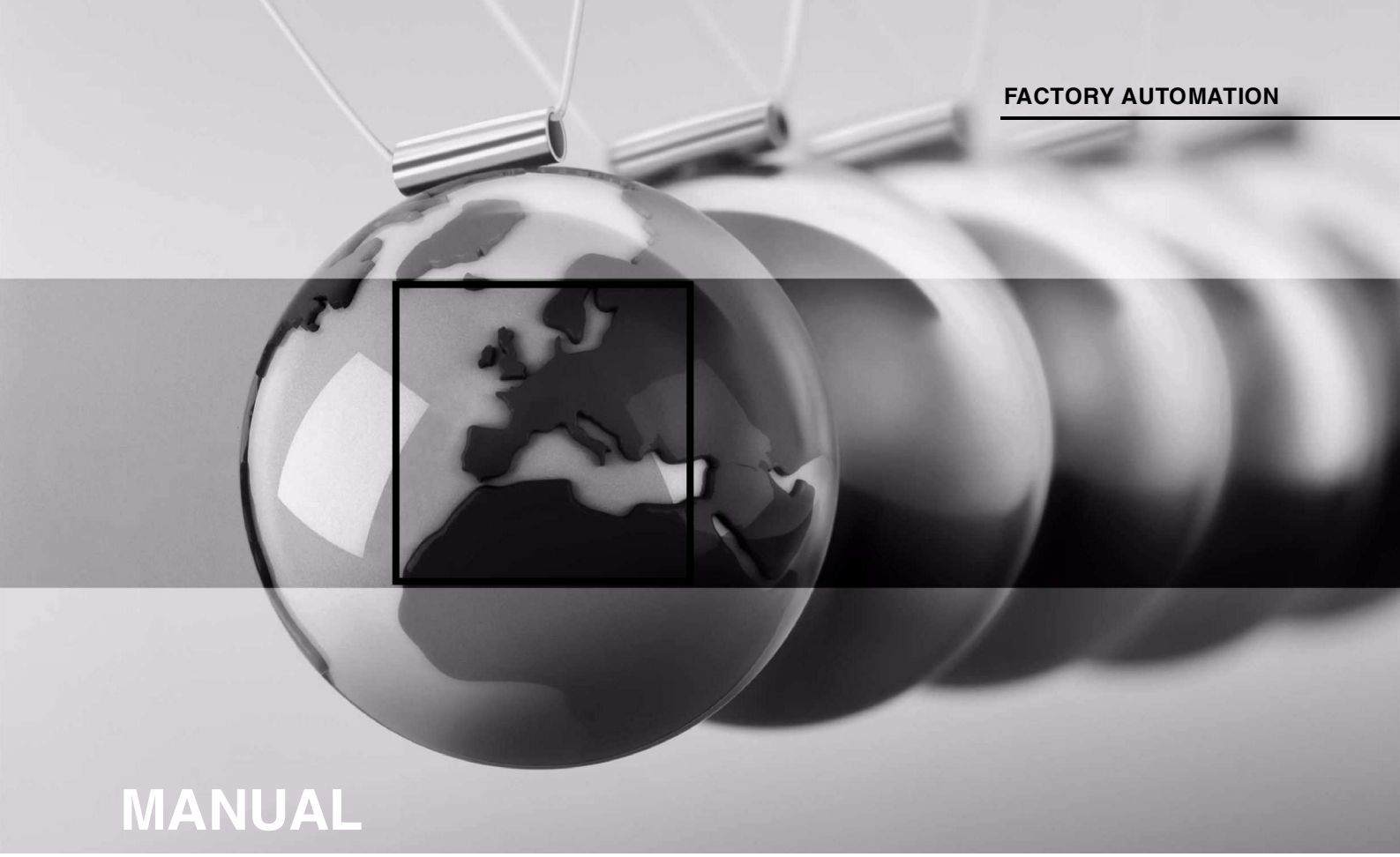
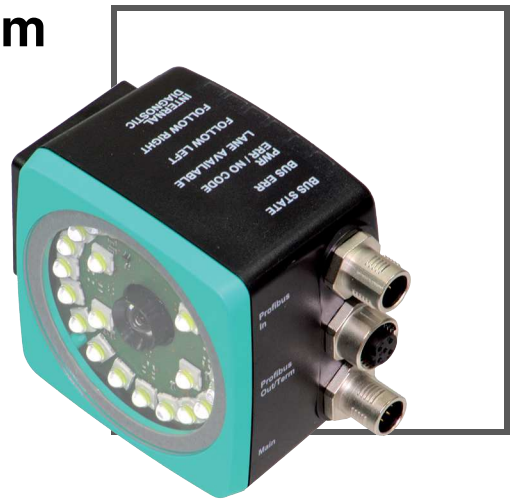


MANUAL

PGV...-F200/-F200A...-B6-V15B

Incident Light Positioning System



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SENSING YOUR NEEDS

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

1 Introduction

Congratulations

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

Symbols used

The following symbols are used in this manual:

Note!

This symbol draws your attention to important information.

Handling instructions

You will find handling instructions beside this symbol

Contact

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

Pepperl+Fuchs GmbH
Lilienthalstraße 200
68307 Mannheim, Germany
Telephone: +49 (0)621 776-1111
Fax: +49 (0)621 776-271111
Email: fa-info@de.pepperl-fuchs.com

2017-08

2 Declaration of Conformity

2.1 CE Conformity

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

Note!

A declaration of conformity can be requested from the manufacturer.

2017-08

3 Safety

3.1 Symbols Relevant to Safety

Danger!

This symbol indicates an imminent danger.

Non-observance will result in personal injury or death.

Warning!

This symbol indicates a possible fault or danger.

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

Caution!

This symbol indicates a possible fault.

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

3.2 Intended Use

This device, when used together with a colored tape affixed to the floor and code tapes printed with Data Matrix codes, constitutes 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 spur.

Prior to mounting, installation, and commissioning of the device you should make yourself familiar with the device and carefully read the instruction manual.

The device is only approved for appropriate and intended use. Ignoring these instructions will void any warranty and absolve the manufacturer from any liability.

Protection of the personnel and the plant is not ensured if the device is not used according to its intended use.

3.3 General Safety Instructions

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

Installation and commissioning of all devices may only be performed by trained and qualified personnel.

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

Note!

Disposal

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

4 Product Description

4.1 Use and Application

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.

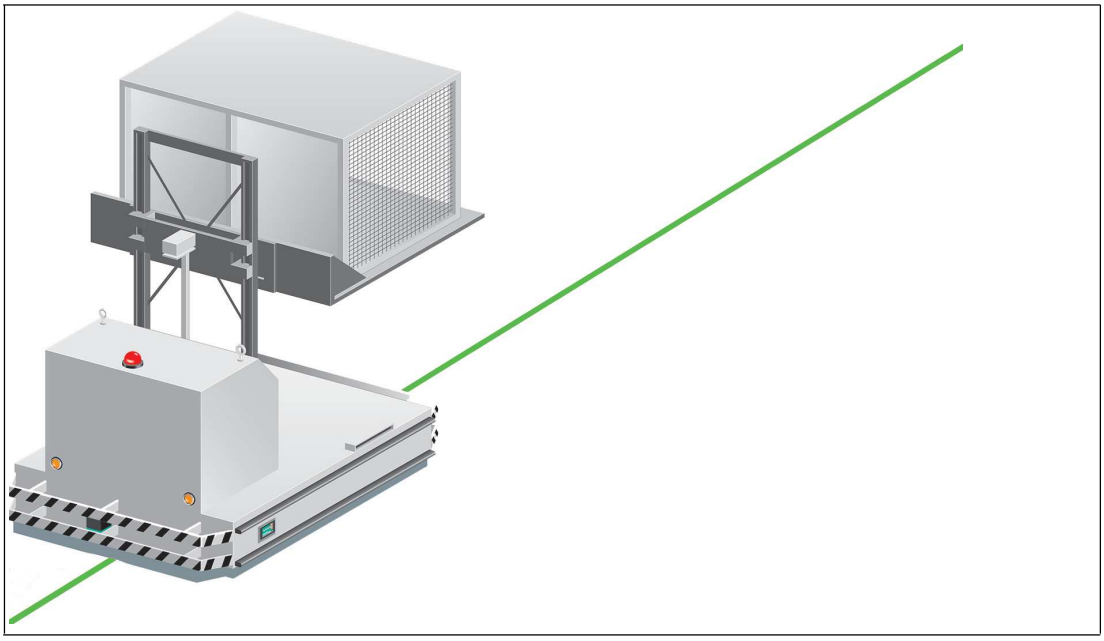


Figure 4.1 Automated guided vehicle with green colored tape

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.

2017-08

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.

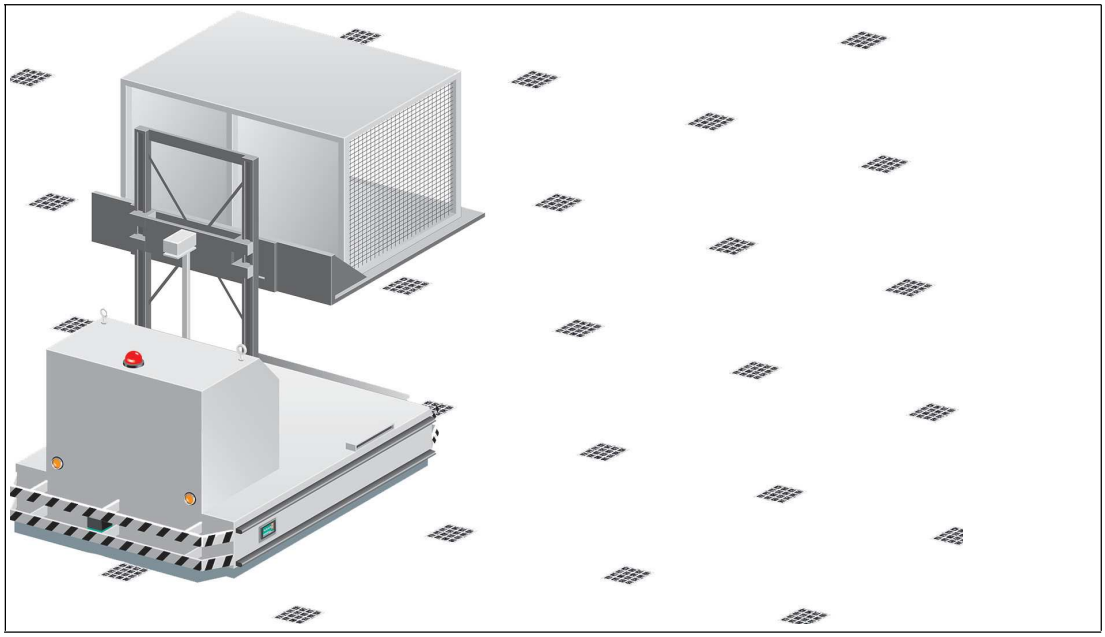


Figure 4.2 Automated guided vehicle with Data Matrix tags

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.

