PGV...-F200/-F200A...-B17-V1D

Incident Light Positioning System

Manual

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1 Safety

1.1 Introduction

1.1.1 Content of this Document

This document contains information that you need in order to use your product throughout the applicable stages of the product life cycle. These can include the following:

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

Note

This document does not substitute the instruction manual.

Note

For full information on the product, refer to the instruction manual and 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 consists of the following parts:

- Present document
- Instruction manual
- Datasheet

Additionally, the following parts may belong to the documentation, if applicable:

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

1.1.2 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

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Note

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The documentation comprises the following parts:

- This document
- Datasheet

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

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- EU declaration of conformity
- Attestation of conformity
- Certificates
- Control drawings
- Functional safety manual
- Additional documents

1.1.4 Manufacturer

Pepperl+Fuchs Group Lilienthalstraße 200, 68307 Mannheim, Germany
Internet: www.pepperl-fuchs.com

1.1.5 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.

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1.1.6 Symbols Used

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

Warning Messages

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

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

Danger!

This symbol indicates an imminent danger.

Non-observance will result in personal injury or death.

Warning!

This symbol indicates a possible fault or danger.

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

Caution!

This symbol indicates a possible fault.

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

Informative Symbols

Note

This symbol brings important information to your attention.

Action

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

2 Product Description

2.1 Use and Application

Intended Use

This device, when used together with a colored tape affixed to the floor and code tapes printed with Data Matrix codes, constitute a high-resolution lane tracking and positioning system. It can be used in all applications where automated guided vehicles (AGV) are to be positioned precisely at marked positions along a given lane.

The read head forms part of the positioning system in the Pepperl+Fuchs incident light process. The read head's features include a camera module and an integrated illumination unit. The read head uses these features to detect a colored tape stuck to the floor or a painted color lane to track the lane. The read head detects Data Matrix tags to navigate within a grid. The read head also detects control codes and position markers in the form of Data Matrix codes printed on a self-adhesive code tape. Data Matrix code tapes and Data Matrix tags have priority over colored tapes or colored lanes.

The Data Matrix code tapes are installed in a fixed position instead of or along with the colored tape. The read head is located on an automated guided vehicle (AGV) and guides this vehicle along the colored tape.

Note

Priority

Data Matrix code tapes and Data Matrix tags have priority over colored tapes or colored lanes.

If the read head detects a Data Matrix code tape or Data Matrix tags in the field of view, colored tapes or colored lanes in the field of view are ignored.

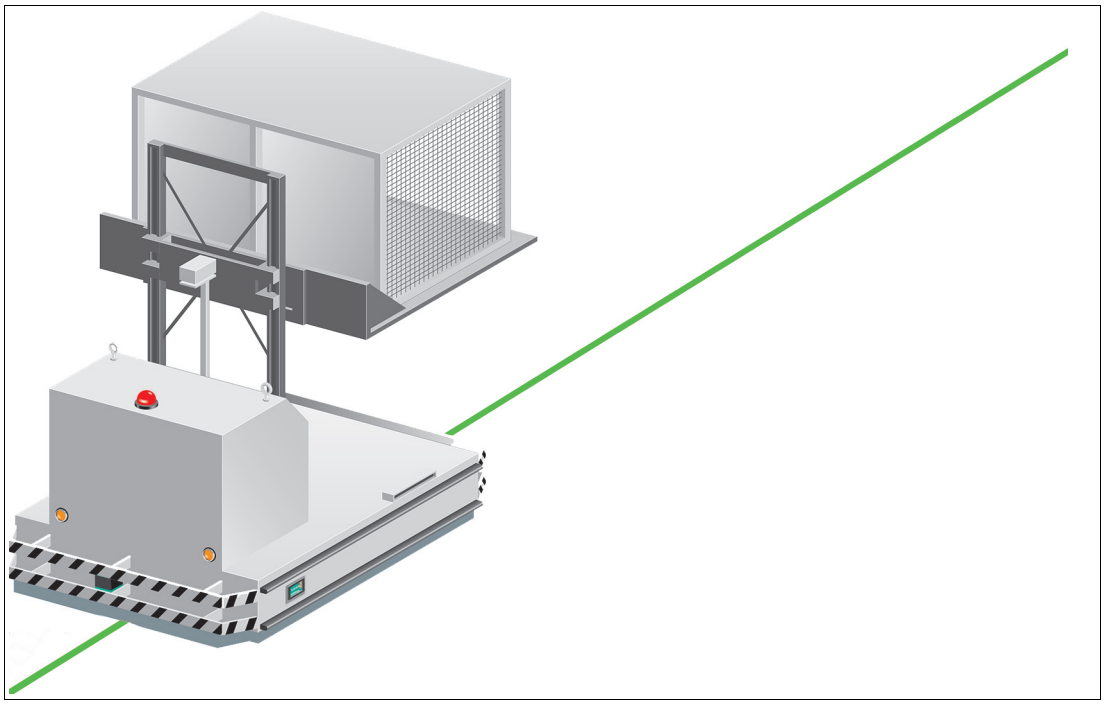

Figure 2.1 Automated guided vehicle with green colored tape

Tag Mode

In addition to the tracking, you can use the read head 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 consecutively and include position information. The read head reports the position of the AGV in relation to the zero point of the Data Matrix tag to the controller.

The tag mode allows the AGV to move freely in as large a grid as desired, without having to mark the crossing paths with lane tapes.

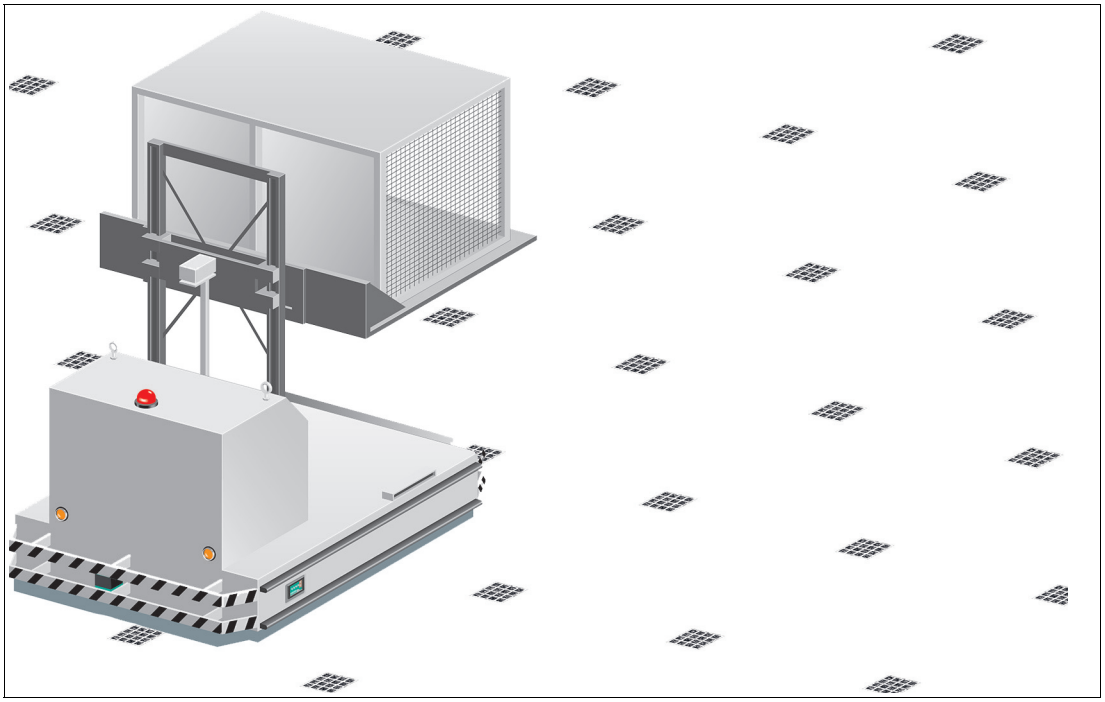

Figure 2.2 Automated guided vehicle with Data Matrix tags

The read head switches automatically between tag mode and lane tracking. This allows an automated guided vehicle to be guided from one Data Matrix tag grid via a colored or Data Matrix lane to another Data Matrix tag grid.

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

2.2 LED Indicators and Controls

The PGV... reader is equipped with seven indicator LEDs for carrying out visual function checks and rapid diagnostics. The reader is equipped with two buttons at the back for activating parameterization mode. Button 1 is labeled ADJUST. Button 2 is labeled CONFIG.

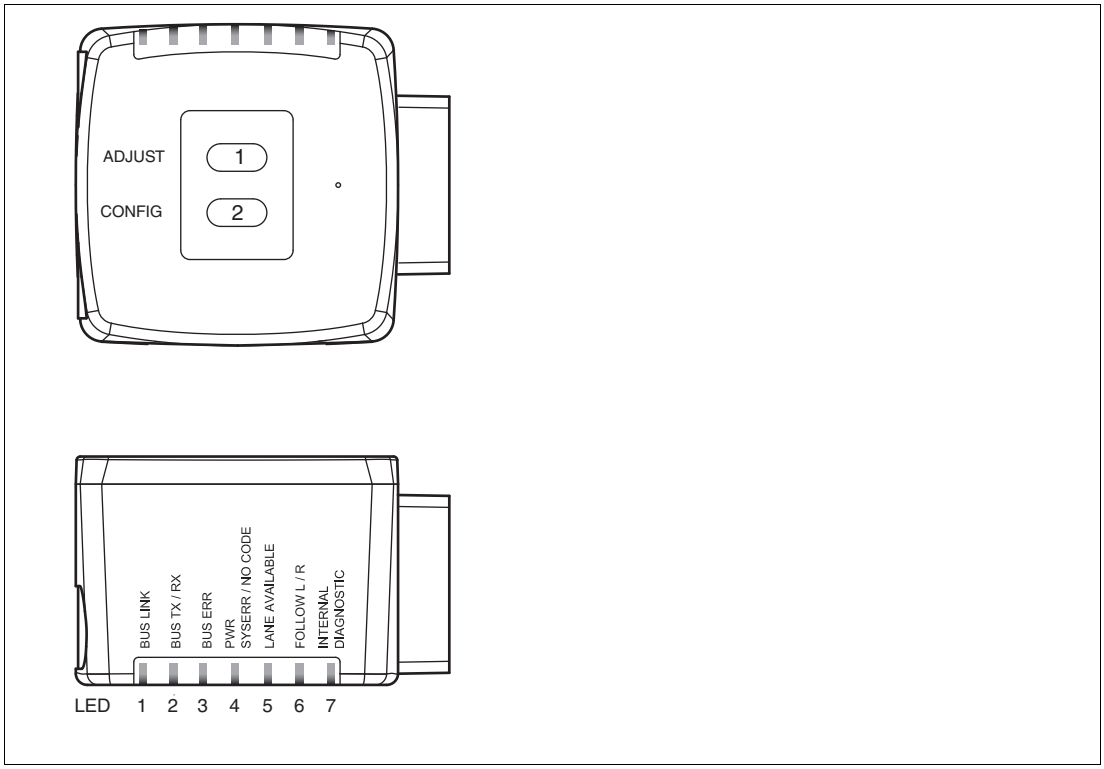

Figure 2.3

LED	[#1] BUS STATE	[#2] BUS ERR	[#3] PWR ERR/NO CODE	[#4] LANE AVAILABLE	[#5] FOLLOW LEFT	[#6] FOLLOW RIGHT	[#7] INTERNAL DIAGNOSTIC	
Color	**Yellow**	**Red**	**Green/ red**	**Yellow**	**Yellow**	**Yellow**	**Red/ green/ yellow**	**Description**
Status	x[1]	x	Flashes red	x	x	x	x	Code tape outside read range f_{flash} = 2 Hz
	x	x	Lights up red	x	x	x	x	System error[2]
	x	x	Lights up green	x	x	x	x	Code tape detected, absolute position available
	x	x	x	Lights up	x	x	x	Colored tape detected
	x	x	x	Off	x	x	x	Colored tape outside read range
	x	x	x	x	Off	Off	x	No direction selection activated
	x	x	x	x	Lights up	Off	x	"Follow left-hand lane" activated
	x	x	x	x	Off	Lights up	x	"Follow right-hand lane" activated
	x	x	x	x	Lights up	Lights up	x	"Straight ahead" activated
	Lights up	x	x	x	x	x	x	PROFINET data transfer
	x	Flashes	x	x	x	x	x	PROFINET error f_{flash} = 1 Hz
	x	x	Flashes red	Flashes	Flashes	Flashes	Off	Normal operation. Indication for 2 secs if a button is pressed when the time lock is enabled.
	x	x	Off	Flashes	Off	Off	Off	Preconfiguration/configuration mode active f_{flash} = 2 Hz
	x	x	Lights up red	Flashes	Off	Off	Off	Code card faulty f_{flash} = 2 Hz for 3 sec
	x	x	Green, 1 sec	Flashes	Off	Off	Off	Code card detected f_{flash} = 2 Hz for 3 sec
	x	x	Off	x	x	x	Off	Time lock for buttons disabled

1. x = LED status has no meaning

2. No lane selected, for example

2.3 Accessories

Compatible accessories offer enormous potential for cost savings. Such accessories not only save you a great deal of time and effort when commissioning for the first time, but also when replacing and servicing 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.

Model number	Description
V19-G-ABG-PG9-FE	Grounding terminal and plug (set)
PCV-SC12	Grounding clip
V1SD-G-*M-PUR-ABG-V1SD-G	Bus cable, M12 to M12, available in several different lengths
PCV-AG100	Alignment guide for reader
V19-G-*M-*	Configurable connection cable[1]
PCV-CM20-0*	Event marker
PCV-MB1	Mounting bracket for reader
V19-G-*M-PUR-ABG	Single-ended female cordset, M12, 8-pin, shielded, PUR cable
PCV-LM25	Marker head for code tape
PGV33M-CB19-*	PGV colored tape
PCV-KBL-V19-STR-USB	USB cable unit with power supply

1. Ask your contact person at Pepperl+Fuchs

3 Installation

3.1 Mounting the Read Head

Mount the PGV... read head on the automated guided vehicle using the four screws on the mounting adapter on the read head. Mount the read head in such a way that the lens with the ring light and camera module are directed toward the colored tape.

The mounting must be stable enough so that the read head does not leave its depth of focus range during operation.

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

Optimum Read Distance

Order designation	Read distance [mm]	Depth of focus [mm]	Field of vision (w x h) [mm]
PGV100*	100	±20	117 x 75
PGV150I*	150	±30	170 x 105

Hysteresis

If the read head has detected a colored tape, this colored tape can move in the Y direction from the zero point within the viewing window. The maximum Y value at which the read head can still capture this distance is designated as **Y Value Out** in the following table.

