MANUAL

Safe Position Detection with PCV100-F200-B17-V1D-6011

Data Matrix Positioning System for TIA Portal
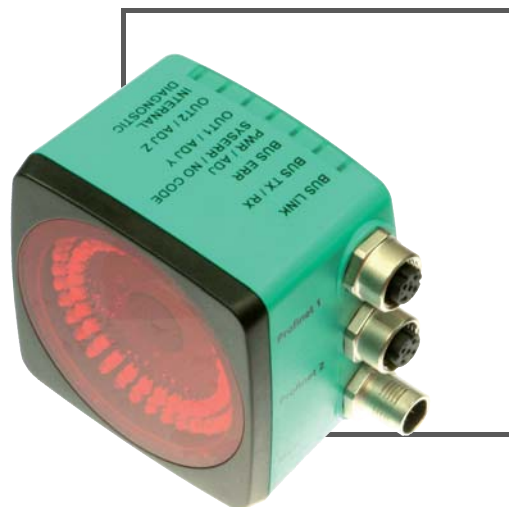
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1 Introduction

1.1 Content of this Document

This document contains information required to use the product in the relevant phases of the product life cycle. This may include information on the following:

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

Note!

Visit www.pepperl-fuchs.com to access further documentation for full information about the product.

The documentation comprises the following parts:

- This document
- Datasheet

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

- EU-type examination certificate
- EU declaration of conformity
- Attestation of conformity
- Certificates
- Control drawings
- Instruction manual
- Other documents

1.2 Target Group, Personnel

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

Only appropriately trained and qualified personnel may carry out mounting, installation, commissioning, operation, maintenance, and dismounting of the product. The personnel must have read and understood the instruction manual and the further documentation.

Prior to using the product make yourself familiar with it. Read the document carefully.

1.3 Symbols Used

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

Warning Messages

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

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

Danger!

This symbol indicates an imminent danger.

Non-observance will result in personal injury or death.

Warning!

This symbol indicates a possible fault or danger.

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

Caution!

This symbol indicates a possible fault.

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

Informative Symbols

Note!

This symbol brings important information to your attention.

Action

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

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2 Product Description

To ensure safe position detection, two PCV100-F200–B17-V1D-6011 readers are used based on the Data Matrix code. The two readers for the reflected light positioning system are fitted at a defined distance from one another to ensure safe position detection. The readers are connected to a fail-safe SIMATIC CPU S7–1500 via PROFINET.

The position values determined by the readers are processed in the control panel. The control panel uses these values to determine a safe position. The data is evaluated by two program modules created using Step 7 Safety (TIA Portal). One module determines the safe position around continuous code tapes, the other module determines the safe position in the case of code jumps.

For applications focused on safety, with TIA program modules it must be possible to provide a safety function in line with EN ISO 13849–1 that you can then have certified.

2.1 System Requirements

■ SIMATIC S7 Safety PLC version S7–1510 S and up.

The application can be used for the SIMATIC Step 7 Safety TIA Portal.

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3 Installation

3.1 Mechanical Structure

Secure the two readers on a moving part of the system such that they are mechanically stable. The readers must be secured at a defined distance from one another. Both readers must read the same code tape.

The maximum distance is 5000 mm.

The master reader returns the position value for outputting the position. A second control reader verifies the position. Mount the control reader in a position rotated by 180°. Mount the master reader in the main conveying direction at the front and the control reader at the back. If necessary, you can invert the mounting.

Attach the code tape in the main conveying direction ascending. In case of breaks in the support rail, e.g., due to track switches or expansion joints, the code tape must be interrupted for 20 mm (= 2 grids on the code). The area of the code tape between 0 mm and 50 mm must not be used. Note that in the case of code jumps (code tape beginning with a new position value), the counting direction of the code tape is the same on both sides of the code jump. This applies in particular to code jumps at moving transitions (track switches, jacks, rotary tables). A maximum of one code jump is permitted between the two readers.

For details of further requirements with regard to routing the code tape, securing the device and handling the electrical connection of the readers, refer to the manual for the readers. The manual "PCV...-F200-B17-V1D" can be found on the Pepperl+Fuchs website at www.pepperl-fuchs.com.