4.2 LED Indicators and Controls

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

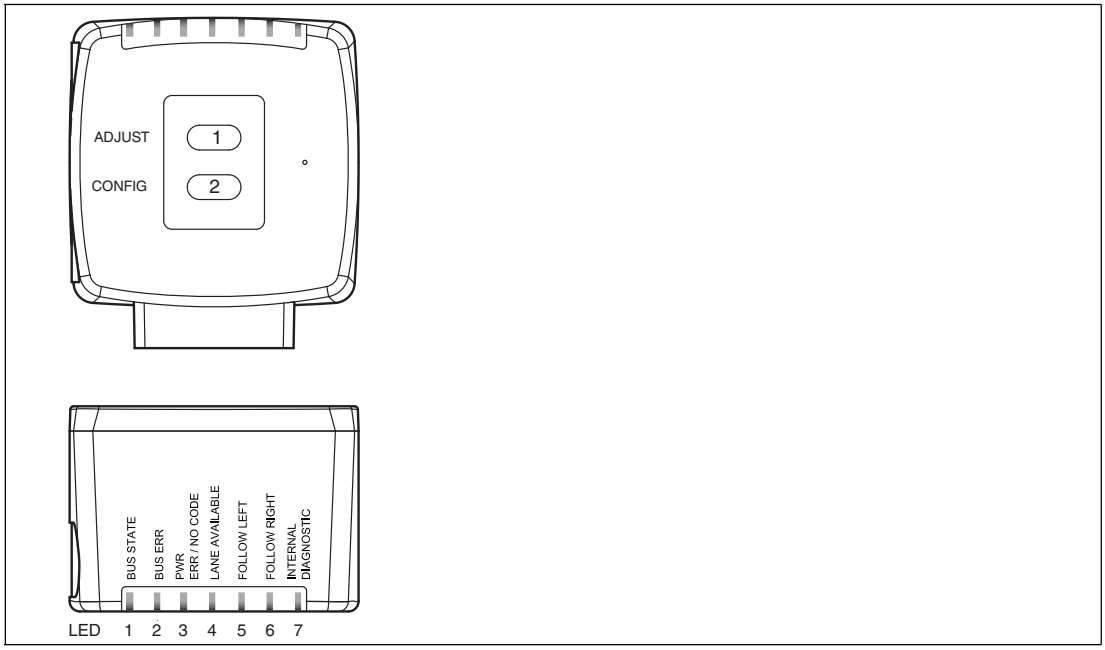


Figure 4.3

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	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[1]
	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 spur" activated
	x	x	x	x	Off	Lights up	x	"Follow right-hand spur" activated
	x	x	x	x	Lights up	Lights up	x	"Straight ahead" activated
	Lights up	x	x	x	x	x	x	PROFIBUS data transfer
	x	Flashes	x	x	x	x	x	PROFIBUS 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 .No spur selected, for example

x = LED status has no meaning

2017-08

4.3 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
PGV-CC25-0*	Code tape, various control codes
PGV*M-CA25-0	Position tape, starting position 0, various lengths
PGV-CR25	Repair tape
PCV-SC12 PCV-SC12A	Grounding clip
PCV-KBL-V19-STR-USB	USB cable unit with power supply, for service interface
V19-G-ABG-PG9-FE	Grounding terminal and plug (set)
V15B-G-*M-PUR ABG-V15B-G	PROFIBUS bus cable, M12 to M12, available in several different lengths
VAZ-V1S-B	Stopping plug for M12 connector
ICZ-TR-V15B	Terminator for PROFIBUS
V19-G-*M-*	Configurable connection cable[1]

1.Ask your contact person at Pepperl+Fuchs

5 Installation

5.1 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

2017-08

Read Head Dimensions

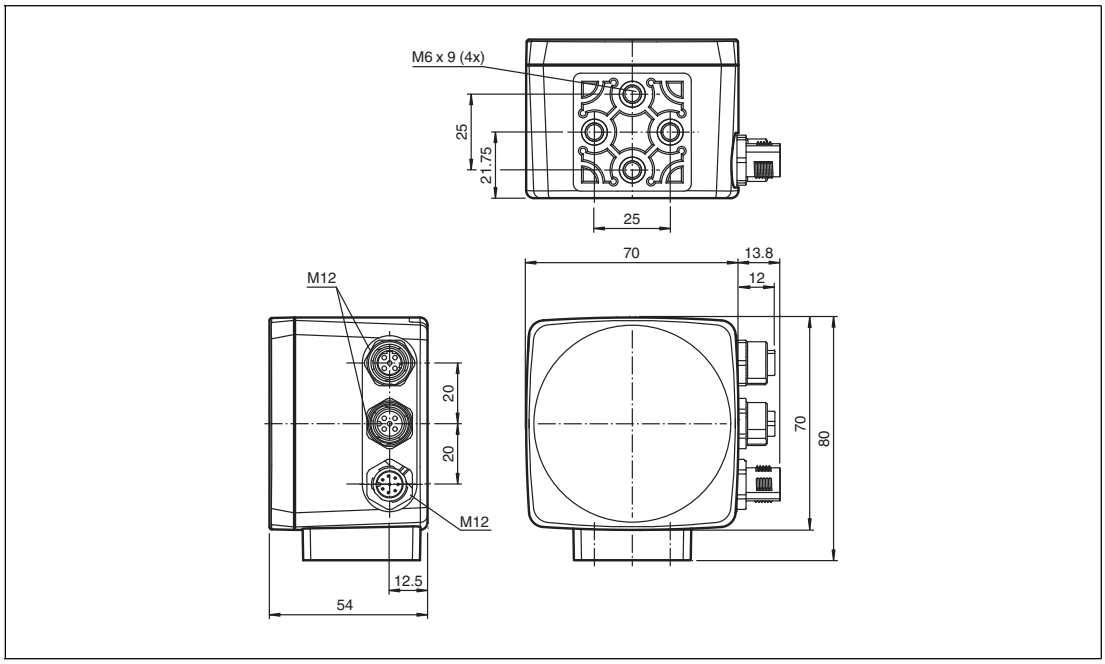


Figure 5.1 Housing *-F200-*

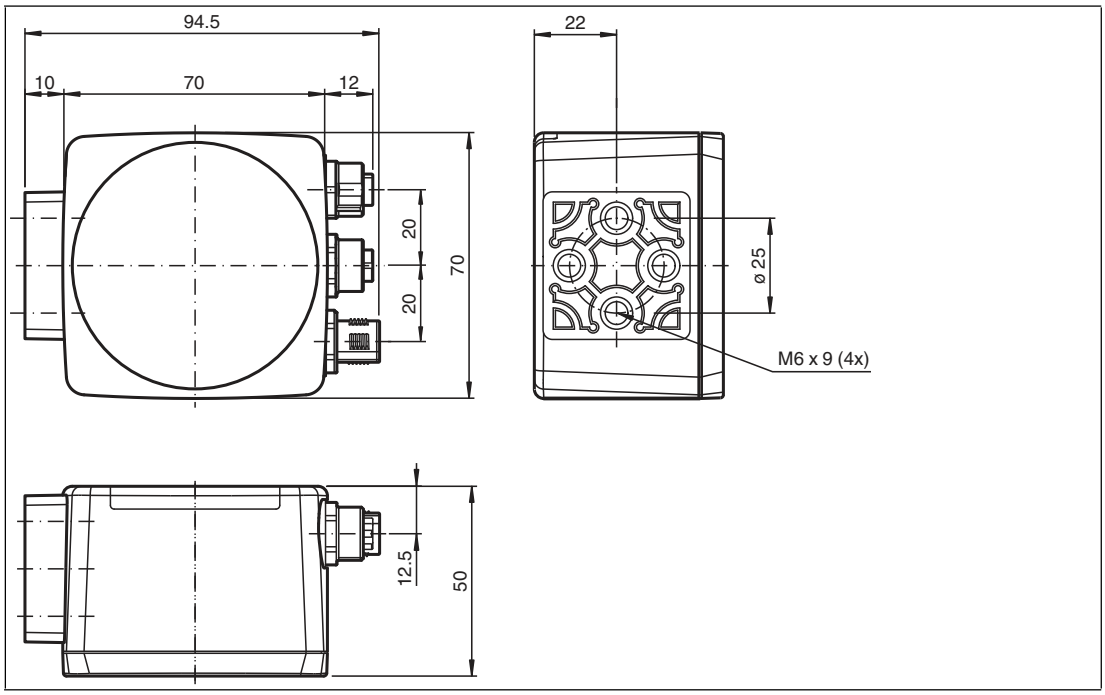


Figure 5.2 Housing *-F200A-*

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.

5.2 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®.

2017-08

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.

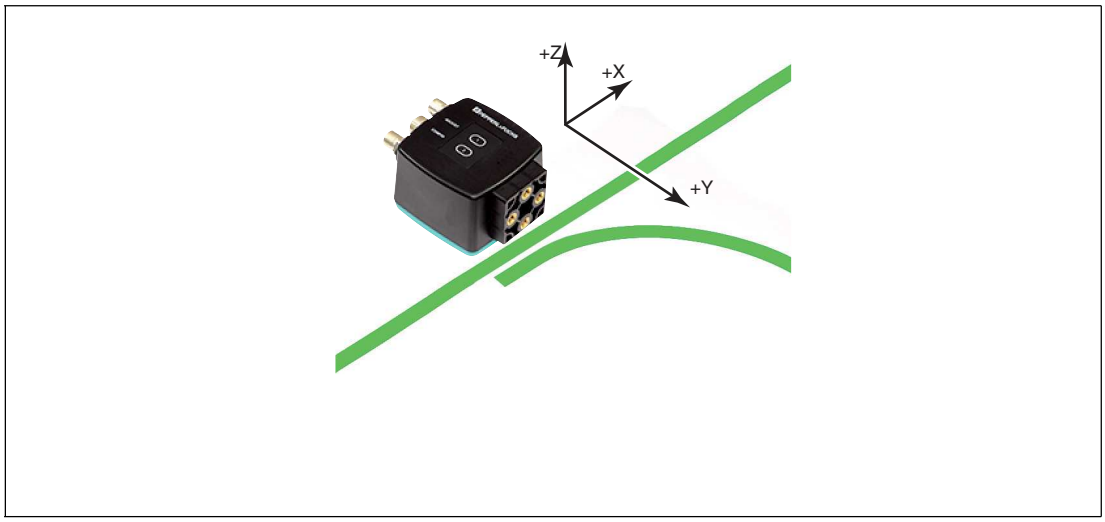


Figure 5.3 Field of view and coordinates of the sensor

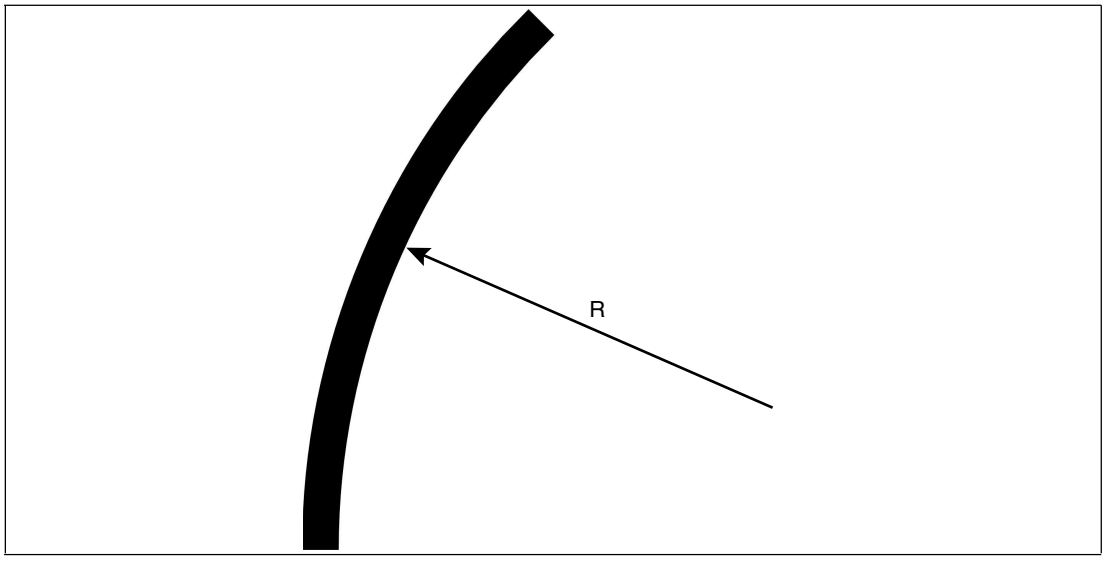


Figure 5.4 Curve radius: R ≥ 50 cm

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.