If the read head swivels onto a colored tape, the read head can capture the distance of the colored tape from the zero point only if the tape is less than a certain distance away from the zero point. This distance is designated as **Y value In** in the following table. The difference between Y Value Out and Y Value In is the hysteresis. See "Distance Output" on page 19.

Order designation	Max. Y Value Out [mm]	Min. Y Value In [mm]
PGV100*	60	45
PGV150I*	60	60

Read Head Dimensions

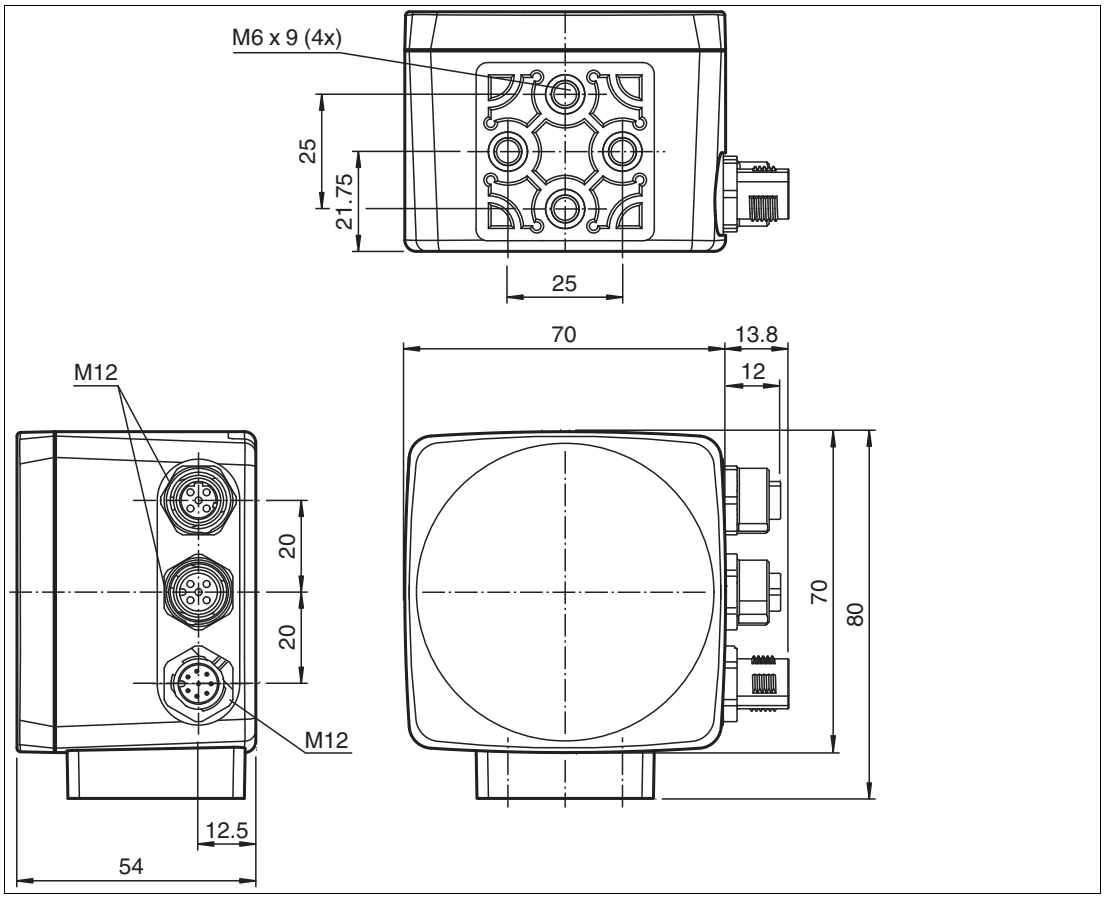

Figure 3.1 Housing *-F200-*

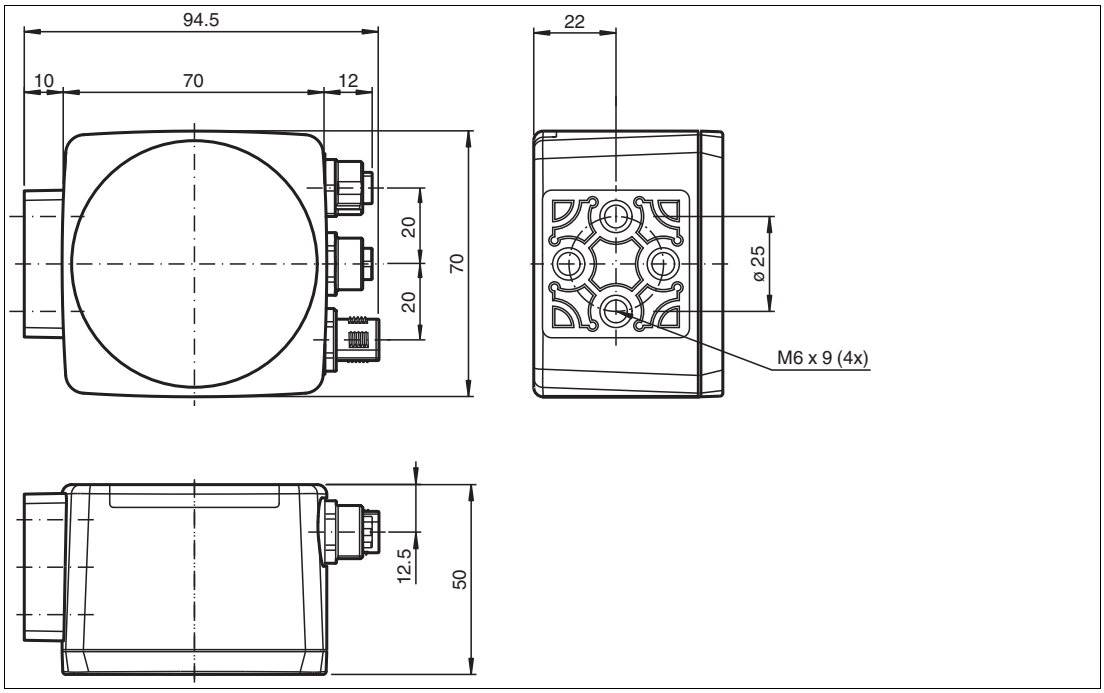

Figure 3.2 Housing *-F200A-*

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Caution!

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

Using longer screws may damage the read head.

Caution!

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

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

3.2 Mounting the Colored Tape and Code Tape

Colored tape

The colored tape must be flexible, conformable, and resistant to abrasion, with a matte finish.

The colored tape must meet the following specifications:

- Tape width: 10 mm ... 40 mm
- Color of the tape
  - Blue = RAL 5015
  - Green = RAL 6032
  - Red = RAL 3001
- Tape thickness > 0.1 mm
  The thickness of the tape is irrelevant to read head operation.
- Breaking load > 25 N/cm
- Breaking elongation > 180%
- Adhesive strength > 2 N/cm
- Temperature resistance: -20 °C ... 70 °C

Secure the colored tape to the floor such that the following conditions are met:

- Data Matrix code tapes for positioning are used instead of the colored tape.
- Data Matrix control codes are positioned parallel to the colored tape.

Color Selection

Select the color of the colored tape so that the contrast between the floor color and the color of the colored tape is as great as possible. Ideally, use the complementary color.

Due to the integrated lighting of the read head, some floor colors appear to be different in the camera. If you have problems with the color selection of the colored tapes, please consult your contact at Pepperl+Fuchs.

Mounting the Colored Tape

1. Clean the surface of any greasy or oily deposits and dust.
2. Ensure that the surface is dry, clean, and stable.
3. Please observe the following section "Basics" when mounting the colored tape and, if necessary, the instructions from the colored tape manufacturer.

Note

Priority

Data Matrix code tapes and Data Matrix tags have priority over colored tapes or colored lanes.

If the read head detects a Data Matrix code tape or Data Matrix tags in the field of view, colored tapes or colored lanes in the field of view are ignored.

Cleaning Colored Tape/Code Tape

Significant contamination on the colored or code tapes can impair the detection by the read head. Clean the colored and code tapes with isopropanol if necessary. If the contamination is severe, you can use a non-corrosive plastic cleaner, e.g., Caramba®.

Note

To avoid polishing the surface, do not apply strong pressure when cleaning. A shiny surface of the colored or code tapes leads to impairment in detection by the read head.

Basics

The read head detects a colored tape on a floor as a lane. The width of the colored tape must be between 10 mm and 40 mm; the default width is 18 mm. The zero point is located in the center of the colored tape. You can use 3 defined colors. See the section entitled "Colored tape"

The sensor always moves in the X direction. In the sensor's field of view, X indicates an upward movement.

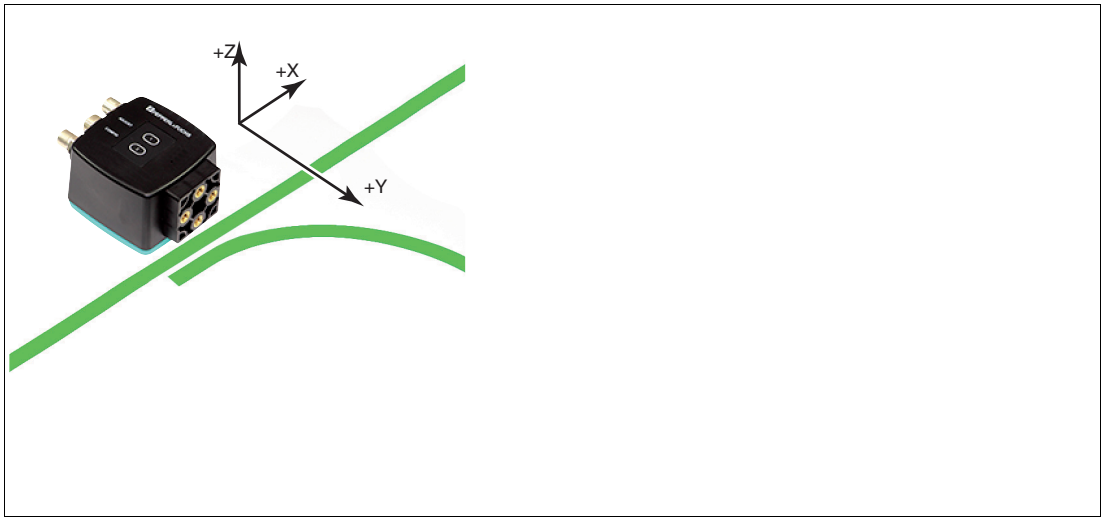

Figure 3.3 Field of view and coordinates of the sensor

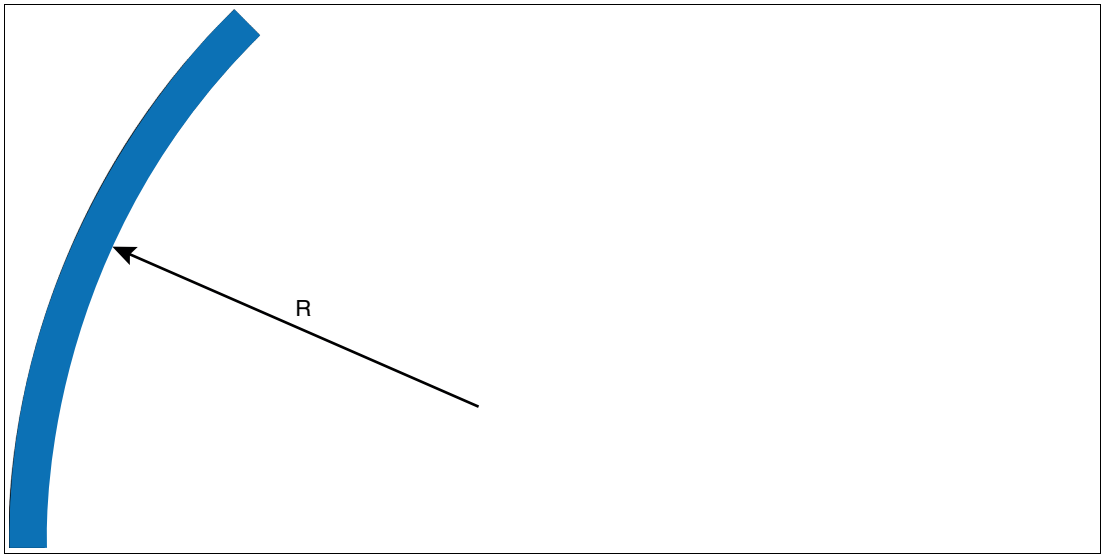

Figure 3.4 Curve radius: R ≥ 50 cm

Select a curve radius that can handle the turning circle of your automated guided vehicle. The colored tape must always be located in the reading window of the read head.

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Angle Output

Note

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

The read head detects a change of the angle of the colored tape and the Data Matrix code tape and outputs this value to the controller. The output value is different for colored tapes and Data Matrix code tapes.

Colored tape

The read head detects the angle in relation to the tracked lane with a resolution of 360 (corresponds to 1°). The angle is specified relative to the tracked lane because a colored tape does not include any direction information. The output angle covers the range from -45° to 45°. The resolution is 1°.