Safe Position Detection PCV…-F200-B17-V1D — Example

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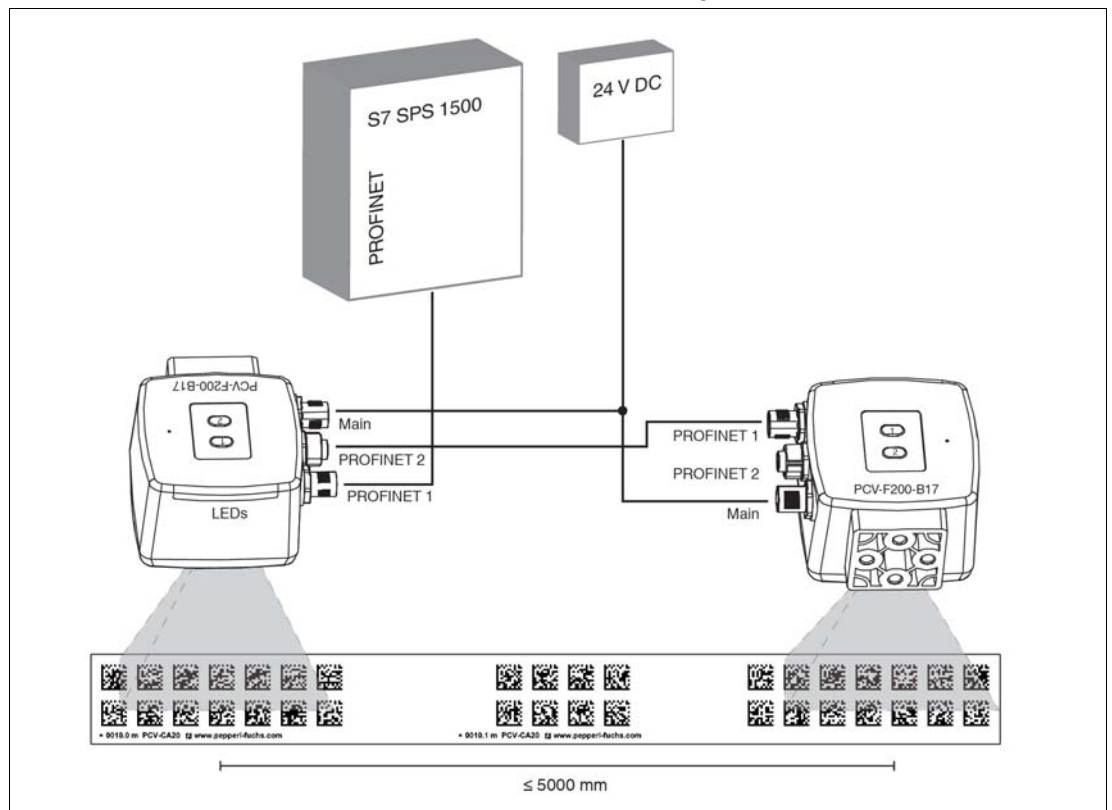
3.2 Electrical Connection

The PCV... reader is connected to the side of the housing by means of an 8-pin M12 x 1 connector plug. This connection is used to provide the power supply and communicate with the Vision Configurator. The configurable inputs and outputs for the reader are also available on this connection.
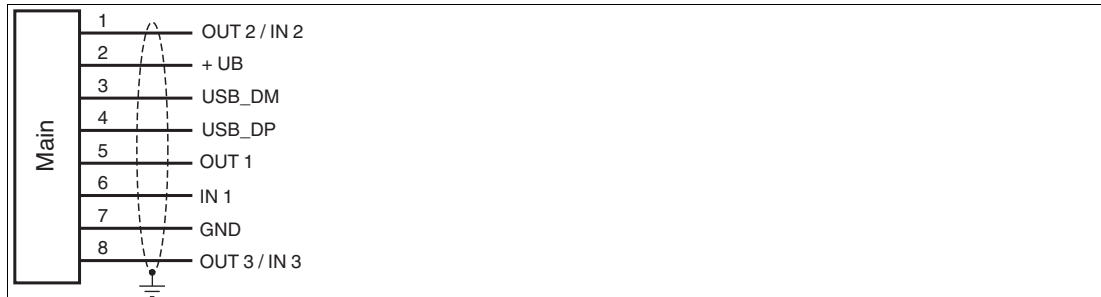

Figure 3.1

Connector Assignment

Figure 3.2

Color Assignment

Pepperl+Fuchs single-ended female cordsets are manufactured in accordance with EN 60947-5-2. When using a type V19-... single-ended female cordset with an open cable end () 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

Communication

PROFINET is used for communication.