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°.

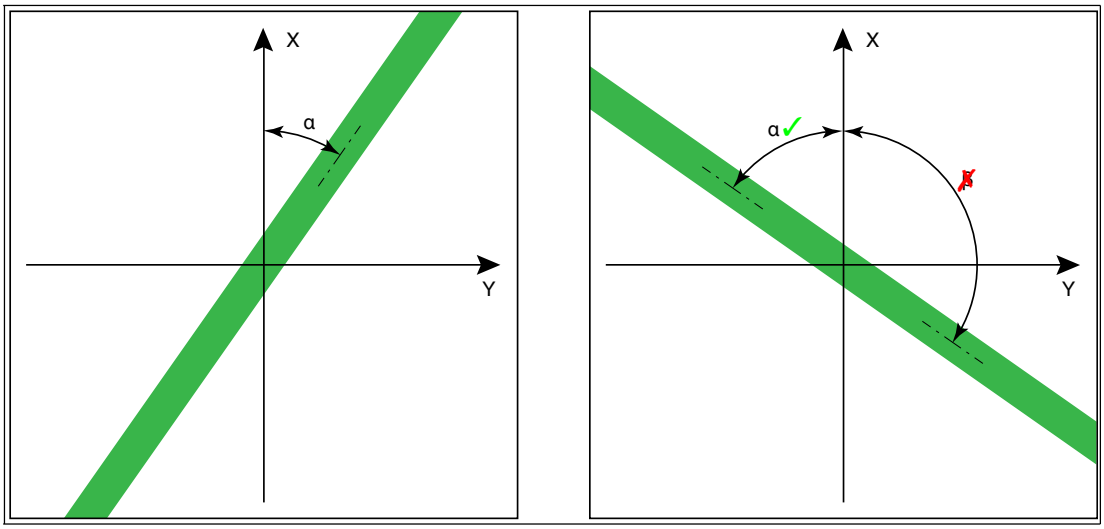


Figure 5.5 Relative angle

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°

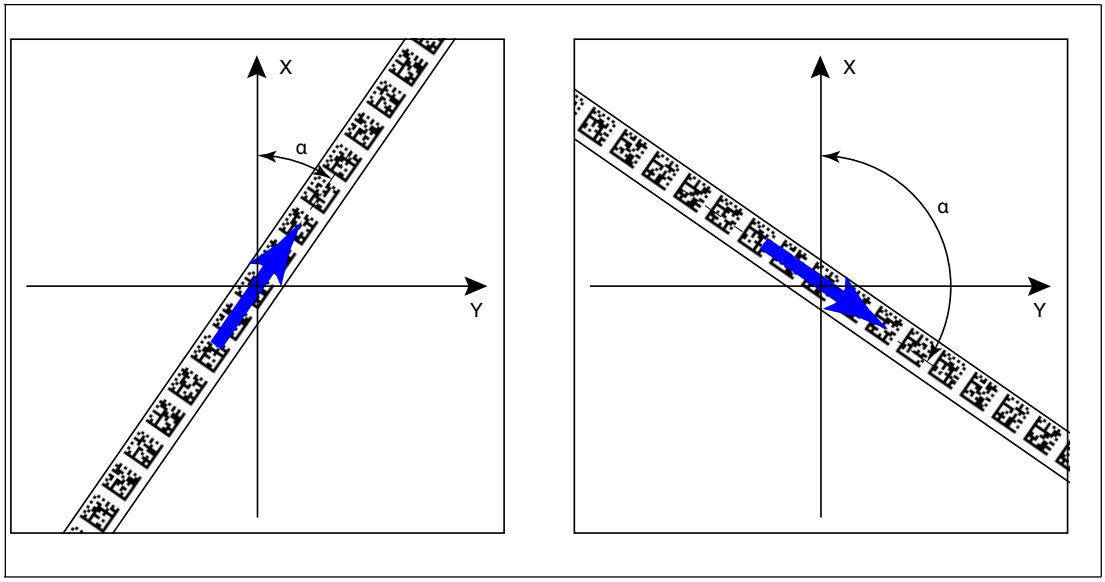


Figure 5.6 Absolute angle

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.

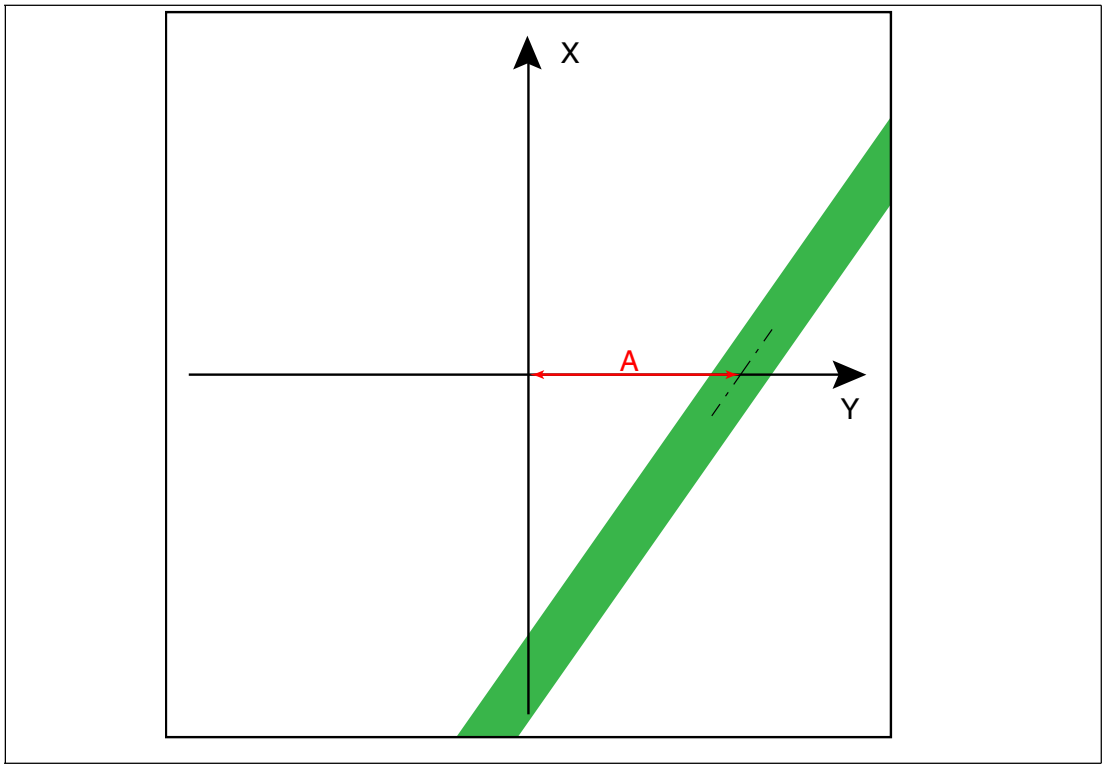


Figure 5.7 Distance A for colored tape

Data Matrix code tape

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

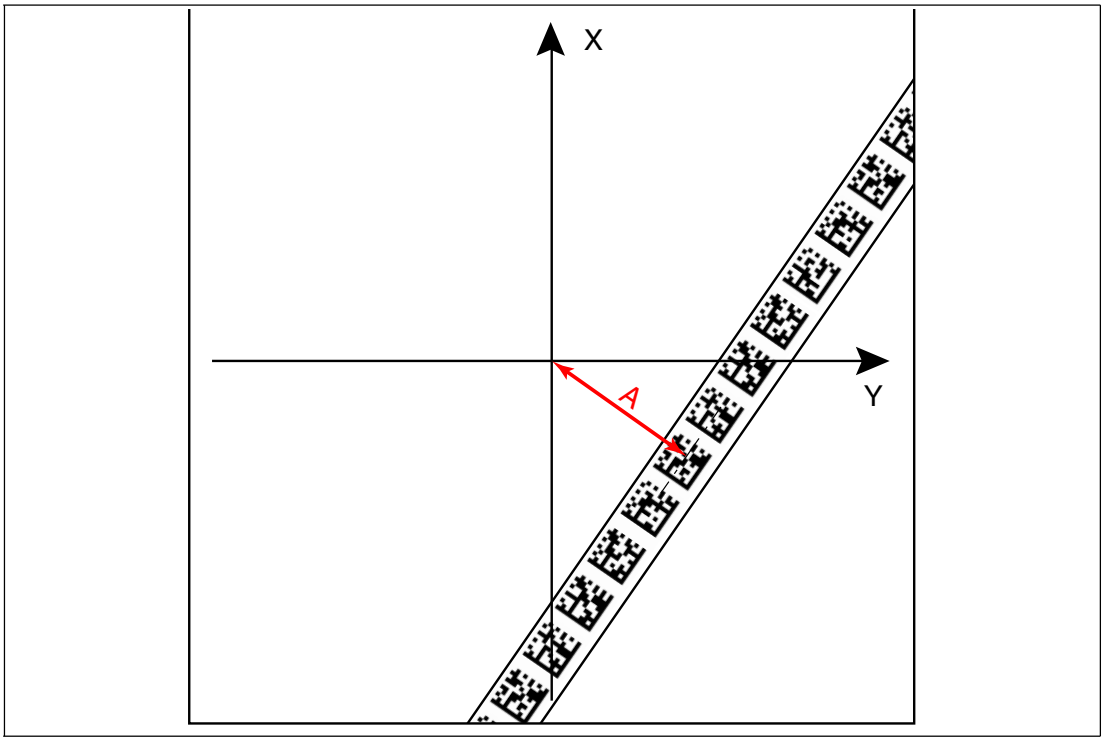


Figure 5.8 Distance A for Data Matrix code tape

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:

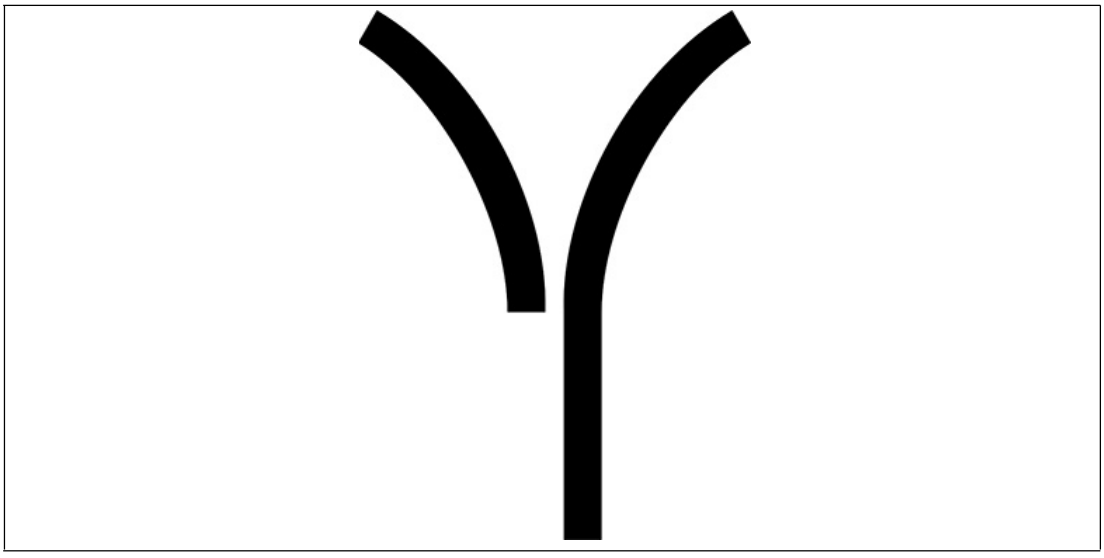


Figure 5.9 Separate lane branches off/converges

2017-08

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.