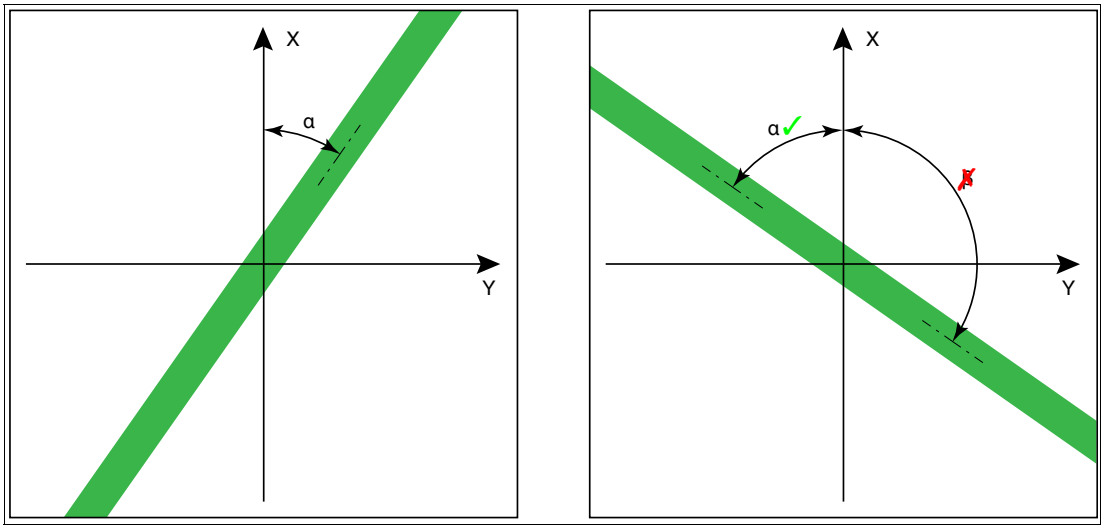


Figure 3.5 Relative angle

Data Matrix code tape

The read head detects the absolute angle in relation to the tracked lane with a maximum resolution of 0.1°. The angle is specified absolutely relative to the tracked lane, since a Data Matrix code contains tape 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°

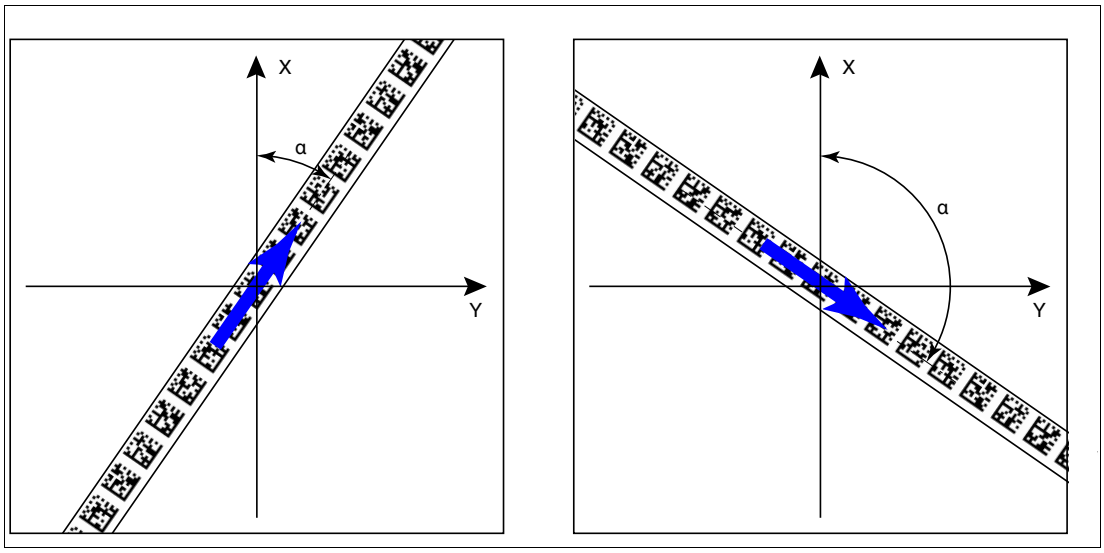


Figure 3.6 Absolute angle

Distance Output

The read head detects the distance from the zero point in the Y direction of a colored tape or a Data Matrix code tape and outputs this value to the controller. The output value is different for colored tapes and Data Matrix code tapes due to the lack of an X position for colored tapes.

Colored tape

The read head outputs the Y value at which the colored tape intersects the Y axis as the distance.

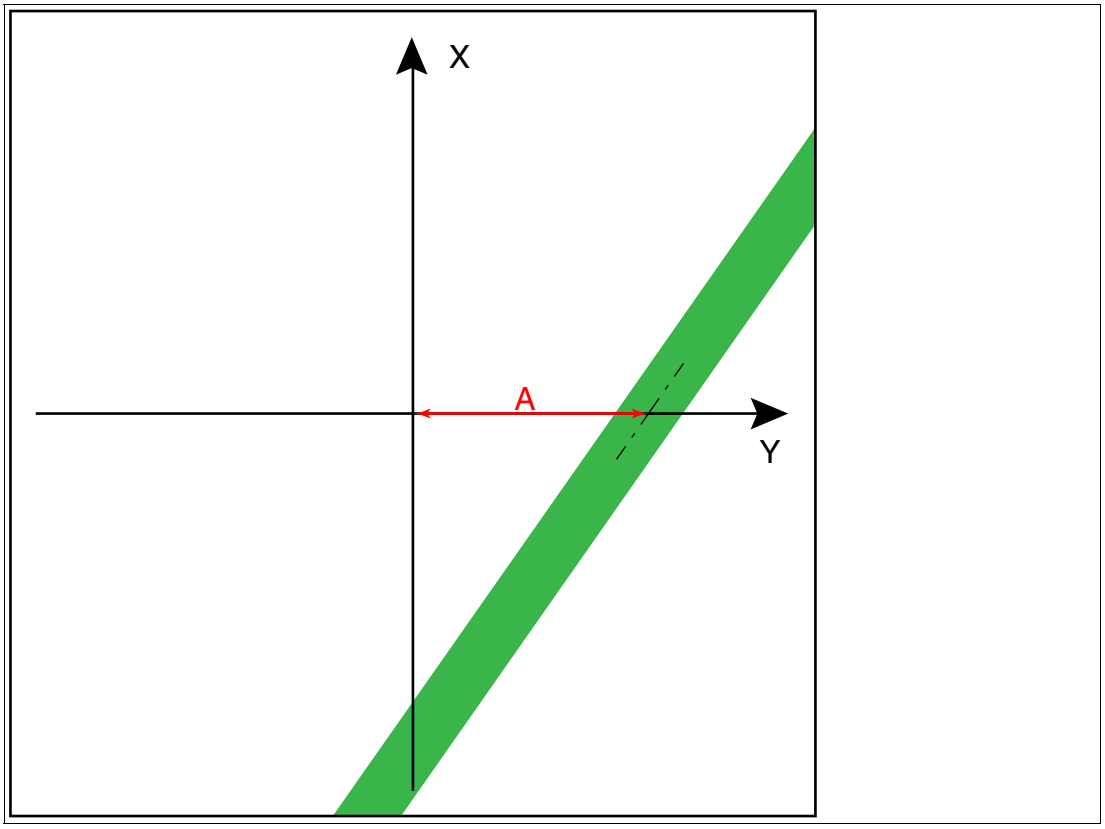


Figure 3.7 Distance A for colored tape

Data Matrix code tape

The read head indicates the vertical distance of the zero point in relation to the Data Matrix code tape.

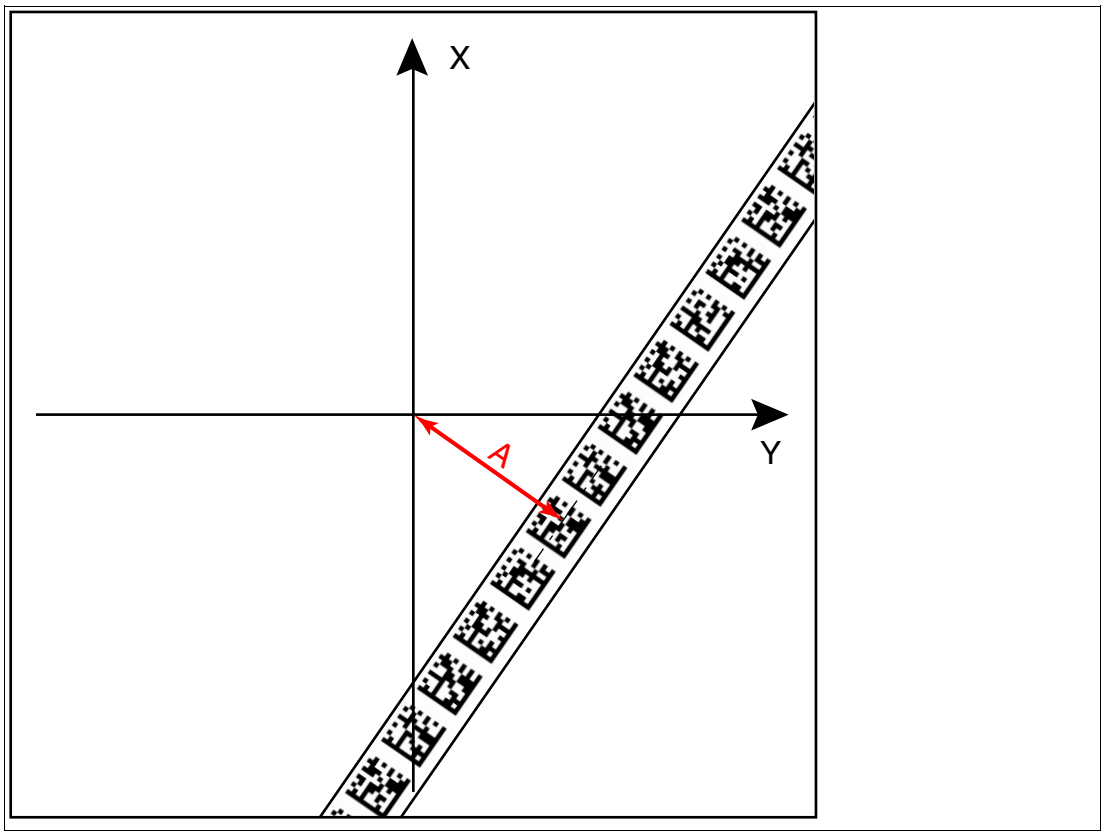


Figure 3.8 Distance A for Data Matrix code tape

Branches

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 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 indicates this as an intersection.

Branches or intersections can be displayed as follows:

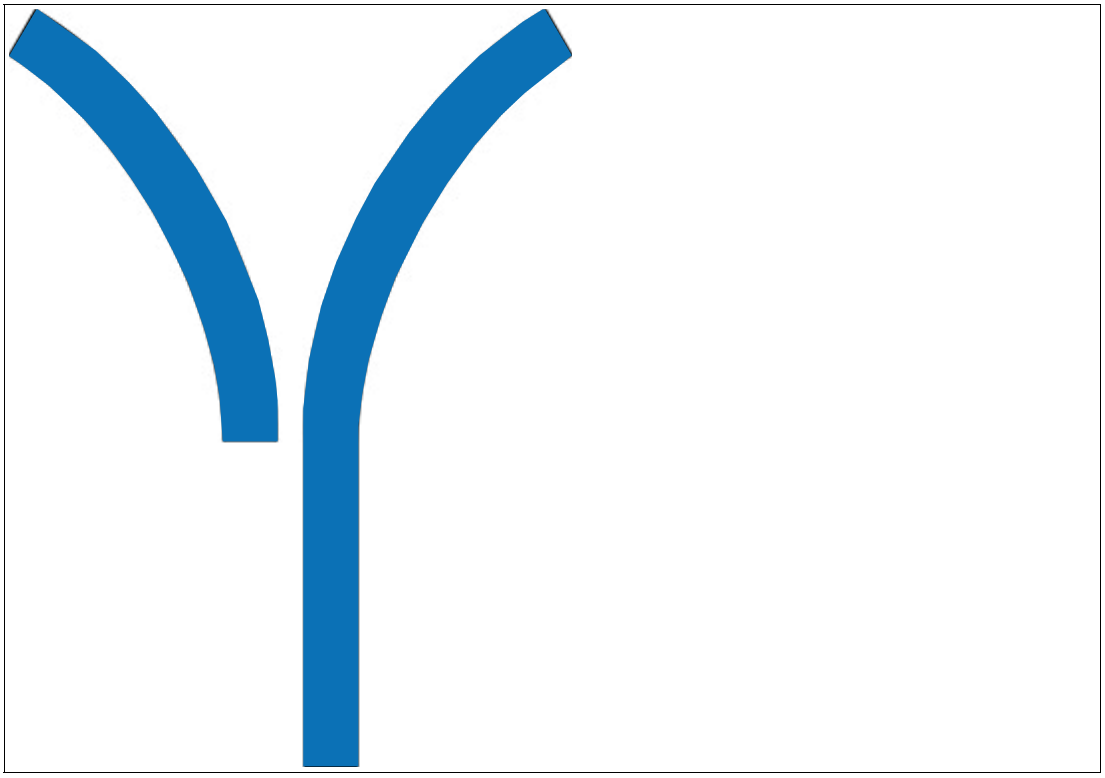


Figure 3.9 Separate lane branches off/converges

The read head can make the following direction decisions based on the lane and possible branches:

- Follow left-hand lane
- Straight ahead
- Follow right-hand lane

The direction decision is signaled to the read head via the controller. If there is no direction decision, the read head displays an error message.

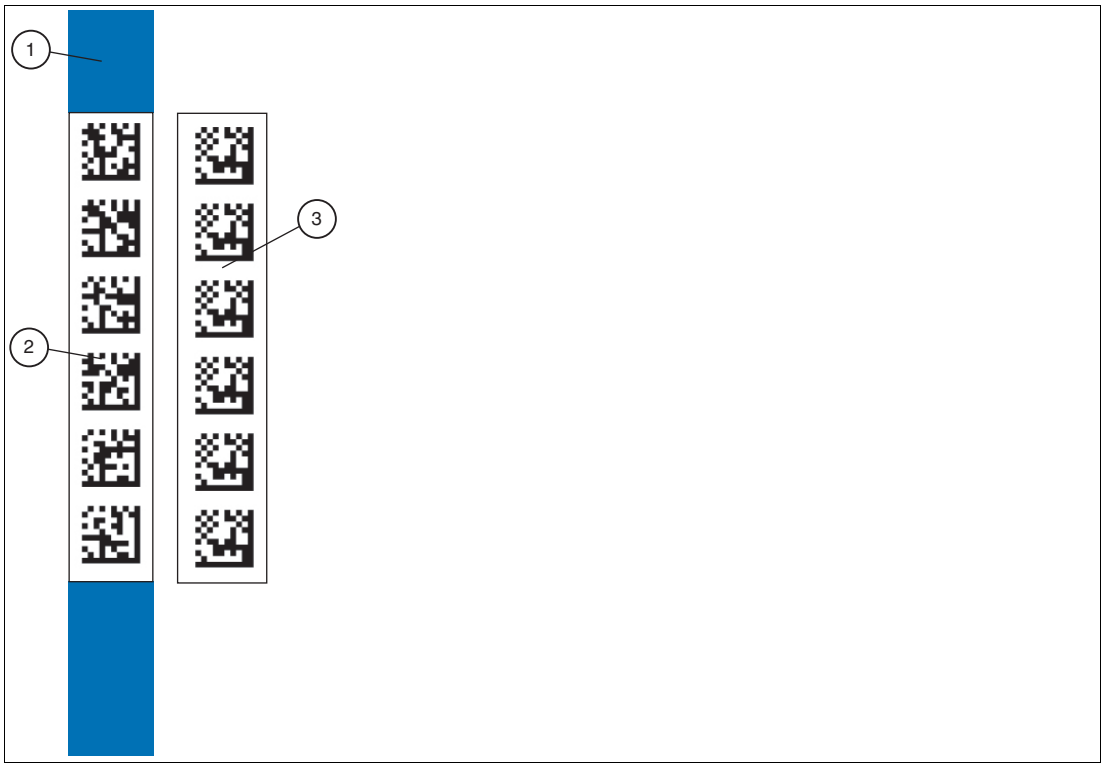
Code Tapes for Control and Positioning

In addition to tracking the lane, the read head can also detect Data Matrix codes. This process involves evaluating both control and position information. Data Matrix control codes are used as event markers. Control codes provide information on branches. Data Matrix code tapes for positioning indicate the absolute position of the read head.