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

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

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

The following points relating to shielding must also be noted:

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

Additional Ground Connection

Order Designation	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.

3.3 PROFINET Connection

The PCV... read head is connected to PROFINET via two 4-pin, D-coded device sockets, M12 x 1, **PROFINET 1** and **PROFINET 2**, on the side of the housing.
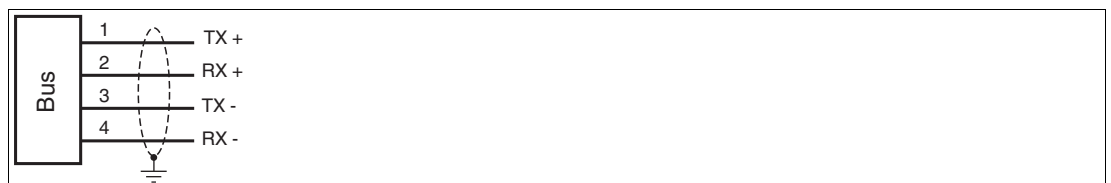

Figure 3.3

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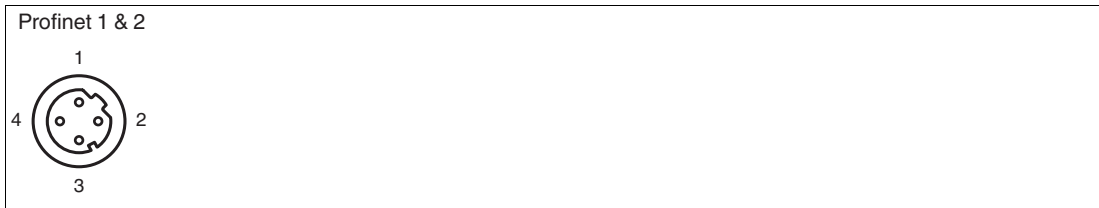
Connector Assignment

Figure 3.4

For details of suitable PROFINET cables, .

3.4 PLC Hardware Configuration

Modules Status_1 and X-Position_1 are required as a minimum when configuring the hardware for the reader in order to ensure safe position detection. Additional modules for specific evaluations can be added if necessary.
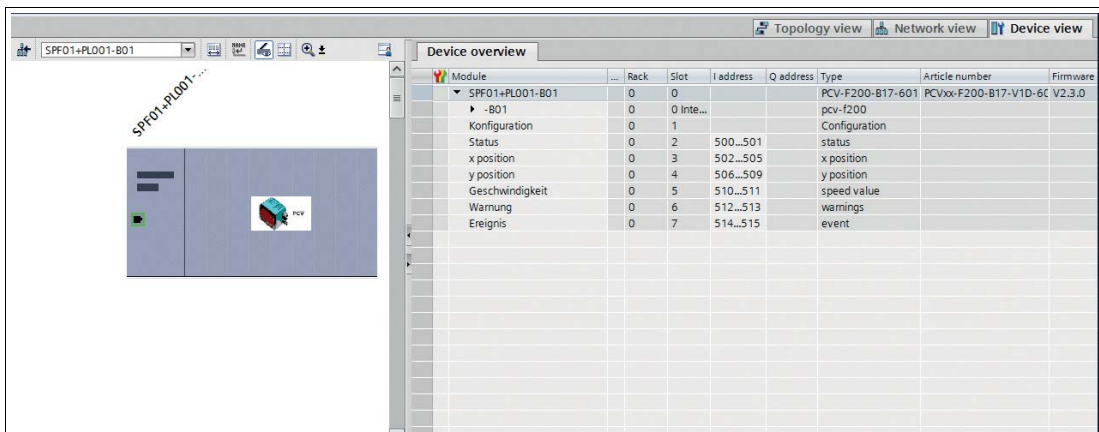

Figure 3.5   Modules contained in the hardware configuration

To determine the safe position, the following settings are required when configuring the readers:

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Orientation of Master Reader

Position the master reader at an angle of 0° in relation to the code tape. If the text on the back of the reader can be read from the same direction as the text on the code tape, the reader is in the correct position.