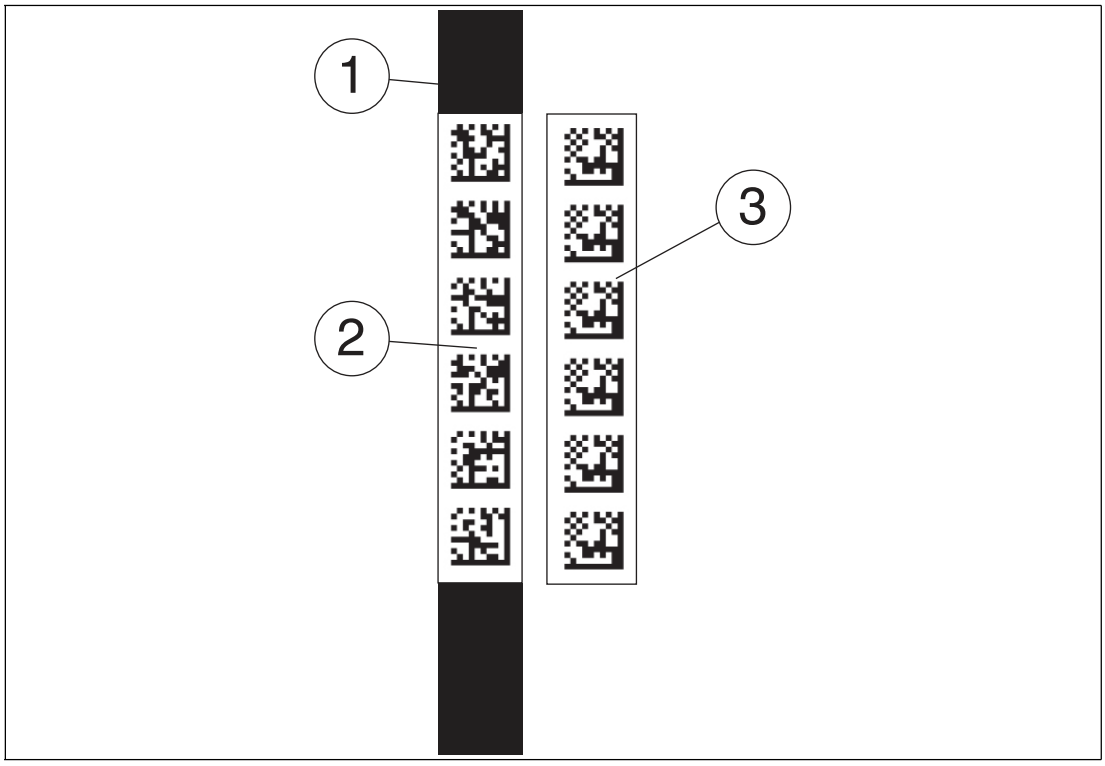
Code Tapes for Control and Positioning

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:

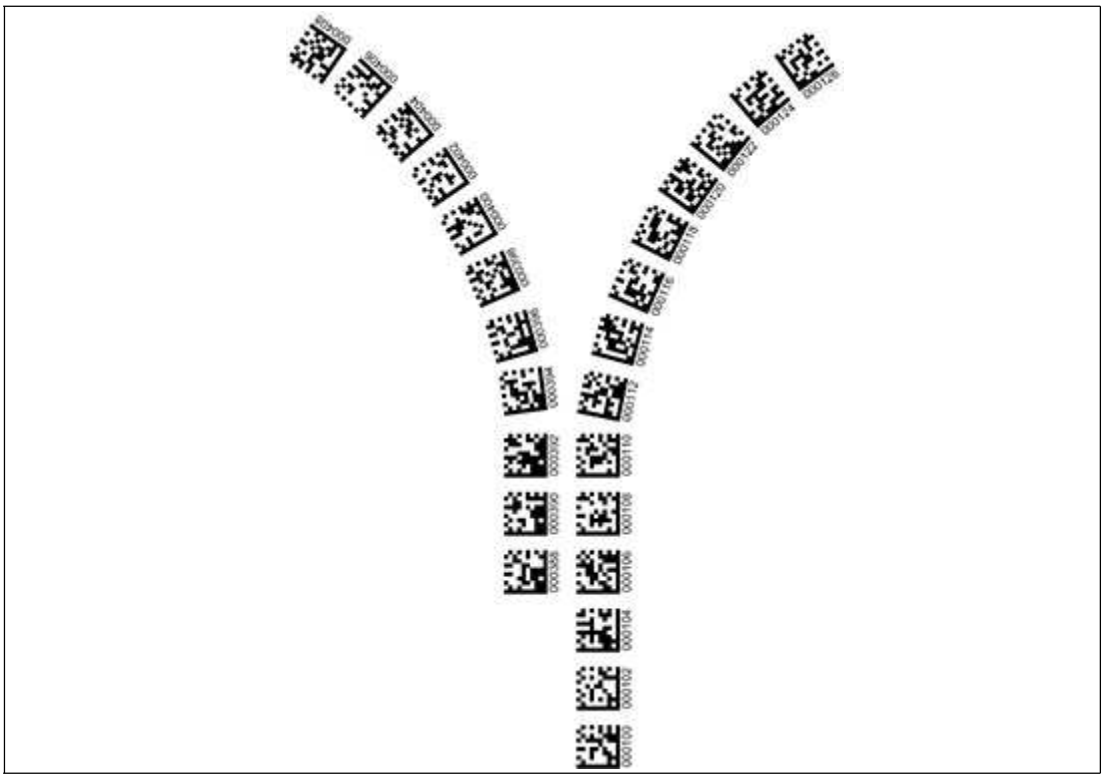


Figure 5.10 Separate lane branches off/converges

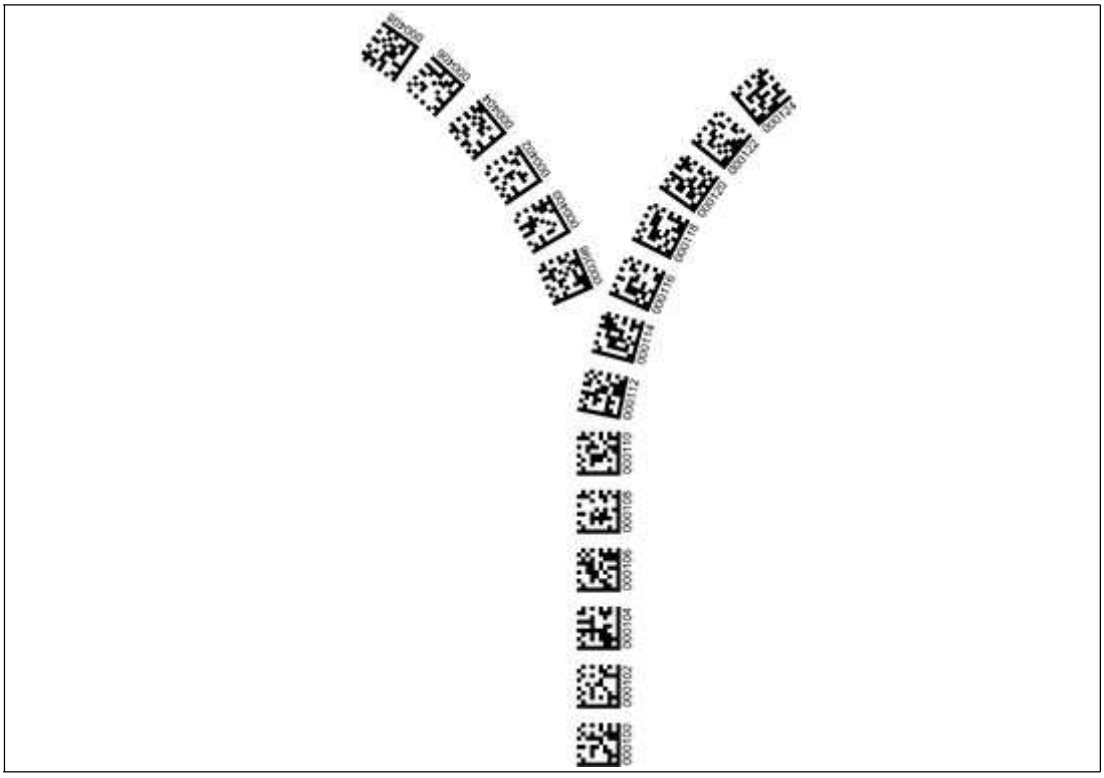


Figure 5.11 Same lane branches off/converges

2017-08

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. See chapter 6.1.
- 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.

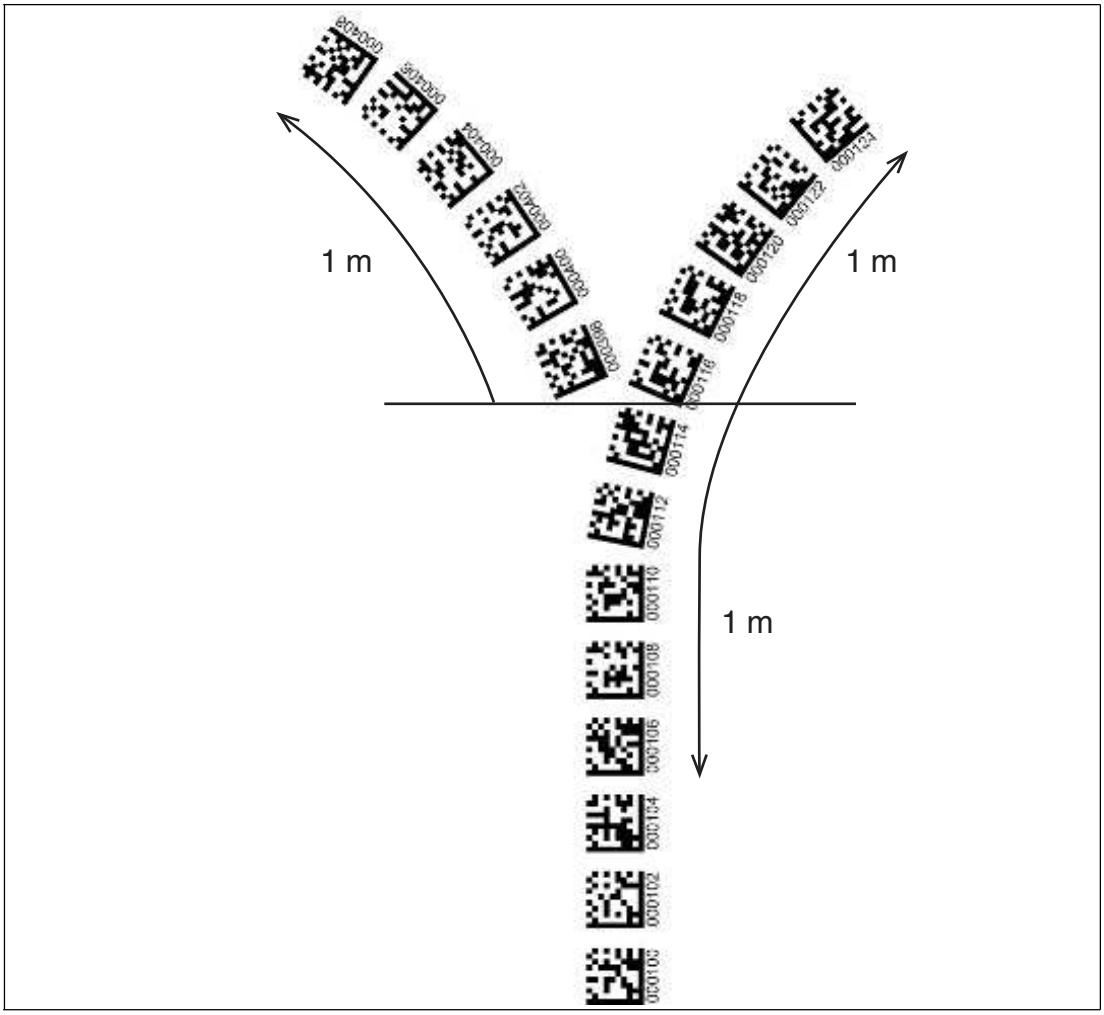


Figure 5.12 Distances

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.