Note the following conditions:

Data Matrix code tapes for positioning are used instead of the colored tape.

Data Matrix control codes are used in tandem with the colored tape or Data Matrix position code.



1 Colored tape

2 Data Matrix position code

3 Data Matrix control code

Branches or intersections with position information can be displayed as follows:

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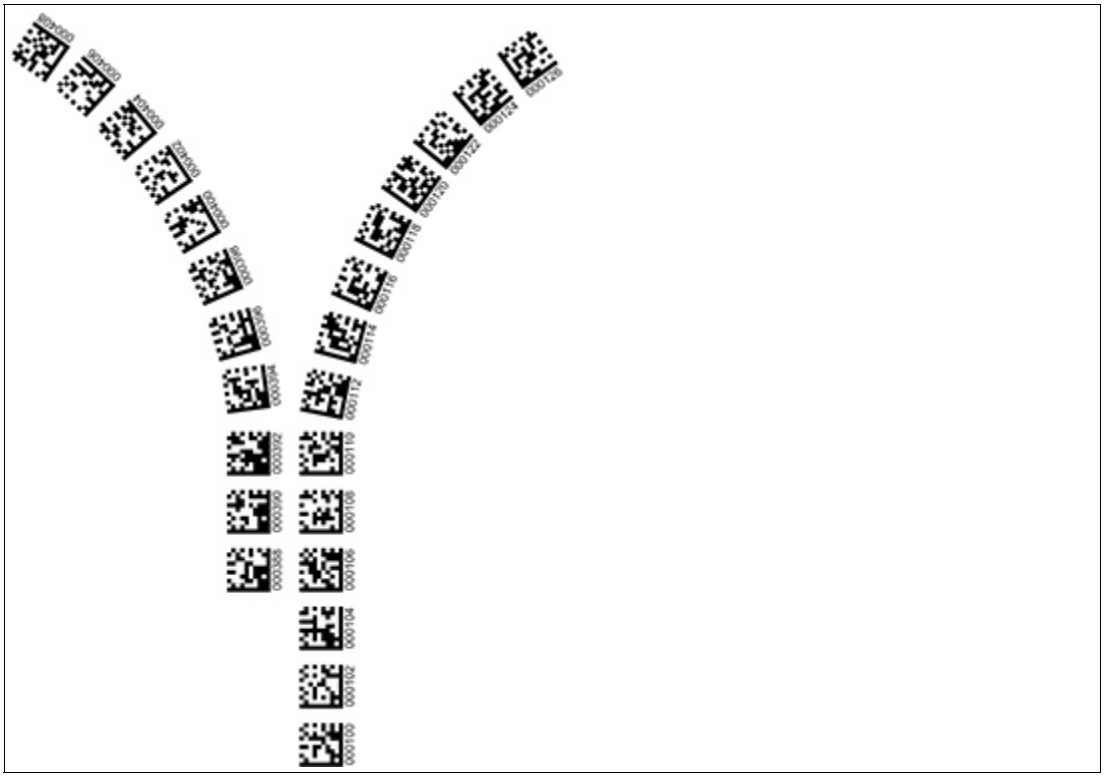

Figure 3.10 Separate lane branches off/converges

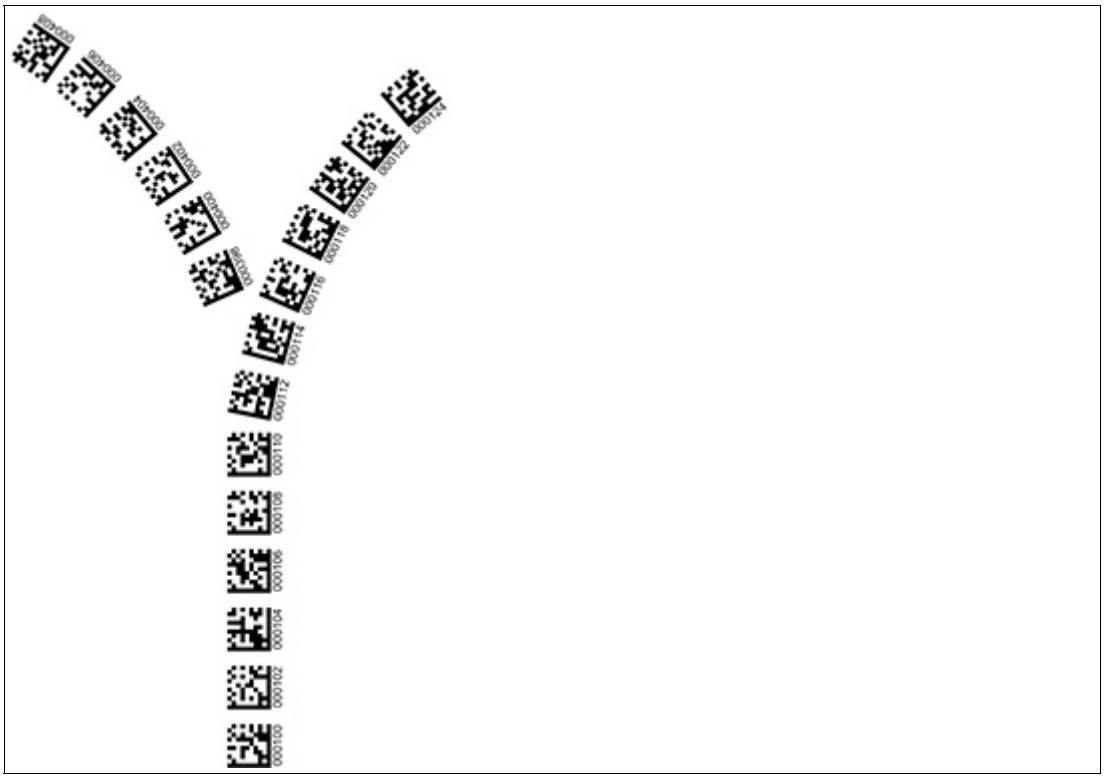

Figure 3.11 Same lane branches off/converges

Note

Direction Decision

The direction decision at a branch of a Data Matrix code tape remains in effect until the read head has moved more than 50 cm from the branch.

It is not possible to change the direction decision within a branch!

Note

Priority

Data Matrix code tapes and Data Matrix tags have priority over colored tapes or colored lanes.

If the read head detects a Data Matrix code tape or Data Matrix tags in the field of view, colored tapes or colored lanes in the field of view are ignored.

Note

Branches/Intersections with Data Matrix Position Code

Observe the following guidelines less than 1 m before and after branching or intersection of a lane with a position code:

- The position codes of the main lane must run continuously for 2 m. The position codes of the branching/intersecting lane must run continuously for 1 m. The read head outputs the X-value of the Data Matrix code tape that is specified the direction decision. .
- Do not use repair tape.
- Do not use colored tape.
- The difference between the absolute position of the main lane and the starting position of the branching/intersecting lane must be greater than 1 m.

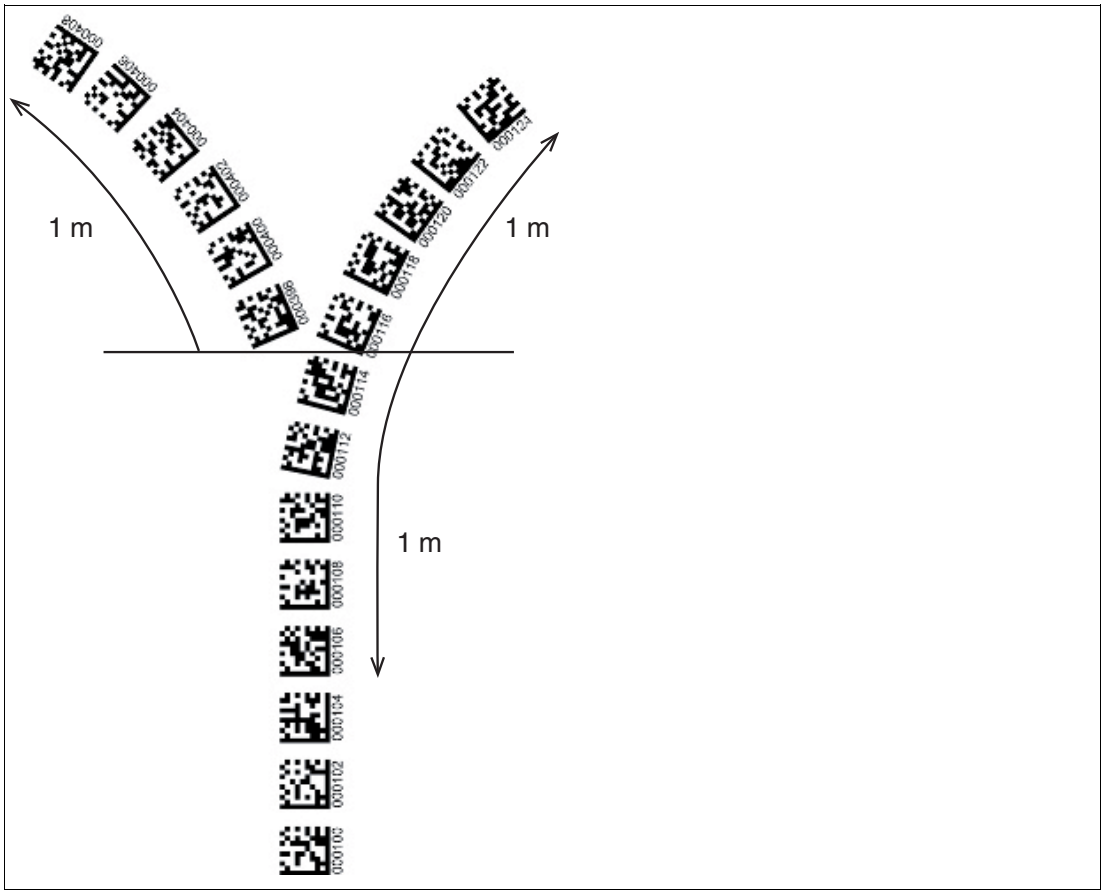

Figure 3.12 Distances

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Behavior of the Read Head at Branches and Corners

The read head behaves differently depending on the type of branch and the specified lane. The read head must know the upcoming direction decision.

A second lane branches off to the left from the straight lane:

The read head follows the straight lane if the direction decision "follow right-hand lane" has been made.

A second lane branches off to the right from the straight lane:

The read head follows the straight lane if the direction decision "follow left-hand lane" has been made.

A single lane with a position code turns to the left or right:

The read head follows the position code if the direction decision "straight ahead" has been made.

Note

Loss of Information

Ensure that Data Matrix codes are not positioned over one another at a branch, as otherwise data may be lost.

It is not permitted to create a mixture of lanes made from colored tape and Data Matrix codes at branches or intersections.

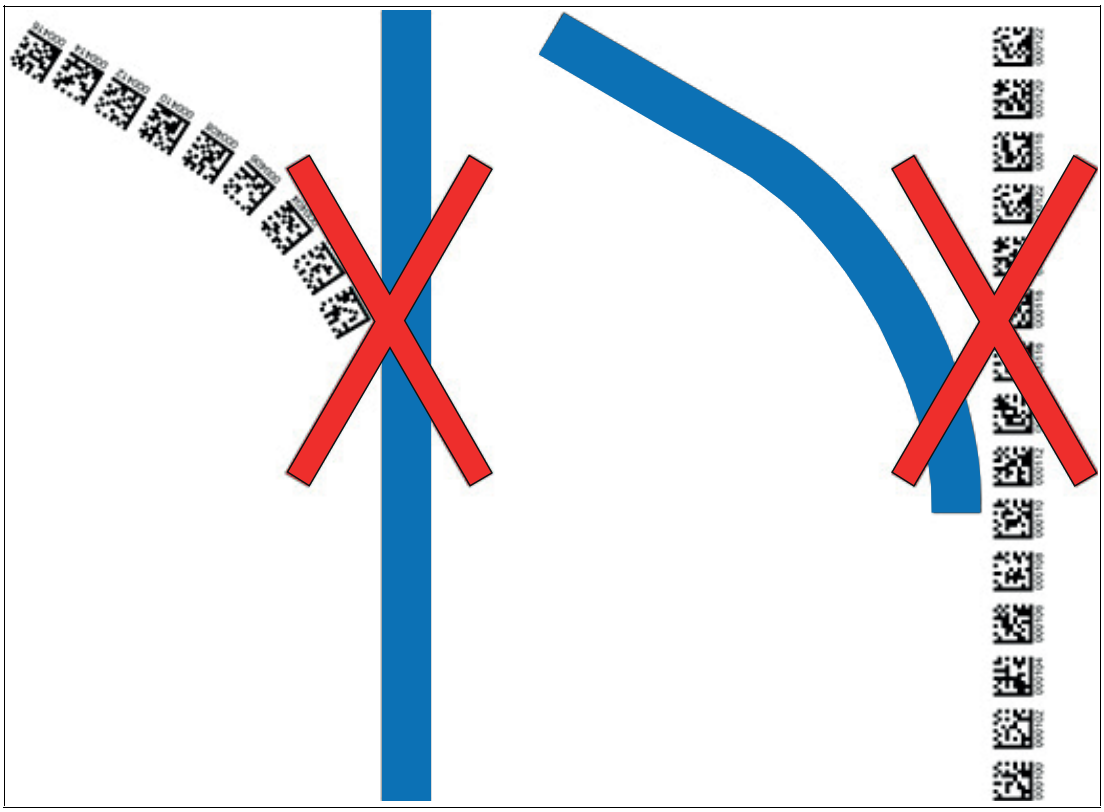

Figure 3.13 Mixture of lanes with colored tape and Data Matrix codes

Control codes can be mounted in the immediate vicinity of a branch with Data Matrix codes for positioning, but not near an intersection. The control code must be mounted directly next to the guiding lane.

