggressive plastic cleaner to clean the code tapes.

Note

We do not recommend the use of conveyor brushes or permanent cleaning systems. These can damage the surface of the code tapes and make the Data Matrix codes unreadable.

Note

Damage to the surface is often invisible to the naked eye. Only an image capture with the read head itself shows whether interfering reflections occur at the relevant point.

7.4 Repair

Do not repair or manipulate the device.

If there is a defect, always replace the device with an original device.

Only use accessories specified by the manufacturer.

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8 Disposal

The device, built-in components, packaging, and any batteries contained within must be disposed in compliance with the applicable laws and guidelines of the respective country.

9 Appendix

9.1 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**	**I**
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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