2017-08

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

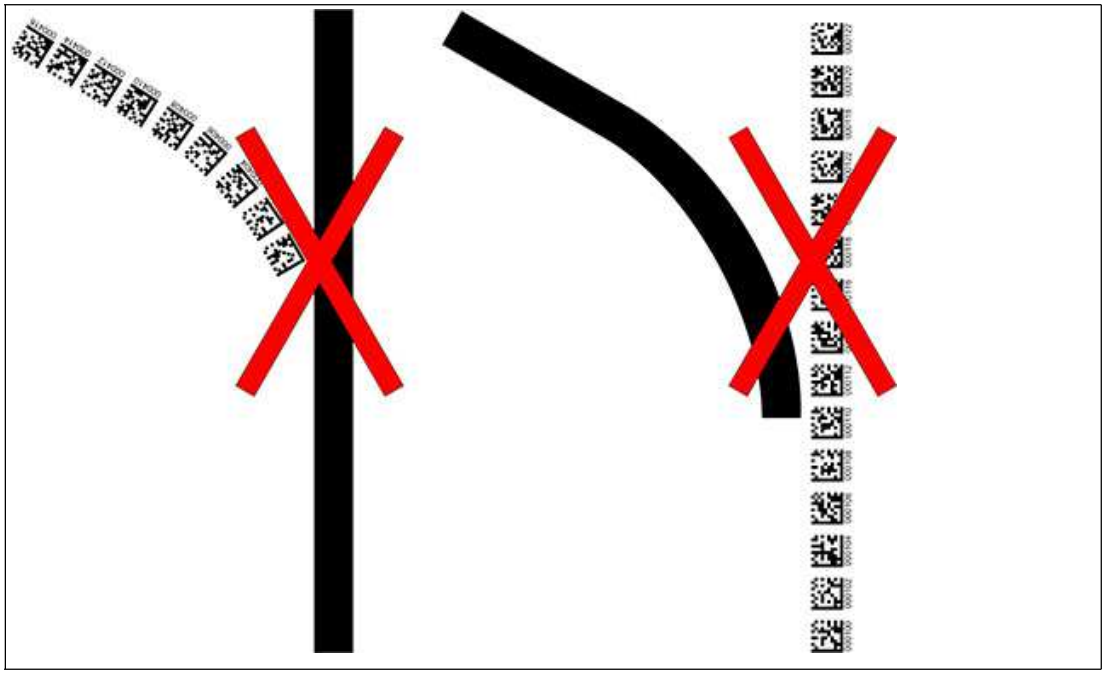


Figure 5.13 Mixture of lanes with colored tape and Data Matrix codes

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.

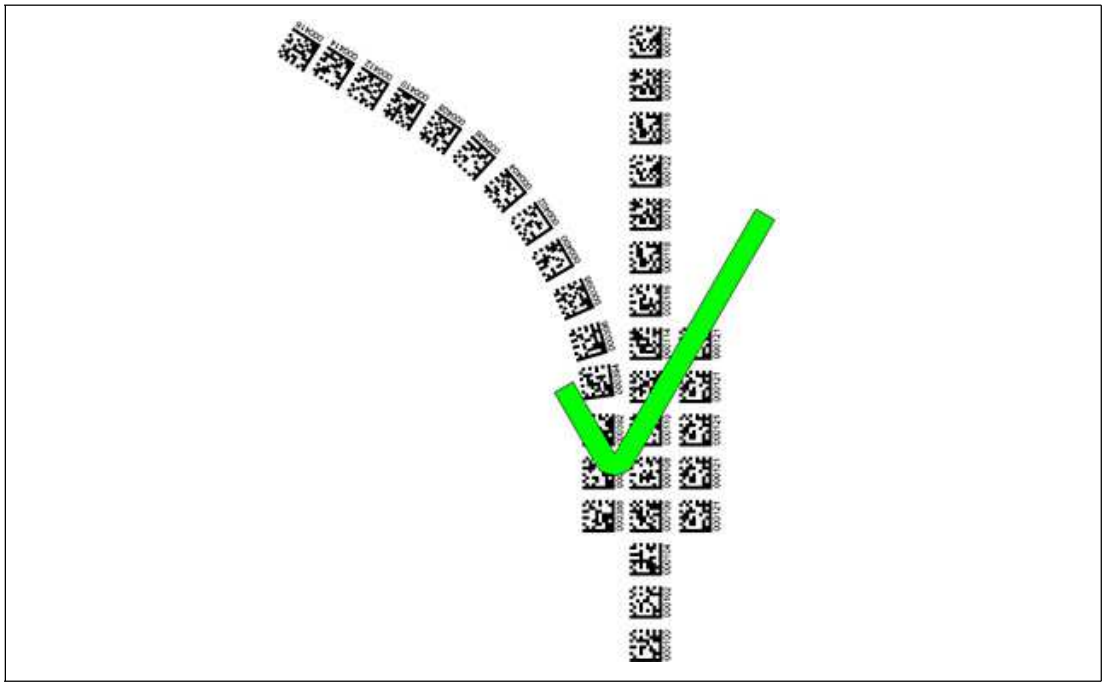


Figure 5.14 Branch with control code

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.

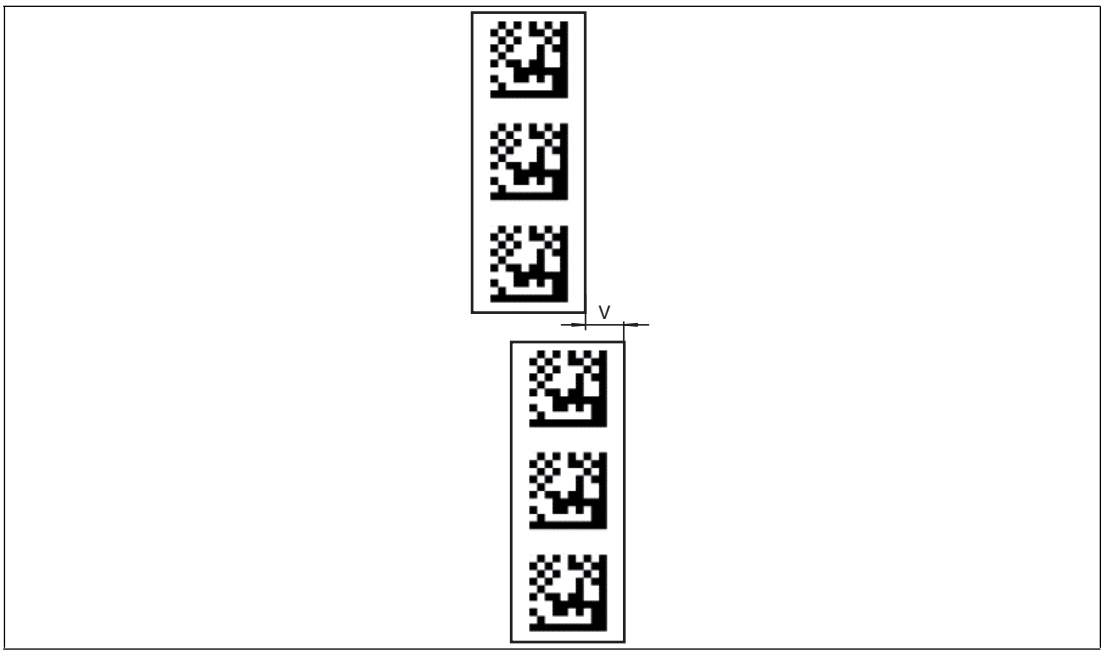


Figure 5.15 Offset: 0 mm ≤ V ≤ 5 mm

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.

2017-08

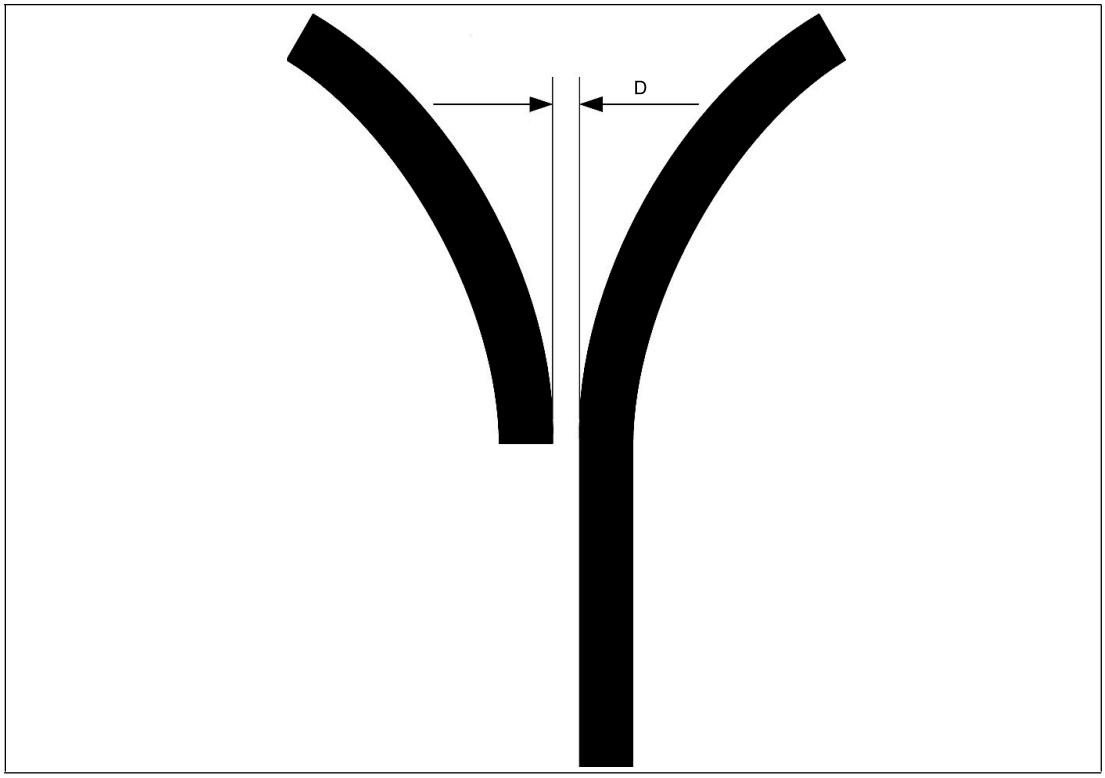


Figure 5.16 Distance: 7.5 mm ≤ D ≤ 15 mm

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.