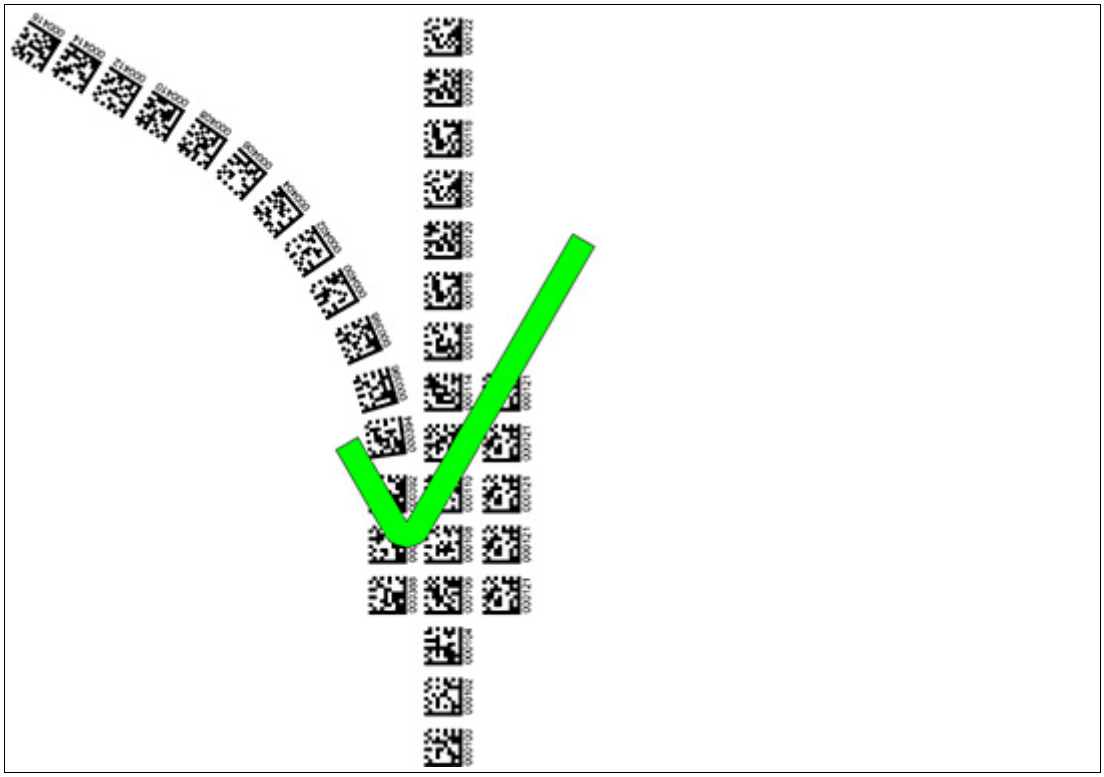

Figure 3.14 Branch with control code

Distances

To ensure that the read head can clearly detect and assign colored tapes and Data Matrix codes, minimum and maximum distances must be observed when creating the lanes.

Offset V between position codes of a lane must not be greater than 5 mm.

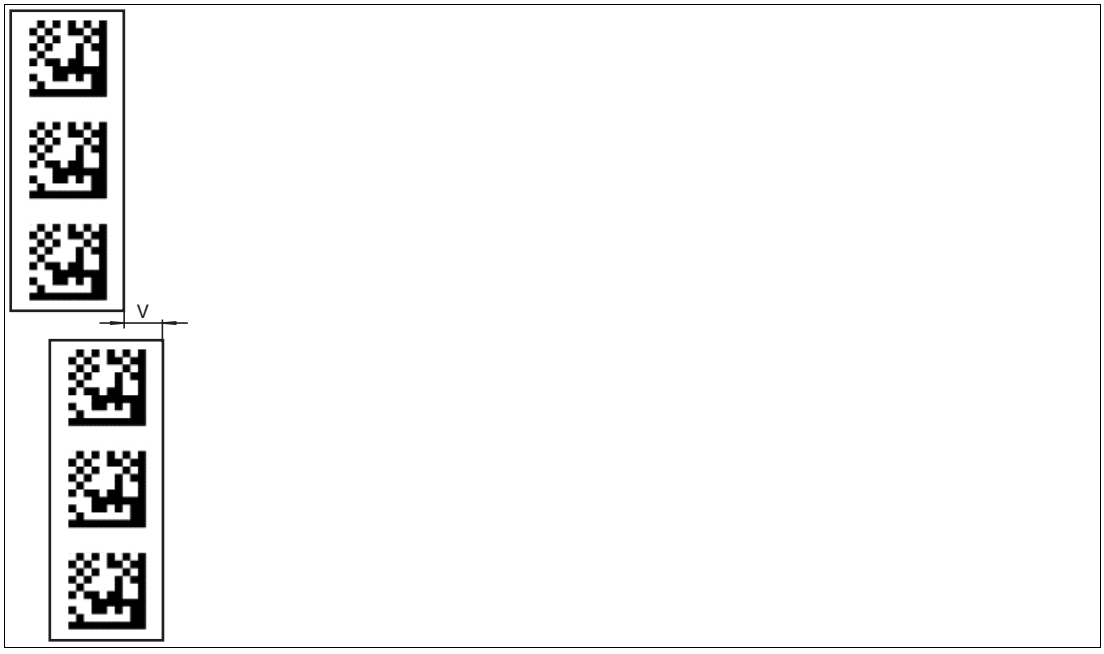

Figure 3.15 Offset: 0 mm ≤ V ≤ 5 mm

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The distance D between the colored tapes at a branch or intersection as a separate lane must not exceed 15 mm. The distance decreases if the guiding colored tape cannot be detected by the read head in the center of the reading window.

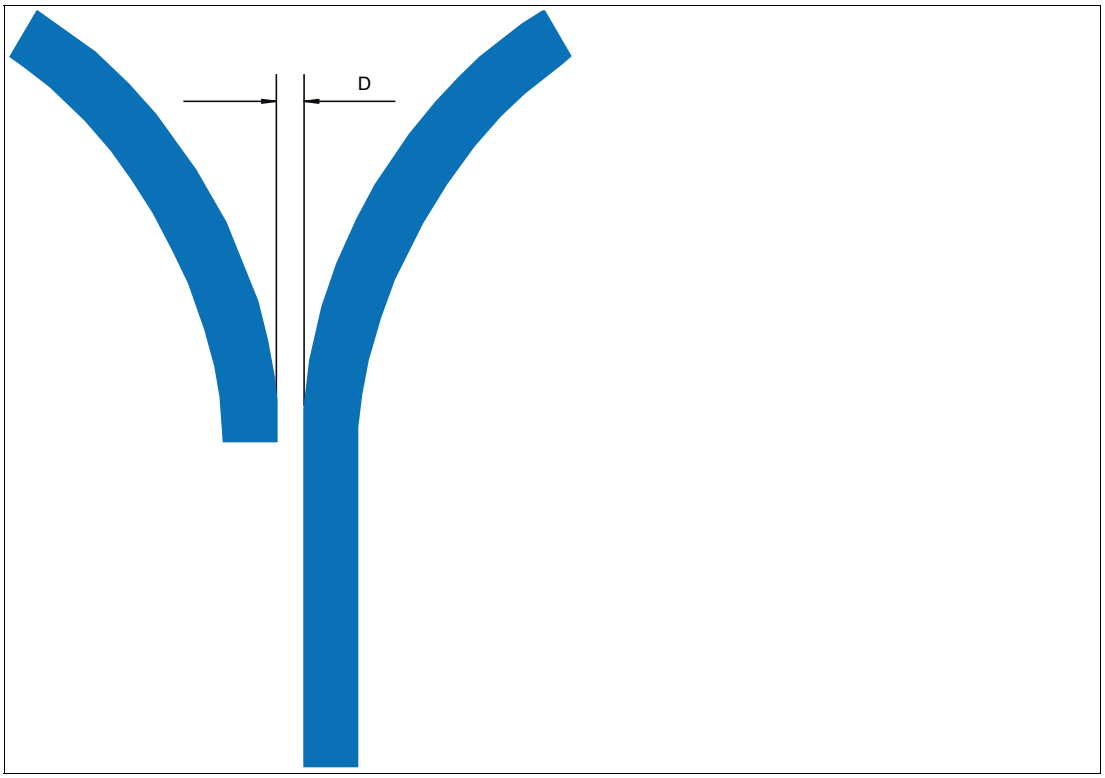

Figure 3.16 Distance: 7.5 mm ≤ D ≤ 15 mm

The distance between the Data Matrix code tapes at a branch or intersection as a separate lane must be between 0 mm and 5 mm.

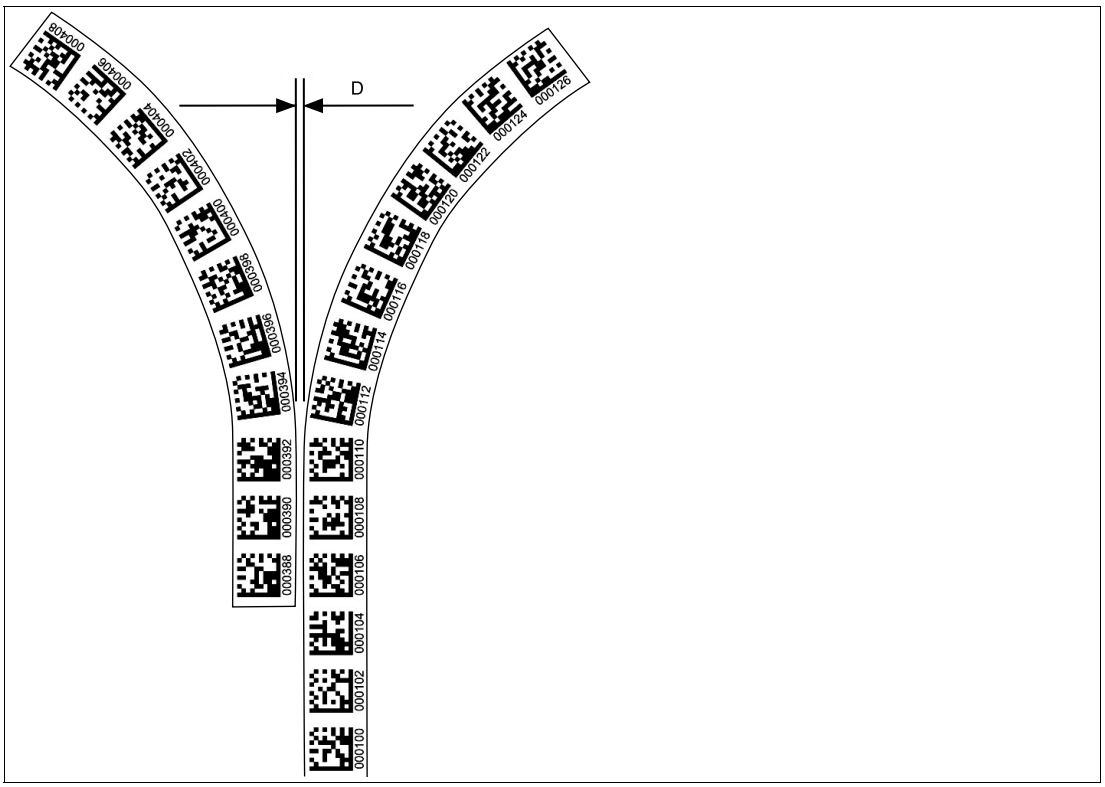

Figure 3.17 Distance: 0 mm ≤ D ≤ 5 mm

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

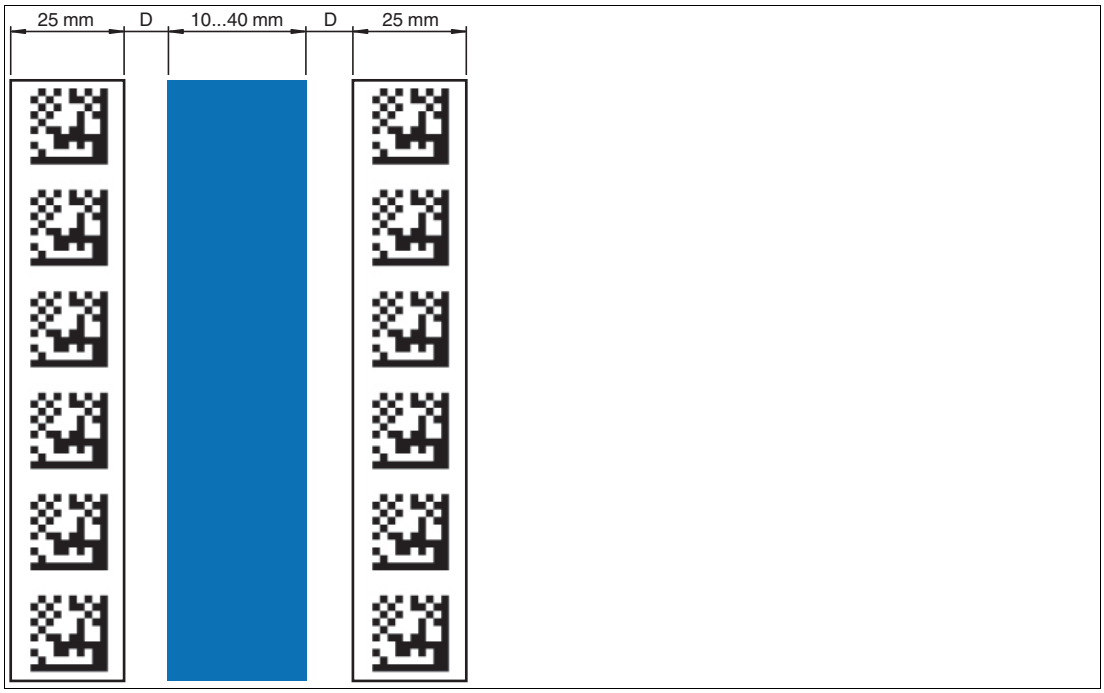

Figure 3.18 0 mm ≤ D ≤ 5 mm

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

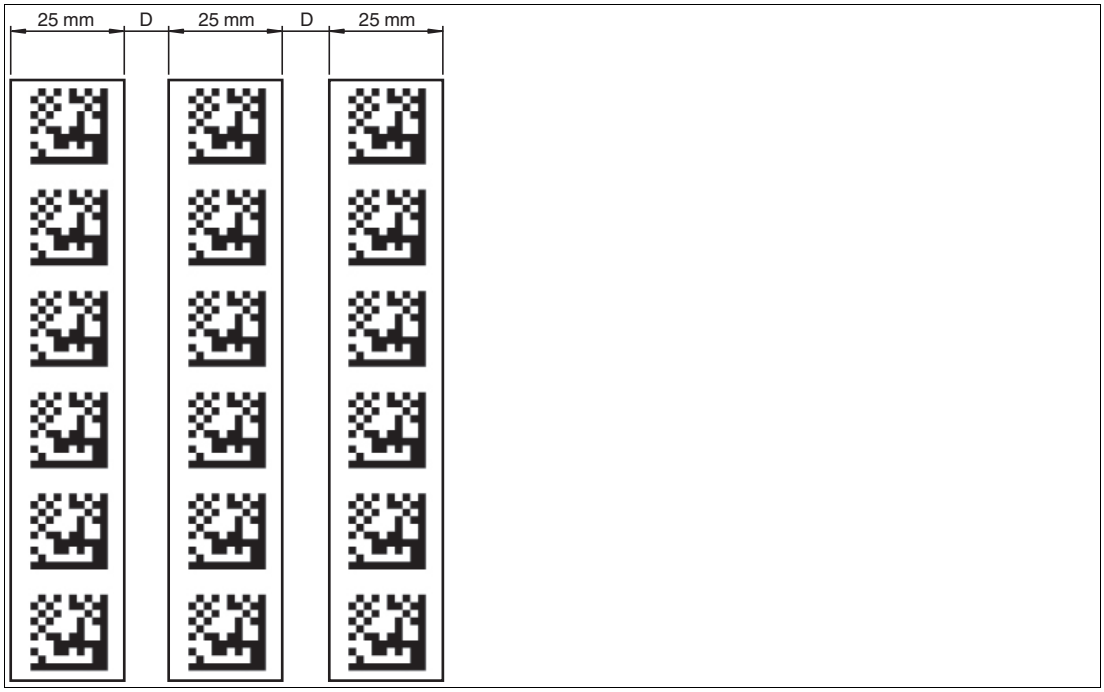

Figure 3.19 0 mm ≤ D ≤ 5 mm

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A lane can switch from a colored tape to a Data Matrix code tape and back again as often as required. The distance between the colored tape and the edge of the Data Matrix code must be between 0 mm and 10 mm