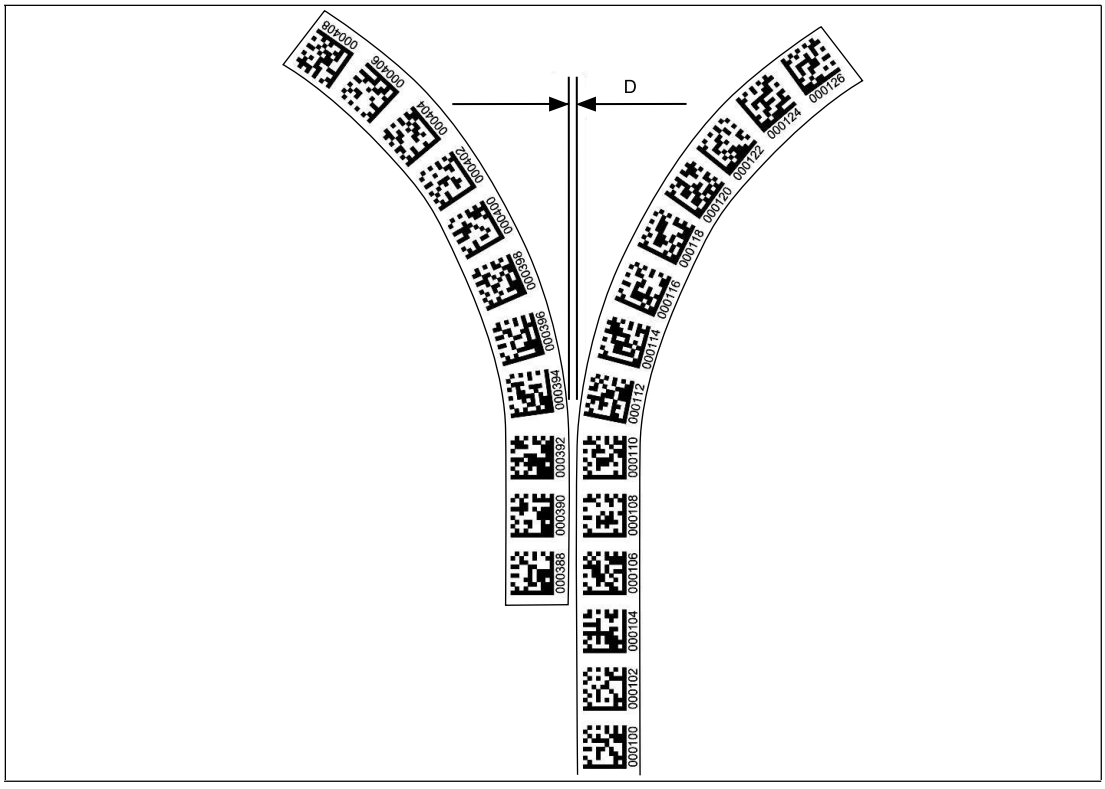


Figure 5.17 Distance: 0 mm ≤ D ≤ 5 mm

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

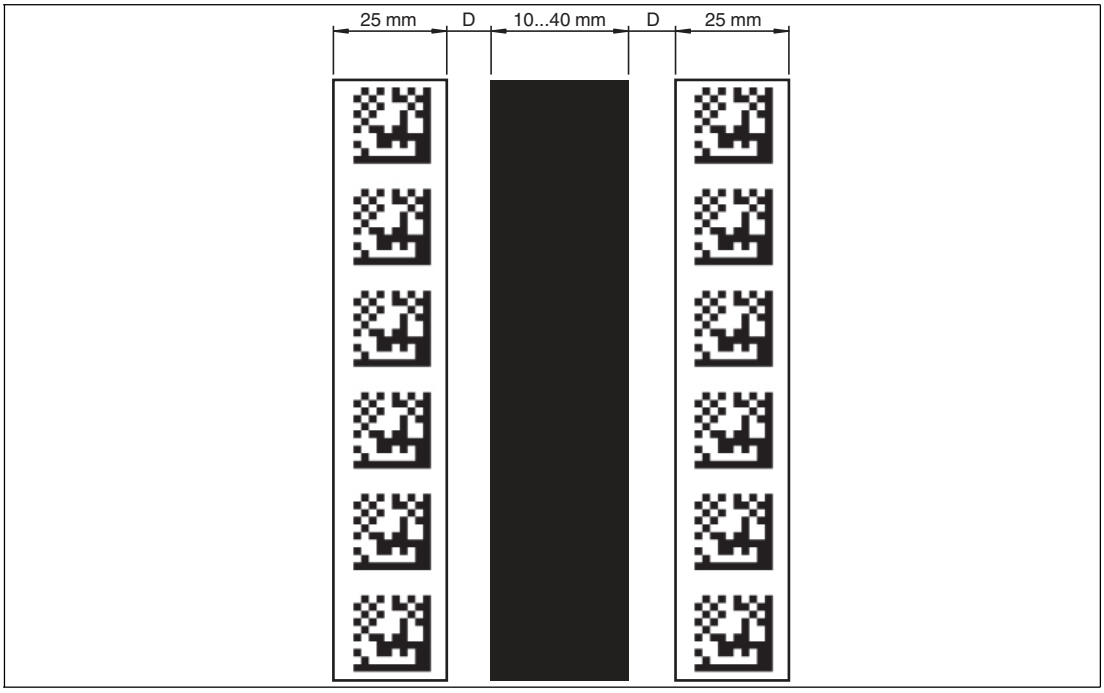


Figure 5.18 0 mm ≤ D ≤ 5 mm

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

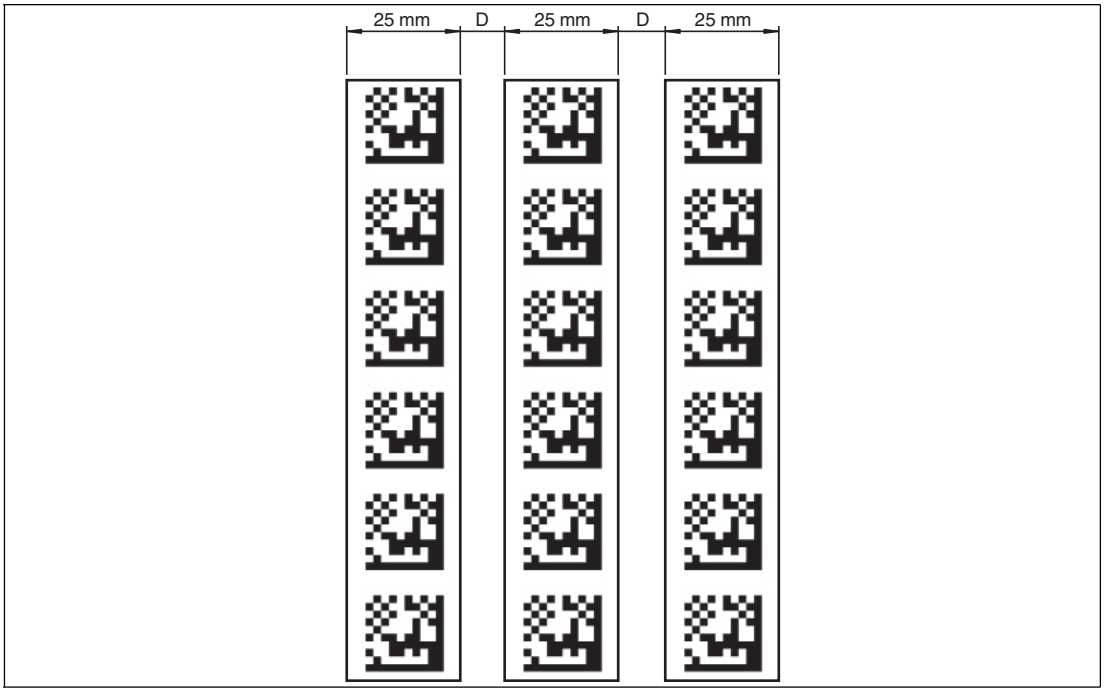


Figure 5.19 0 mm ≤ D ≤ 5 mm

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

2017-08

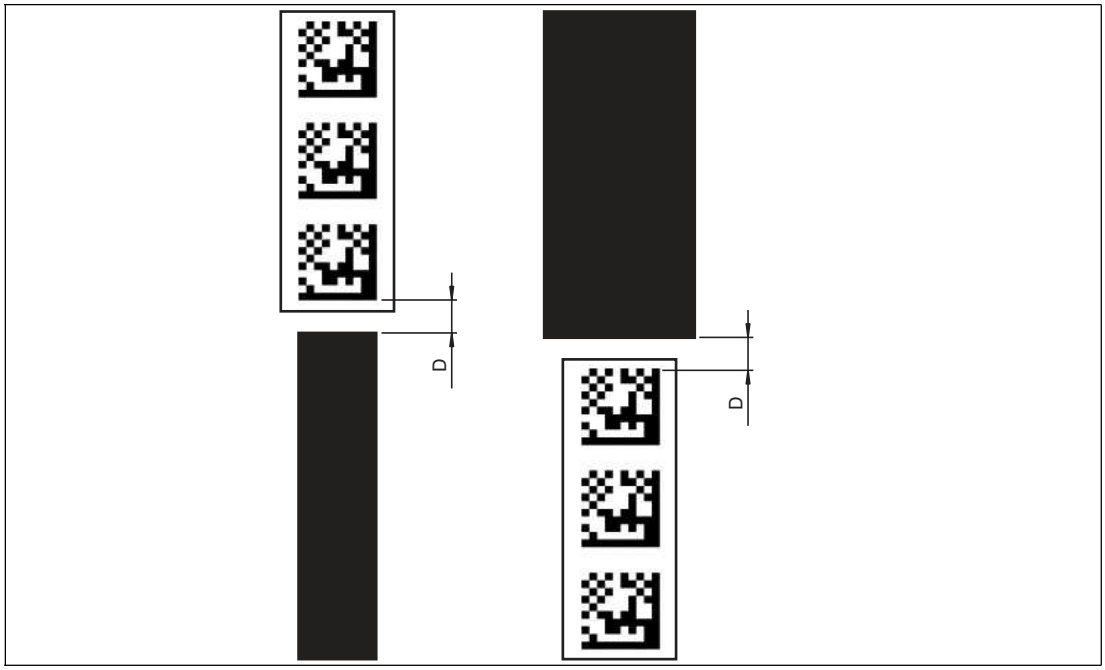


Figure 5.20 0 mm ≤ D ≤ 10 mm

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

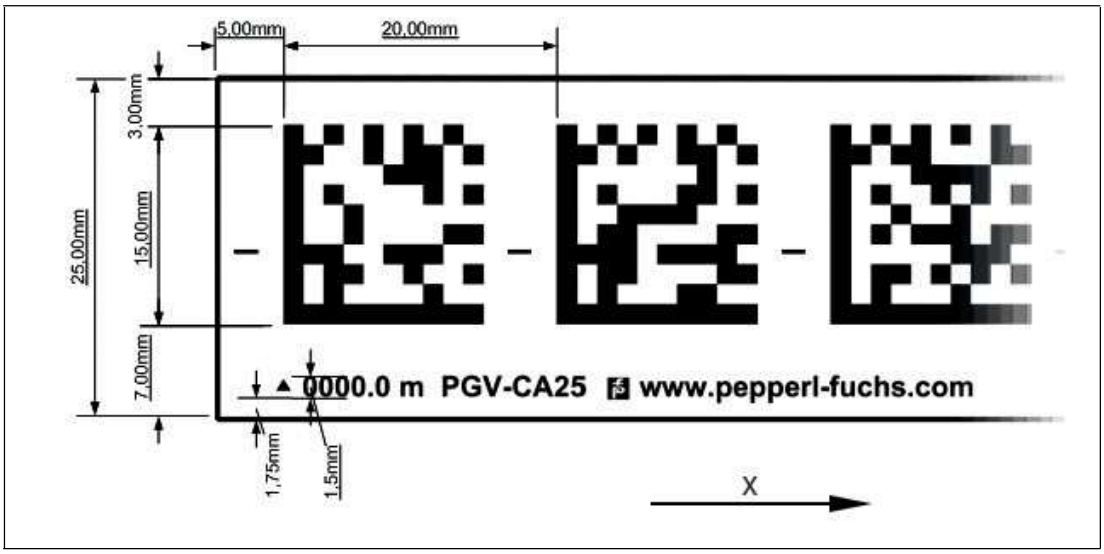


Figure 5.21 The center line indicates the center of the code tape and not the center of the code

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 5.1 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!

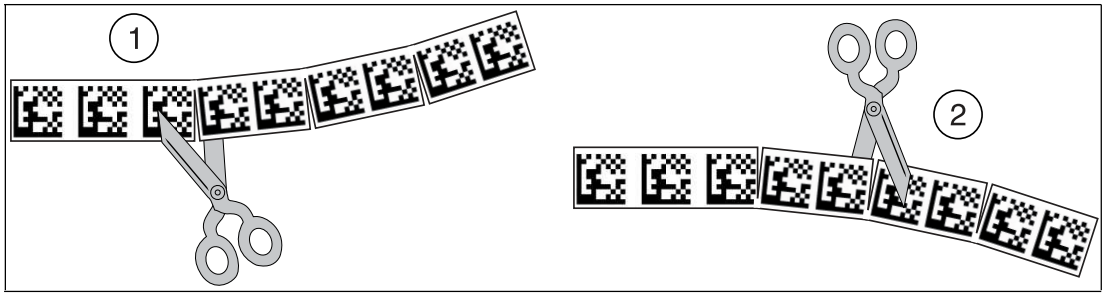
Stop edges

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.



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.

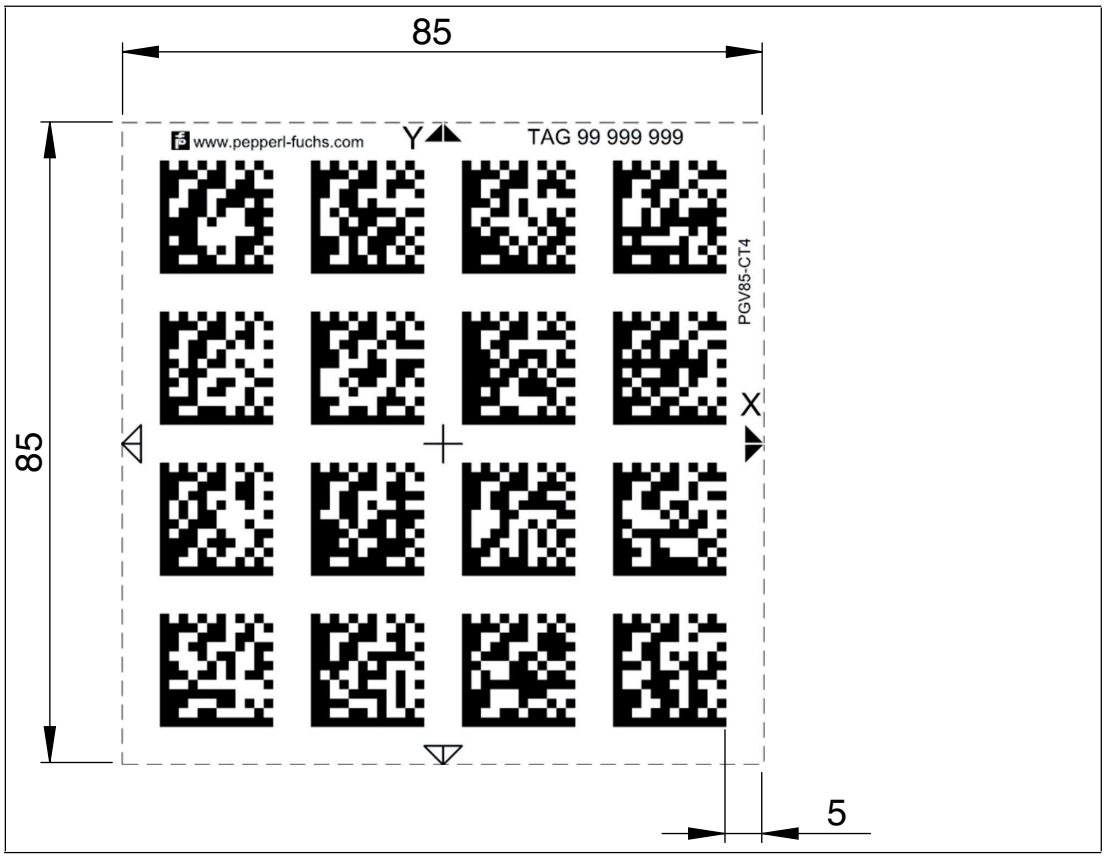


Figure 5.22 Data Matrix tag with the number 99999999 and position information

5.3 Electrical Connection

The reader is connected electrically via an 8-pin M12 x 1 connector on the side of the housing. The power is supplied via this connection. The configurable inputs and outputs on the reader are located at this connection.

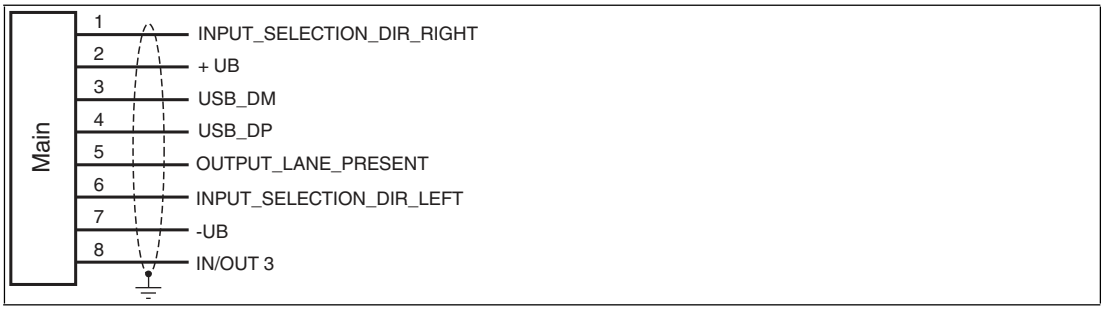


Figure 5.23

Connector Assignment

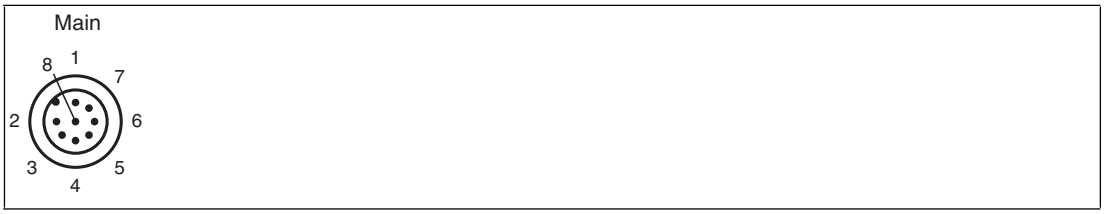