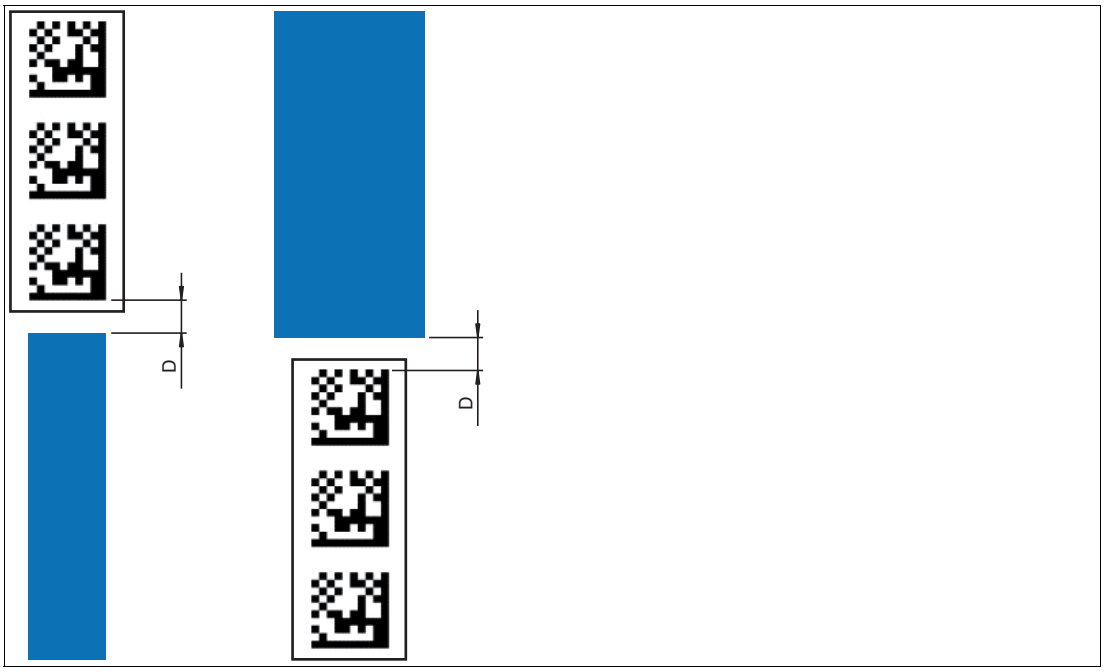

Figure 3.20 0 mm ≤ D ≤ 10 mm

The Y value does not change if the colored tape and the Data Matrix code tape are aligned. Ensure that the center line of the colored tape and the center line of the Data Matrix code are on a line.

Caution!

Alignment

The Data Matrix code is not on the center line of the code tape.

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

Installing the Code Tape

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

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

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.

Code Tape Dimensions

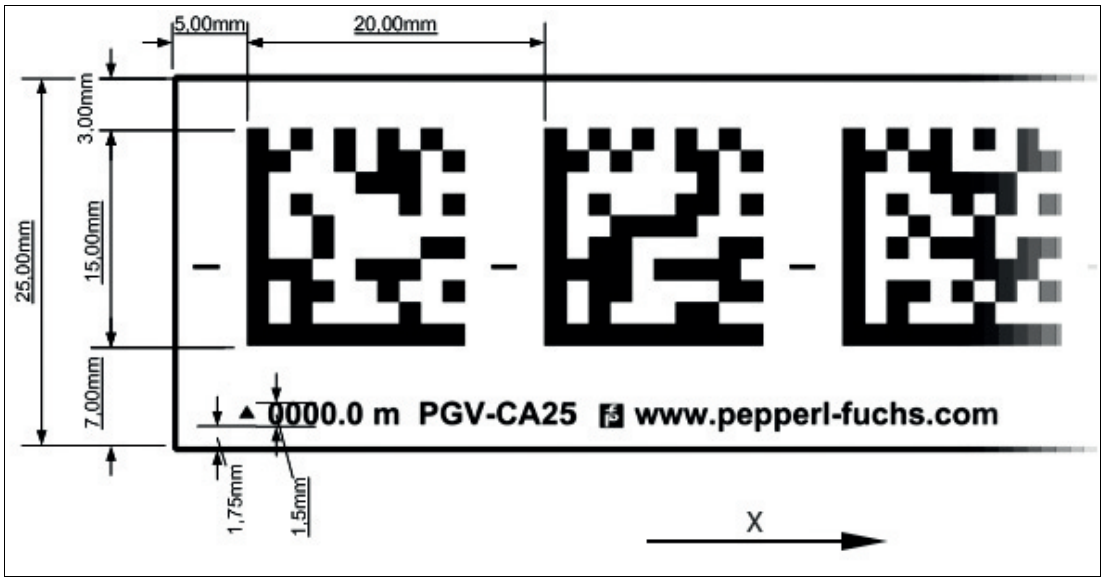

Figure 3.21 The center line indicates the center of the code tape and not the center of the code

Position the code tape so that the **www.pepperl-fuchs.com** label and the position markings are to the right of the Data Matrix code in the X direction. The position values then increase along the X direction.

Data Matrix Code Tapes with a Starting Position of 0 m

Order designation	Description
PGV10M-CA25-0	Code tape, length: 10 m
...	...
PGV100M-CA25-0	Code tape, length: 100 m

Table 3.1 See also data sheet PGV*-CA25-* at www.pepperl-fuchs.com

Data Matrix control codes

Order designation	Description
PGV-CC25-001	Code tape, Control Code 001, length: 1 m
...	...
PGV-CC25-999	Code tape, Control Code 999, length: 1 m

Caution!

Stop edges

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

Note

Bends

If mounting the code tape in corners, cut the code tape several times as illustrated.

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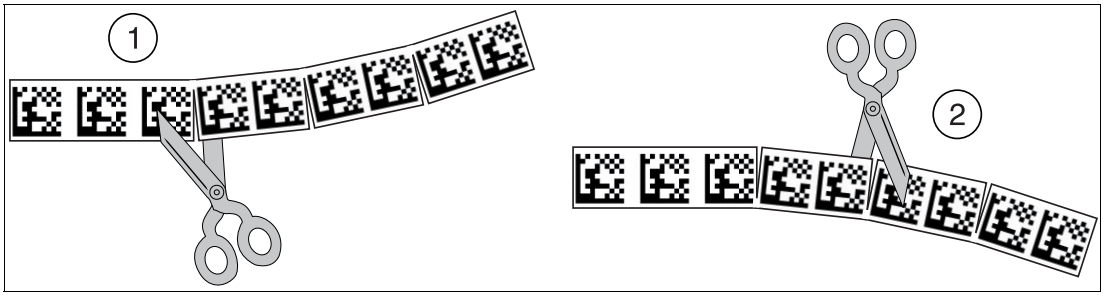

1 Bend to the left

2 Bend to the right

Data Matrix Tag

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.

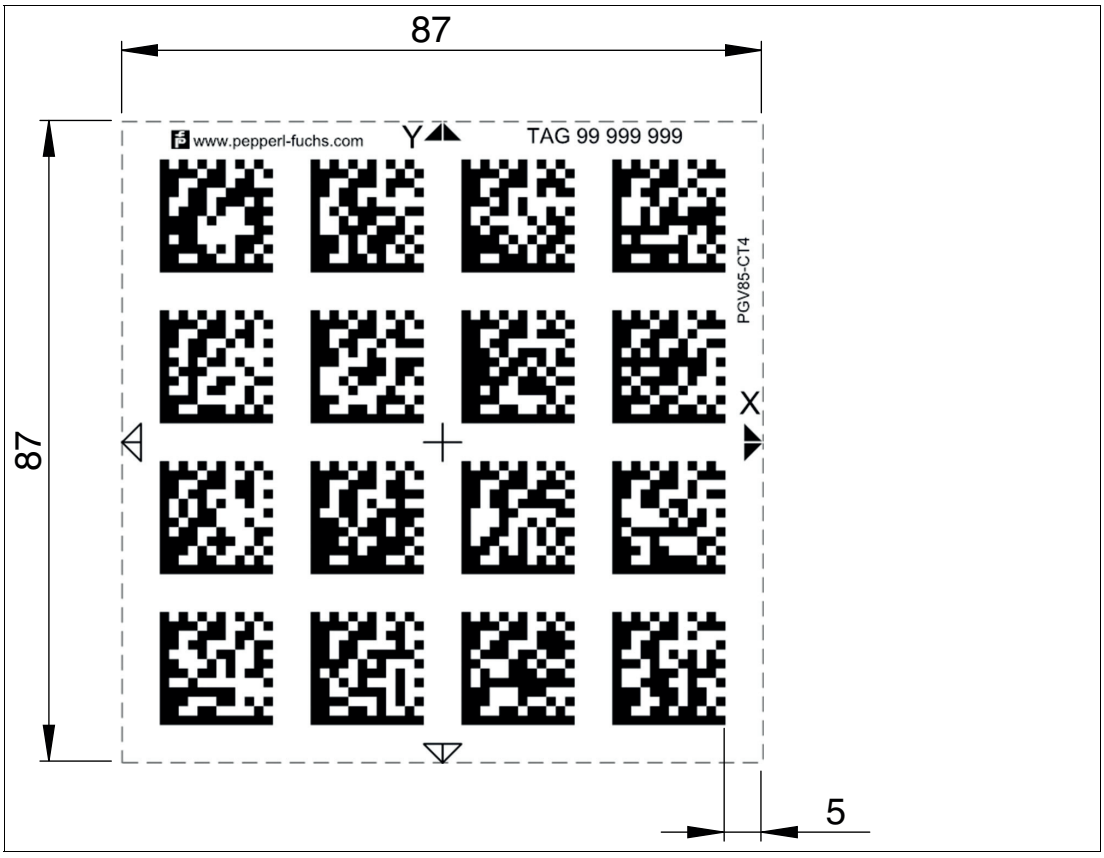

Figure 3.22 Data Matrix tag with the number 99999999 and position information

3.3 Electrical Connection

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

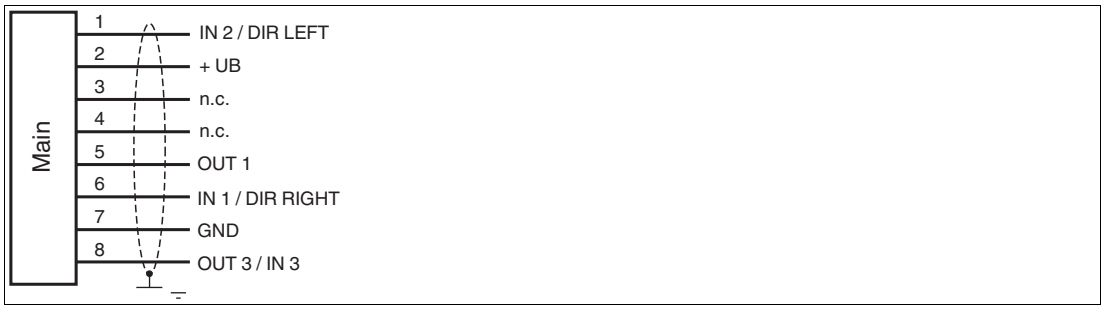

Figure 3.23

Connector Assignment

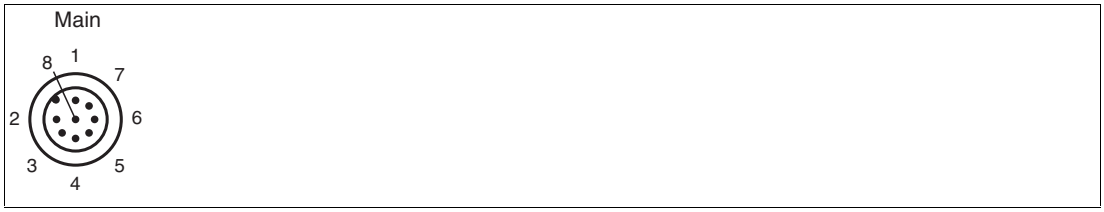

Figure 3.24

Color Assignment

Pepperl+Fuchs female cordsets are manufactured in accordance with EN60947-5-2. When using a type V19-... single-ended female cordset with an open cable end (see chapter 2.3) on the **Main** connection, the following color assignment applies:

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

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Shielding Cables

The shielding of connection lines is required to suppress electromagnetic interference. Establishing a low resistance or low impedance connection with the protective conductor or equipotential bonding circuit is a particularly important factor in ensuring that these interference currents do not become a source of interference themselves. Only use connection lines with braid. Avoid connection lines with foil shield because this would increase the line capacities. The shielding is integrated at both ends, i.e., in the switch cabinet or on the PLC, **and** on the read head. The grounding terminal available as an accessory allows easy integration in the equipotential bonding circuit.

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

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

The following points relating to shielding must be noted:

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

Additional Ground Connection

Tip

Using a short ground wire, add a ground to the nearest ground connection.

Model number	Description
PCV-SC12	Clip for mounting an additional ground connection.
PCV-SC12A	

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.