Figure 5.24

Color Assignment

Pepperl+Fuchs single-ended cordsets (female) are manufactured in accordance with EN60947-5-2. When using a type V19-... (see chapter 4.3) female cordset with an open cable end on the **Main** connection, the colors are assigned as follows:

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

Shielding Cables

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

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

- An equipotential bonding cable is not laid or cannot be laid.

2017-08

- A film shield is used.

The following points relating to shielding must also be noted:

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

Additional Ground Connection

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

5.4 PROFIBUS Connection

The reader is connected to PROFIBUS via a 5-pin M12 x 1 **Bus in** connector and a 5-pin M12 x 1 **Bus out** device socket, located on the side of the housing.

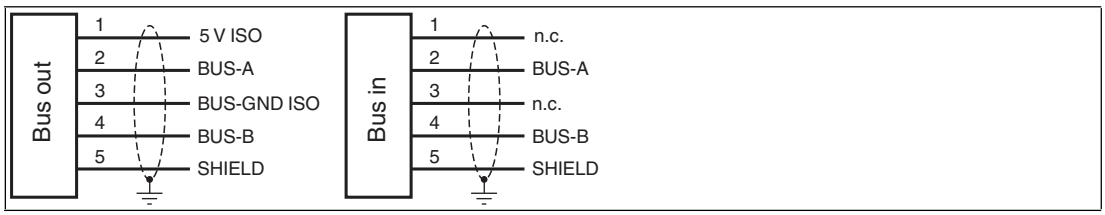


Figure 5.25

Connector Assignment

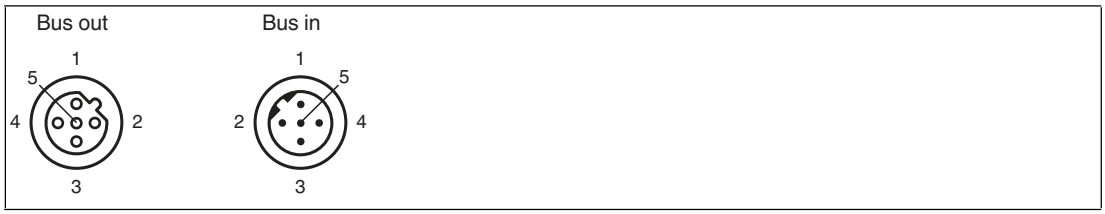


Figure 5.26

For details of suitable PROFIBUS cables, see chapter 4.3.

6 Commissioning

Warning!

Do not operate the power switch in a hazardous location.

6.1 Specifying the First Direction Decision

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 direction decision via the INPUT_SELECTION_DIR_RIGHT and INPUT_SELECTION_DIR_LEFT inputs. .