3.4 PROFINET Connection

The PGV... reader is connected to PROFINET via two 4-pin, D-coded connector sockets, M12 x 1, **PROFINET 1** and **PROFINET 2**, on the side of the housing.

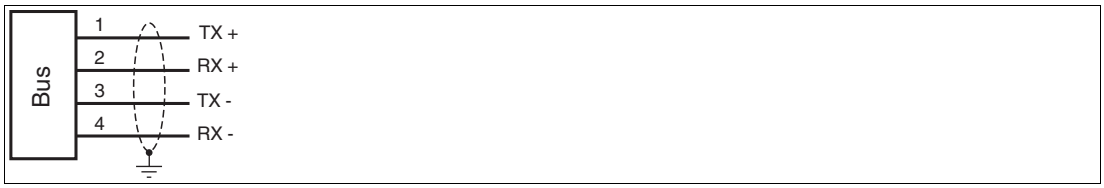

Figure 3.25

Connector Assignment

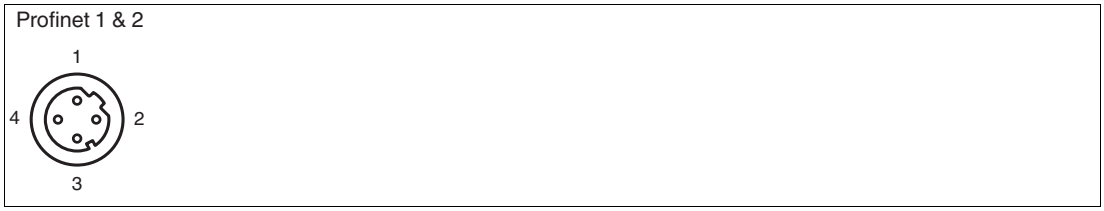

Figure 3.26

For details of suitable PROFINET cables .see chapter 2.3

4 Commissioning

4.1 Direction Decision

The read head has several ways of following colored tapes and Data Matrix code tapes depending on the parameterization. Depending on the input signal, the read head follows the right-hand lane, the left-hand lane, or the better lane.

To ensure that the read head does not report any error messages after being switched on, a direction decision must be specified. You can control the decision direction via inputs INPUT_SELECTION_DIR_RIGHT (IN2/DIR_RIGHT) and INPUT_SELECTION_DIR_LEFT (IN1/DIR_LEFT) or via the protocol. See chapter 3.3.

Direction Decision via Input Signal

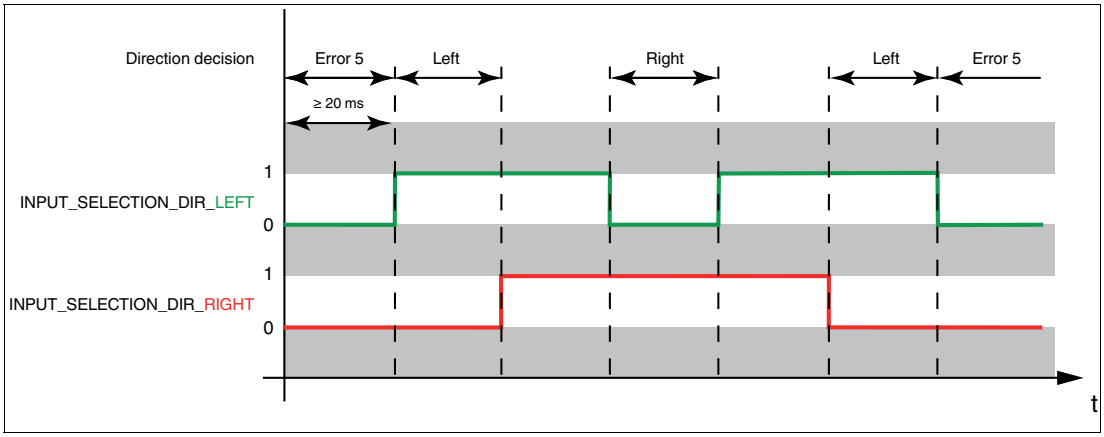

Figure 4.1

Input 2 INPUT_SELEC-TION_DIR_LEFT	Input 1 INPUT_SELEC-TION_DIR_RIGHT	Direction Decision
0	0	No lane is selected Error code 5
0	1	Follow right-hand lane
1	0	Follow left-hand lane
1	1	Colored tape: follow lane with better quality Data Matrix code tape: follow lane with more detailed position information Data Matrix tag: no significance

Table 4.1

Direction Decision via Protocol

Direction control via the protocol. See chapter 5.1.5.2

If direction decisions are made via the protocol, subindex 12 "Input source selection" must be switched to "Software" in the global primary data.

Note

If direction decisions are sent to the read head via a protocol, the input signals from the hardware input are ignored until the read head is reset. .

Following the Lane with Better Quality

You can parameterize the read head so that it follows the color lane with better quality.

Example

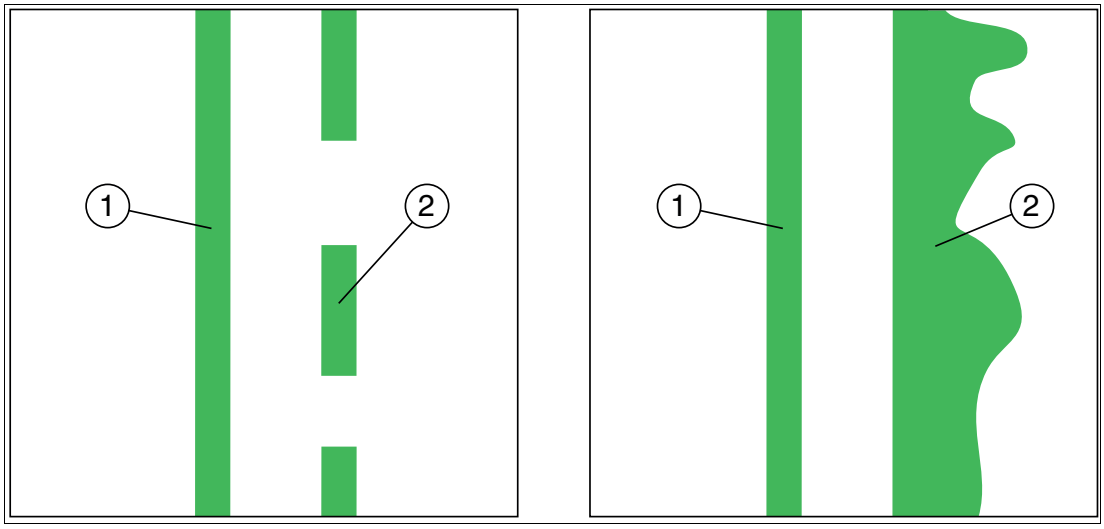

Figure 4.2 1 - Better color lane
2 - Worse color lane

Following the Lane with More Detailed Position Information

You can parameterize the read head so that it follows the Data Matrix code tape that has more detailed current position information.

Example

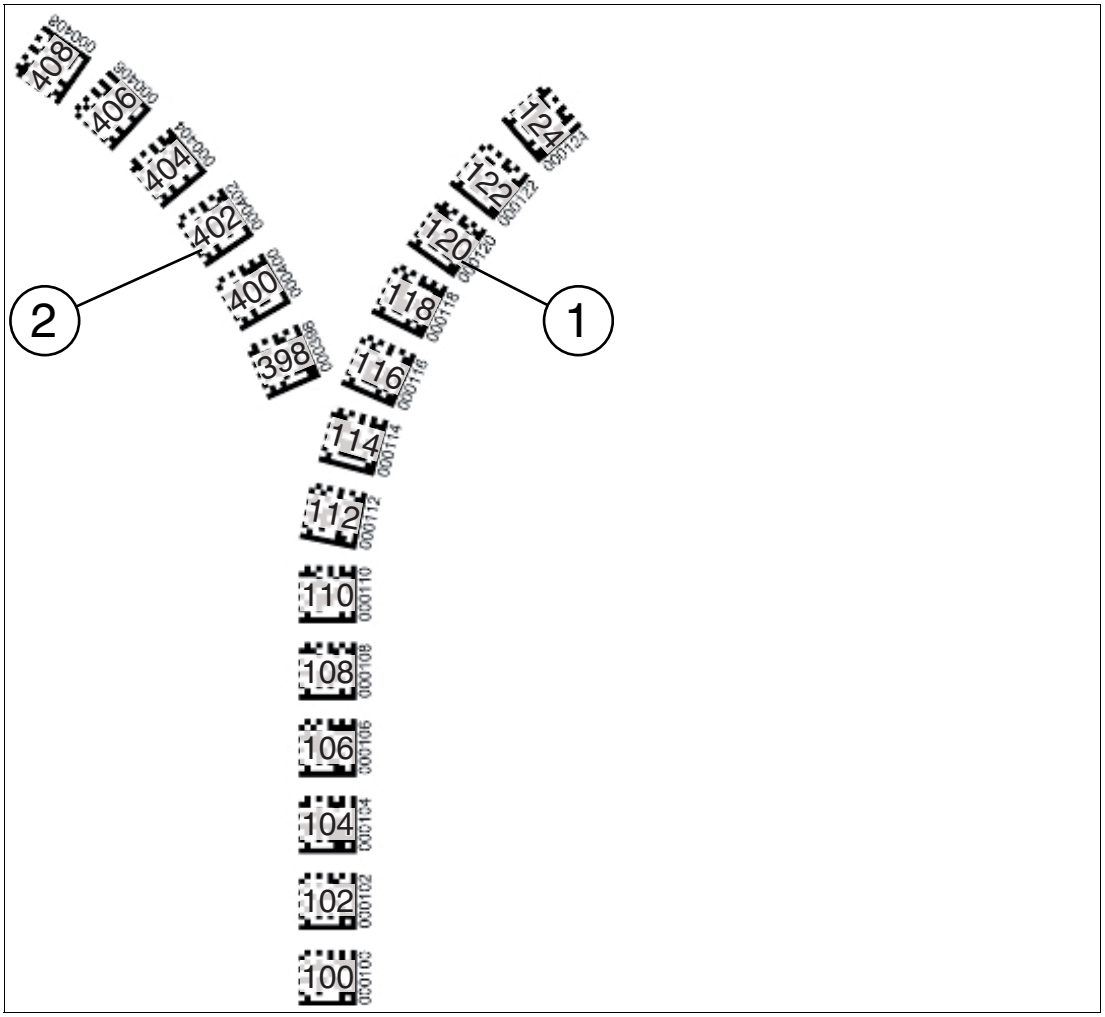

Figure 4.3 1 - More detailed position information
2 - New position information

4.2 Project Planning Using Device Description

As with PROFIBUS DP, a field device is integrated into the project planning tool by way of a device description. The field device properties are described in the GSD file. The GSD file contains the field device data (technical features and information for communication) that you need to operate the device in a PROFINET network.

Import the GSD file into a project planning tool. Peripheral addresses are assigned to the individual channels of the field devices. The peripheral input addresses incorporate the received data. The user program evaluates and processes this data. The user program generates the peripheral output values and sends them to the control interface.

Once project planning is complete, the IO controller receives the planning and configuration data. The IO controller parameterizes and configures the field devices automatically.

Downloading the GSD File

You can find the relevant GSD file in the **Software** 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 type information about the device (e.g., the product description or the item number) into the search function.

5 Operation and communication

5.1 Communication via PROFINET

5.1.1 General Information on Communication via PROFINET

PROFINET is an open standard for industrial automation based on industrial Ethernet. PROFINET integrates information technology with established standards such as TCP/IP and XML in automation technology.

Within PROFINET, PROFINET IO is the communication concept for the construction of decentralized applications. This means that decentralized field devices are integrated through PROFINET IO. The familiar IO view of PROFIBUS DP is used where the usable data of the field devices is transferred to the controller process image in cycles. PROFINET IO is a device model consisting of slots and channels, which is based on the main features of PROFIBUS DP. The field device properties are written in a Generic Station Description Markup Language (GSDML) based on XML. PROFINET IO is engineered in the same way as has long been the case for system integrators of PROFIBUS DP. The decentralized field devices are assigned in the design of a controller.

PROFINET IO distinguishes between the following three device types:

- IO controller: Controller that executes the automation program.
- IO device: Decentrally assigned field device that is assigned to an IO controller.
- IO supervisor: Programming unit/PC with commissioning and diagnostic functions.

5.1.2 PROFINET IO Interface

The PGV*-F200-B17-V1D readers are PROFINET I/O devices that communicate cyclically with the assigned PROFINET I/O control unit during operation.

The PROFINET interface of the PGV*-F200-B17-V1D readers supports:

- A transfer rate of 100 Mbit/s
- The real-time category RT
- The range of functions in accordance with **Conformance Class B**
- The identification and maintenance functions (I&M) IM0 – IM4

5.1.2.1 Identification & Maintenance (I&M) Data

Identification and maintenance data (I&M data) is information stored in a device. I&M data uniquely identifies a device within a plant. The identification data (I data) includes information about the device, for example the item number and device name. Identification data cannot be changed.

Maintenance data (M data) includes information about the device within the plant, for example the installation location and installation date. Maintenance data is initially stored in the device during installation. Maintenance data can be changed.

Accessing and Editing I&M Data

The Step7 software from Siemens can be used to display and change the I&M data.

1. To do so, open the hardware configuration **HW Config** and call up the "Target system" menu.
2. Open one of the following functions:
   - "Download module identification"
   - "Download module identification in PG"

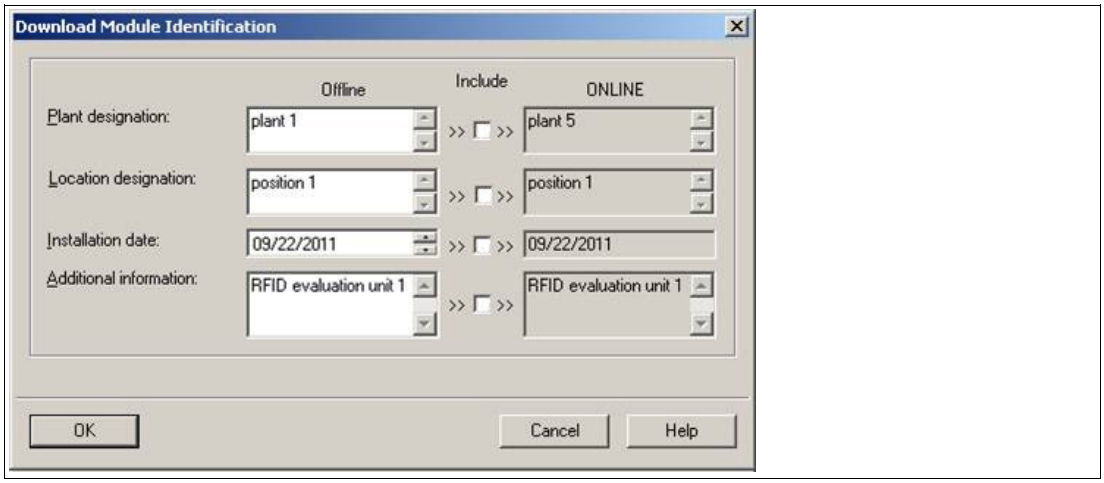

Figure 5.1

3. Depending on the requirement, read or edit the following I&M data:
   - I&M data 1: higher-level assignment, location designation
   - I&M data 2: installation date
   - I&M data 3: additional information

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5.1.3 Project Planning Using Device Description

As with PROFIBUS DP, a field device is integrated into the project planning tool by way of a device description. The field device properties are described in the GSD file. The GSD file contains the field device data (technical features and information for communication) that you need to operate the device in a PROFINET network.

Import the GSD file into a project planning tool. Peripheral addresses are assigned to the individual channels of the field devices. The peripheral input addresses incorporate the received data. The user program evaluates and processes this data. The user program generates the peripheral output values and sends them to the control interface.

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You can find the relevant GSD file in the **Software** 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 type information about the device (e.g., the product description or the item number) into the search function.

5.1.4 PROFINET Address and Identifying a Device

Every PROFINET IO device has a unique device identification. This device identification consists of the following:

- A unique **MAC address**. This MAC address is printed on the back of the device.
- A **device name**. The default device name is `pgv-f200`.
- An **IP address**. The default IP address is `192.168.2.2`.

5.1.5 PROFINET Modules

1 word = 16 bit value

1 byte = 8 bit value

5.1.5.1 Modules with response telegram

The following modules enable reader data to be retrieved using PROFINET.

Module 1

Bit no.	Content
0 ... 15	Status[1]
16 ... 47	Position Data Y[2]
48 ... 63	Angle Data[3]

1. see "Status"
2. see "Position Data Y"
3. see "Angle Data"

Module 2

Bit no.	Content
0 ... 15	Status[1]
16 ... 47	Position Data Y[2]
48 ... 63	Angle Data[3]
64 ... 95	Position Data X[4]
96 ... 111	Position Data Z[5]

1. see "Status"
2. see "Position Data Y"
3. see "Angle Data"
4. see "Position Data X"
5. see "Position Data Z"

Module 3

Bit no.	Content
0 ... 15	Status[1]
16 ... 23	Data Matrix Control Code Status[2]
24 ... 39	Data Matrix Control Code Number[3]

1. see "Status"
2. see "Data Matrix Control Code Status"
3. see "Data Matrix Control Code Number"

Module 4

Bit no.	Content
0 ... 15	Status[1]
16 ... 47	Position Data Y[2]
48 ... 63	Angle Data[3]
64 ... 95	Position Data X[4]
96 ... 127	Data Matrix Tag Number

1. see "Status"
2. see "Position Data Y"
3. see "Angle Data"
4. see "Position Data X"

Module 5

Bit no.	Content
0 ... 15	Status[1]
16 ... 31	Bitmask Warning[2]
32 ... 47	Error No.[3]

1. see "Status"
2. see "Warning"
3. see "Error Codes"

Status

Size	Type	Content
1 word	Input data	16-bit status

Response

Bit no.	Content Byte 1 Status	Function
0	ERR	Error message, see **Error Codes**
1	NP	No absolute X-Position
2	WRN	Warnings present, see **Warning Module**
3	CC	Control Code detected
4	-	Reserved
5	FR	Follow right-hand lane
6	FL	Follow left-hand lane
7	NL	No lane detected
8	RP	Relative Position
9	LC	Bit field LSB, Number of detected lanes
10	LC	Bit field MSB, Number of detected lanes
11	TA	Data Matrix Tag present
12 ... 15	-	Reserved

Error Codes

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

Data Matrix Control Code Status

Bit no.	Content Byte 1 X data
0	S0
1	S1
2	O0
3	O1

The orientation O describes the orientation of the data matrix control code in the reading pane. The position S describes the position of a data matrix control code in relation to the data matrix code tape.

O1	O0	Description
0	0	The control code is orientated the same as the ascending code tape
0	1	The control code is rotated clockwise by 90° in relation to the orientation of the ascending code tape
1	0	The control code is rotated clockwise by 180° in relation to the orientation of the ascending code tape
1	1	The control code is rotated clockwise by 270° in relation to the orientation of the ascending code tape

S1	S0	Description
0	0	No control code found
0	1	The control code is located to the right of the data matrix code tape, or to the right of the colored tape
1	0	The control code is located to the left of the data matrix code tape, or to the left of the colored tape
1	1	The control code is not readable

Data Matrix Control Code Number

Size	Type	Content
1 word, consistent	Input data	16-bit Z data MSB first

Response

Bit no.	Content Word 1 Z data
0	NCC01
1	NCC02
2	NCC03
3	NCC04
4	NCC05
5	NCC06
6	NCC07
7	NCC08
8	NCC09
9	NCC10
10	NCC11
11	NCC12
12	NCC13
13	NCC14
14	NCC15
15	NCC16

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Position Data X

Size	Type	Content
2 words, consistent	Input data	32-bit X data MSB first Resolution: 0.1 mm, 1 mm, 10 mm, binary coded in two's complement

Response

Bit no.	Content	
	Word 1 X data	Word 2 X data
0	XP16	XP00
1	XP17	XP01
2	XP18	XP02
3	XP19	XP03
4	XP20	XP04
5	XP21	XP05
6	XP22	XP06
7	XP23	XP07
8	XP24	XP08
9	XP25	XP09
10	XP26	XP10
11	XP27	XP11
12	XP28	XP12
13	XP29	XP13
14	XP30	XP14
15	XP31	XP15

Position Data Y

Size	Type	Content
2 words, consistent	Input data	32-bit Y data MSB first Resolution: 0.1 mm, 1 mm, 10 mm, binary coded in two's complement

Response

Bit no.	Content	
	Word 1 Y data	Word 2 Y data
0	YP16	YP00
1	YP17	YP01
2	YP18	YP02
3	YP19	YP03
4	YP20	YP04
5	YP21	YP05
6	YP22	YP06
7	YP23	YP07
8	YP24	YP08
9	YP25	YP09
10	YP26	YP10
11	YP27	YP11
12	YP28	YP12
13	YP29	YP13
14	YP30	YP14
15	YP31	YP15

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Position Data Z

Size	Type	Content
1 word, consis-tent	Input data	16-bit Z data MSB first Resolution: 1 mm

Response

Bit no.	Content Word 1 Z data
0	ZP01
1	ZP02
2	ZP03
3	ZP04
4	ZP05
5	ZP06
6	ZP07
7	ZP08
8	ZP09
9	ZP10
10	ZP11
11	ZP12
12	ZP13
13	ZP14
14	ZP15
15	ZP16

Angle Data

Size	Type	Content
1 word, consistent	Input data	16-bit angle data MSB first Resolution: 1°

Response

Bit no.	Content Word 1 Angle Data
0	ANG01
1	ANG02
2	ANG03
3	ANG04
4	ANG05
5	ANG06
6	ANG07
7	ANG08
8	ANG09
9	ANG10
10	ANG11
11	ANG12
12	ANG13
13	ANG14
14	ANG15
15	ANG16

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Warning

Size	Type	Content
1 word, consis-tent	Input data	Last warnings Last warning no.

Response

Bit no.	Content Word 1 Last warning data
0	WRN01
1	WRN02
2	WRN03
3	WRN04
4	WRN05
5	WRN06
6	WRN07
7	WRN08
8	WRN09
9	WRN10
10	WRN11
11	WRN12
12	WRN13
13	WRN14
14	WRN15
15	WRN16

Warning data set

Bit no.	Content Word 1	Description
0	WRN01	A code with non-PGV content was found
1	WRN02	Reader too close to code tape
2	WRN03	Reader too far from code tape
3	WRN04	Y position too large. The sensor is just before OUT
4	WRN05	Y position too small. The sensor is just before OUT
5	WRN06	The reader is rotated or tilted in relation to the code tape
6	WRN07	Low level of code contrast
7	WRN08	Repair tape detected
8	WRN09	Temperature too high
9	WRN10	Reserved
10	WRN11	Reserved
11	WRN12	Reserved
12	WRN13	Reserved
13	WRN14	Reserved
14	WRN15	Reserved

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Bit no.	Content Word 1	Description
15	WRN16	Reserved

Table 5.1 If no warnings are present, all bits in the warning data set are set to 0.

5.1.5.2 Modules with Input Data

The modules below can be used to send data to the reader via PROFINET.

Module 6

Bit no.	Content
0 ... 15	Control Information[1]

1. See "Control Information"

Control Information

Size	Type	Content
1 word, consis-tent	Output data	Control information

Response

Bit no.	Content Word 1 Control Information
0	Follow left-hand lane
1	Follow right-hand lane
2	-
3	-
4	Lighting on/off

5.1.5.3 Global Primary Data

The global primary data allows you to parameterize the reader using PROFINET. Global primary data is always transferred to the reader in full.

Sub-index	Designation	Function	Parameter data	Data type	Primary data
0	Number of Subsequent Parameters			unsigned8	11
1	X resolution	Multiplier for the length in the direction of the X coordinate	Resolution	unsigned32	0.1 mm **1 mm**[1] 10 mm
2	Y resolution	Multiplier for the length in the direction of the Y coordinate	Resolution	unsigned32	0.1 mm **1 mm** 10 mm
3	Angle resolution	Multiplier for the angle output	Resolution	signed32	-16,384 – 16,384 **360 -> 1**°
4	Horizontal offset	Offset in the direction of the X coordinate	Length	signed32	**0 mm** – ±10,000,000 mm
5	Vertical offset	Offset in the direction of the Y coordinate	Length	signed16	**0** – ±16,383 mm
6	Angle offset	Line of vision offset	Angle	signed32	-16,383 – **0** – 16,383
7	No position value X	X value if no code tape is visible	X data at "No Position"	Array of unsigned8 Octet 0-3	Last Valid Position (0x00) **Specified Value (0x01)**
	No Position Specific X Position	Specific X value		Octet 4-7	**0** – 100,000,000
8	No position value Y	Y value if no code tape is visible	Y data at "No Position"	Array of unsigned8 Octet 0-3	Last Valid Position (0x00) **Specified Value (0x01)**
	No Position Specific Y Position	Specific Y value		Octet 4-7	**0** – 16,383
9	No position value angle	Angle output if no colored tape is visible	Angle data at "No Position"	Array of unsigned8 Octet 0-3	Last Valid Position (0x00) **Specified Value (0x01)**
	No Position Specific Angle Position	Fixed angle		Octet 4-7	0 – **65,535**
10	Bandwidth	Width of the colored tape	Width	unsigned32	10 mm – 40 mm **18 mm**

Sub-index	Designation	Function	Parameter data	Data type	Primary data
11	Color	Color of the tape	Color	unsigned32	1 = blue (RAL 5015) **2 = green** (RAL 6032) 4 = red (RAL 3001) 8 = yellow (RAL 1021)
12	Input Source Selection[2]	Selecting the source of the input data	Selection	unsigned32	**0 = hardware input** 1 = Software

1. **Bold** = default values

2. If you would like to control the inputs via the protocol, you must set this parameter to 1 = Software.

5.2 Operation Using Control Codes

In numerous positioning system applications, defined processes (= event) must be started at specific positions. This means that the exact positions must be defined via code tapes for positioning, instead of simple colored tapes. In the context of lane tracking, it is advisable to mark branches using control codes to facilitate the control of the direction decision.

The layout of the lane can be adjusted according to the application in question. If an automated guided vehicle must be positioned exactly, a code tape is mounted for positioning purposes instead of the colored tape. If an event needs to start at a particular position or a direction decision needs to be made, a control code is mounted parallel to the actual lane.

Only a specific event and the associated process then have to be programmed into the system controller. The position in which the corresponding control code is placed next to the colored tape or code tape for positioning does not have to be determined until final commissioning. Even if subsequent changes are made to the layout of a system, the relevant control code is simply moved to the new position without requiring program modifications to be made.

Control codes are short code tapes one meter in length. The control code has an encrypted number. Control codes exist with numbers ranging from 001 to 999.

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

The 1-meter-long control code can be shortened. However, the minimum length should be 3 codes (60 mm). If the speed of the read head increases, a longer control code is required. If the read head travels at maximum speed, a full-length control code of 1 meter must be positioned next to the colored tape or code tape for positioning.

The minimum length of a control code can be calculated according to the following formula depending on the travel speed and trigger period:

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

The trigger period is 40 ms.

Example

Example calculation

The minimum length of the control code at a speed of 3 m/s and a trigger period of 40 ms is:
$L_{Event\ marker}$ = 60 mm + 3 m/s * 40 ms * 2 = **300 mm**

Control codes are identified by the printed number, in this case "Control 12".

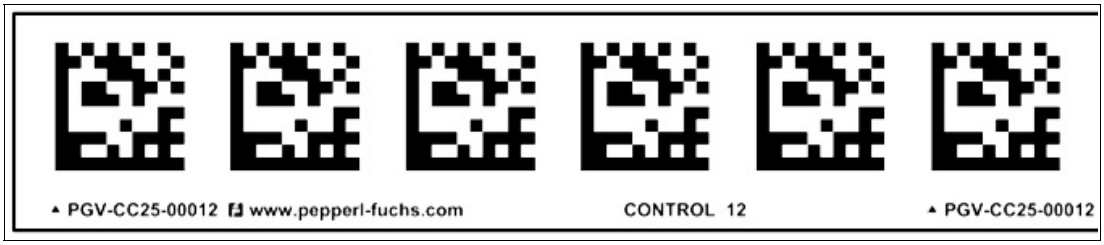

Figure 5.2 PGV-CC25-0012

The illustration shows part of control code #12

Refer to the "Accessories" chapter for order information relating to control codes.

5.3 Operation Using Repair Tape

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

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

Note

When placing a repair tape on the code tape, make sure that the repair tape continues the pattern on the code tape as accurately as possible.

When the read head enters the range of a repair tape, it sets the repair tape flag in its output data.

Note

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

Tip

If repairs are required, the **Code Tape Generator** at www.pepperl-fuchs.com can be used as a short-term workaround. This generator enables segments of code tape to be produced and printed out online.

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

The printout must be used only as an emergency solution. The durability of the paper strip is extremely limited depending on the application!

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

2017-11

6 Appendix

6.1 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**	**I**
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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