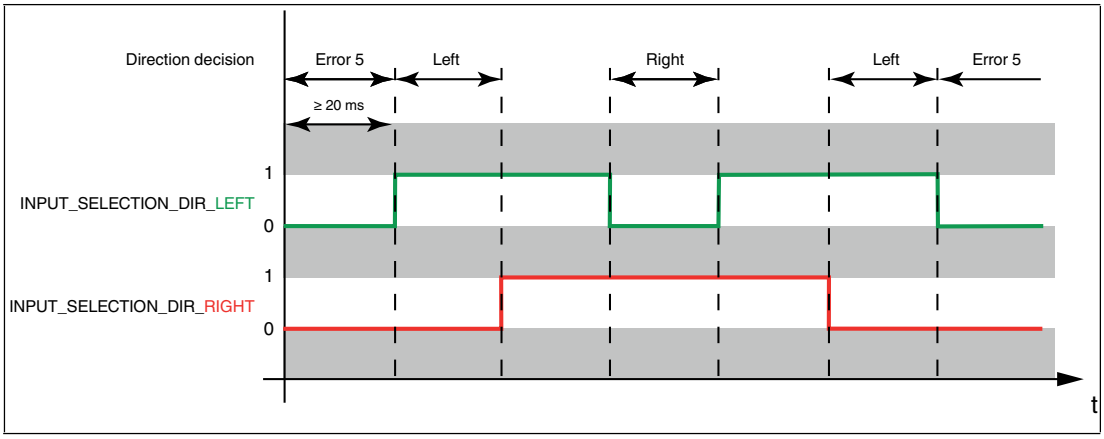


Figure 6.1

Direction Decision via Protocol

If a decision on the direction to take is sent to the read head via a protocol, the input signals are ignored until the read head is reset. .

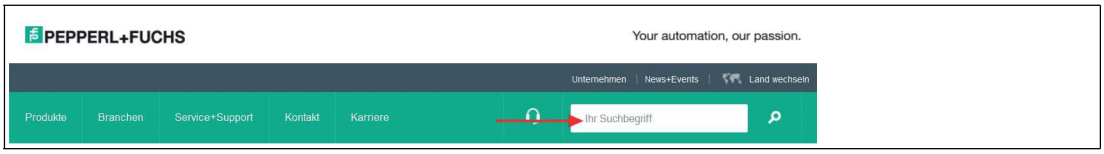
6.2 External Parameterization of the Fieldbus Address Using Code Cards

During external parameterization of the fieldbus address, the reader scans the special code cards optically and configures the relevant fieldbus address. Simply hold the corresponding code cards at the correct distance in front of the lens on the reader.

You can find the manual for the code cards for configuring the fieldbus address at www.pepperl-fuchs.com. See chapter 6.2.1.

6.2.1 Product documentation on the Internet

You can view all the relevant documentation and additional information on your product at http://www.pepperl-fuchs.com. Simply enter the product name or model number in the **Product/Key word search** box and click **Search**.



Select your product from the list of search results. Click on the information you require in the product information list, e.g., **Technical documents**.

A list of all available documents is displayed.

2017-08

7 Operation and Communication

7.1 Communication via PROFIBUS

7.1.1 General Information on PROFIBUS DP

The PROFIBUS DP is a standardized, open fieldbus, which enables data exchange between PLCs, PCs, operating and observation devices, and also sensors and actuators.

For more detailed information on the PROFIBUS DP, refer to the PROFIBUS standard EN 50170 and to the current literature on the subject (e.g. M. Popp, “The New Rapid Way to PROFIBUS DP” available (in German) from the PROFIBUS user organization).

Note!

The PROFIBUS User Organization e.V. Haid- and Neu-Str. (PNO) publishes informational brochures and a PROFIBUS product catalog (www.PROFIBUS.com).

7.1.2 PROFIBUS DP Communication Parameters

The communication parameters can be taken from the GSD file. The GSD file name is **pf0d7b.gsd**.

7.1.3 PROFIBUS DP features

The following is a list of the most important performance features of PROFIBUS DP:

- DP slave functionality with functions Data_Exchange, RD_Inp, RD_Outp, Slave_Diag, Set_Prm, Chk_Cfg, Get_Cfg, Global_Control, Set_Slave_Address.
- Modular DP slave device with one module each for writing and reading data.
- Transfer rates of 9.6 kbit/s, 19.2 kbit/s, 93.75 kbit/s, 187.5 kbit/s, 500 kbit/s, 1.5 Mbit/s, 3 Mbit/s, 6 Mbit/s and 12 Mbit/s auto-synchronizing.
- Adjustable device address 00h … 7Eh.

7.1.4 PROFIBUS DP functions

Function	Description	Master
Set_Prm	Transfers parameter data to a DP slave	Class 1
Chk_Cfg	Transfers the configuration data for testing to a DP slave	Class 1
Get_Cfg	Reads out the configuration data of a DP slave	Class 2
Data_Exchange	Sends output data to a DP slave device and requests input data from a DP slave	Class 1
RD_Inp	Reads the input data of a DP slave	Class 2
RD_Outp	Reads the output data of a DP slave	Class 2
Global_Control	Sends special commands to one or more DP slaves	Class 1
Slave_Diag	Reads the diagnostic information of a DP slave	Class 1
Set_Slave_Address	Modifies the device address	Class 2

7.1.5 PROFIBUS Modules

The PROFIBUS address for the reader can be modified in a non-volatile manner via the "Change station address" (Set_Slave_Add) PROFIBUS function when switching on in a point-to-point connection.

The default address for the reader is 3

1 word = 16 bit value

1 byte = 8 bit value

Position Data X Module

Size	Type	Content
2 words, consistent	Input data	32-bit X data MSB first MSB = **m**ost **s**ignificant **b**yte Resolution: 0.1 mm, 1 mm, 10 mm, binary coded At a resolution of 1 mm and 10 mm: L_{max} = 10.00 km = 10,000,000 mm

Response

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

2017-08

Position Data Y Module

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. 1. Bit = sign bit

Response

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

Angle Data Module

Size	Type	Content
1 word, consistent	Input data	16-bit angle data MSB first Resolution: 1° (default) Value range -16,384 to 16,384 Positive value: clockwise angle Negative value: anticlockwise angle **Example:** Resolution = 1° at an angle resolution of 360 Resolution = 0.1° at an angle resolution of 3600 0 in the event of an unknown angle

Response

Bit no.	Content Word 1 Angle
1	AGL00
2	AGL01
3	AGL02
4	AGL03
5	AGL04
6	AGL05
7	AGL06
8	AGL07
9	AGL08
10	AGL09
11	AGL10
12	AGL11
13	AGL12
14	AGL13
15	AGL14
16	AGL15

2017-08

Status module

Size	Type	Content
1 word	Input data	16-bit status

Response

Bit no.	Content Byte 1 Status	Function
1	ERR	Error message (error code in XP00–XP15); remaining bits = 0, see **Error Codes**
2	NP	No position information/OUT (XP = 0, YP = 0, SP = 0)
3	WRN	Warnings present, see **Warning Module**
4	CC	Control code present
5	0/1	Reserved
6	R	Follow right-hand spur
7	L	Follow left-hand spur
8	NL	No color lane present in the viewing window
9	RP	Repair tape detected
10	0/1	Reserved
...	...	Reserved
16	0/1	Reserved

Error Codes

Error code	Description	Priority
1	Reader rotated 180°	3
2	No clear position can be determined (difference between codes is too great, code distance incorrect, etc.)	4
5	No decision made regarding direction	2
> 1000	Internal error	1

Control Code No. Module

Size	Type	Content
1 words, consistent	Input data	Last control code Last control code no.

Response

Bit no.	Content Word 1 Last control code data
1	CC00
2	CC01
3	CC02
4	CC03
5	CC04
6	CC05
7	CC06
8	CC07
9	CC08
10	CC09
11	CC10
12	CC11
13	CC12
14	CC13
15	CC14
16	CC15

2017-08

Warning Module

Size	Type	Content
1 word, consistent	Input data	Last warnings Last warning no.

Response

Bit no.	Content Word 1 Last warning data	Warning data set description
1	WRN00	A code with non-PGV content was found
2	WRN01	Reader too close to code tape
3	WRN02	Reader too far from code tape
4	WRN03	Y position too large. The sensor is just before OUT
5	WRN04	Y position too small. The sensor is just before OUT
6	WRN05	The reader is rotated or tilted in relation to the code tape
7	WRN06	Low level of code contrast
8	WRN07	Repair tape detected
9	WRN08	Temperature too high
10	WRN09	Reserved
11	WRN10	Reserved
12	WRN11	Reserved
13	WRN12	Reserved
14	WRN13	Reserved
15	WRN14	Reserved
16	WRN15	Reserved

Table 7.1 If no warnings are present, all bits in the warning data set are set to 0.

7.1.6 Global Primary Data

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

Designation	Function	Parameter data	Primary data
X resolution	Multiplier for the length in the direction of the X coordinate	Resolution	0.1 mm **1 mm** 10 mm
Y resolution	Multiplier for the length in the direction of the Y coordinate	Resolution	0.1 mm **1 mm** 10 mm
Angle resolution	Multiplier for the angle output	Resolution	-16,384 – **0** – 16,384 **360**
Horizontal offset	Offset in the direction of the X coordinate	Length	**0 mm** – ±10,000,000 mm
Vertical offset	Offset in the direction of the Y coordinate	Length	**0 mm** – ±10,000,000 mm
Angle offset	Line of vision offset	Angle	-16,383 – **0** – 16,383
No position value X	X value if no code tape is visible	X data at "No Position"	Last valid position **specified value** (**0** – 0xFFFF FFFF$_{hex}$)
No position value Y	Y value if no code tape is visible	Y data at "No Position"	Last valid position **specified value** (**0** – 0xFFFF FFFF$_{hex}$)
No position value angle	Angle output if no colored tape is visible	Angle data at "No Position"	Last valid angle **specified angle** (**0** – 0xFFFF$_{hex}$)
Bandwidth	Width of the colored tape	Width	10 mm – 40 mm **18 mm**
Color	Color of the tape	Color	1 = blue (RAL 5015) **2 = green** (RAL 6032) 3 = red (RAL 3001) 4 = Yellow (RAL 1021)

Table 7.2 **Bold** = default values

2017-08

7.2 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".

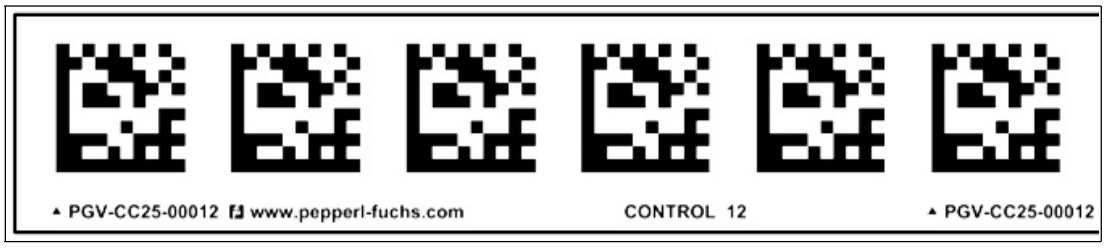


Figure 7.1 PGV-CC25-0012

The illustration shows part of control code #12

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

7.3 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.

2017-08

8 Appendix

8.1 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**

FACTORY AUTOMATION – SENSING YOUR NEEDS

Worldwide Headquarters
Pepperl+Fuchs GmbH
68307 Mannheim · Germany
Tel. +49 621 776-0
E-mail: info@de.pepperl-fuchs.com

USA Headquarters
Pepperl+Fuchs Inc.
Twinsburg, Ohio 44087 · USA
Tel. +1 330 4253555
E-mail: sales@us.pepperl-fuchs.com

Asia Pacific Headquarters
Pepperl+Fuchs Pte Ltd.
Company Registration No. 199003130E
Singapore 139942
Tel. +65 67799091
E-mail: sales@sg.pepperl-fuchs.com

www.pepperl-fuchs.com

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