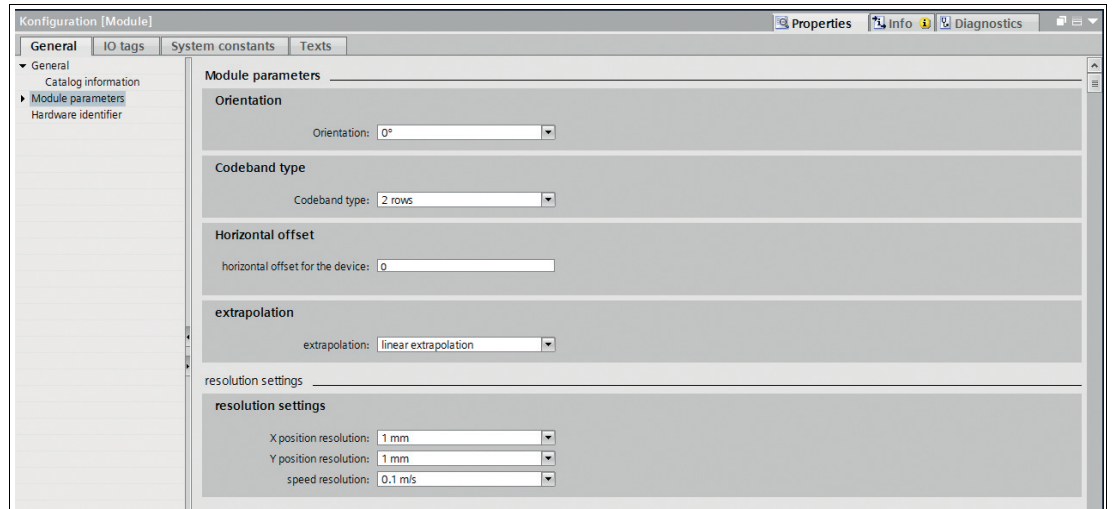The corresponding value must be specified in the module parameters.

Figure 3.6   Orientation of the master read head

Orientation of Control Reader

Position the control reader at an angle of 180° in relation to the code tape. When the position is correct, the text on the code tape appears on the reader if the text on the back of the reader is legible.

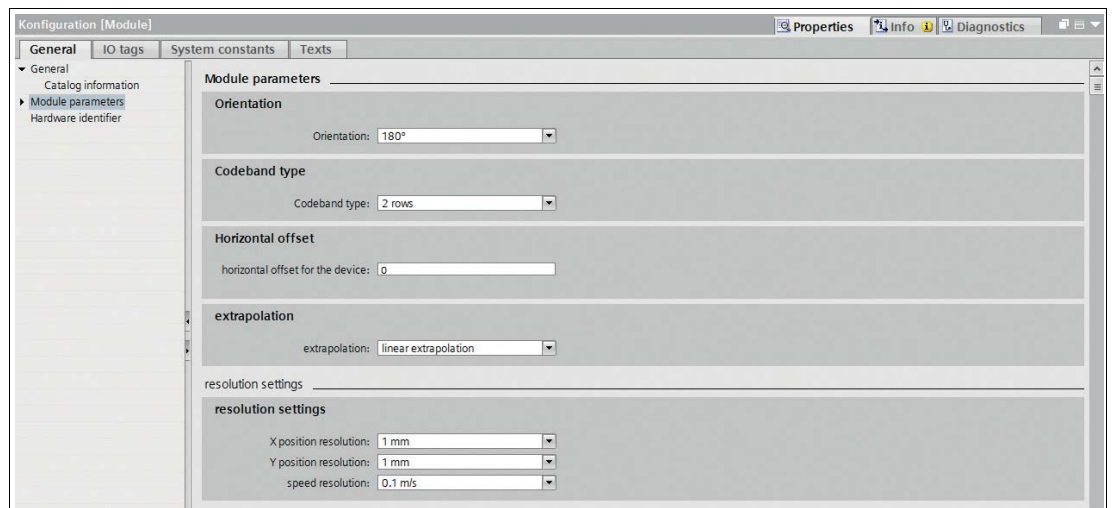Define the corresponding value in the module parameters.

Figure 3.7   Orientation of the control read head

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Resolution of X Position

The "Safe position detection" application is set up for a resolution of 1 mm for the X position. The default value must be set accordingly. The other values for the resolution can be configured individually as required.
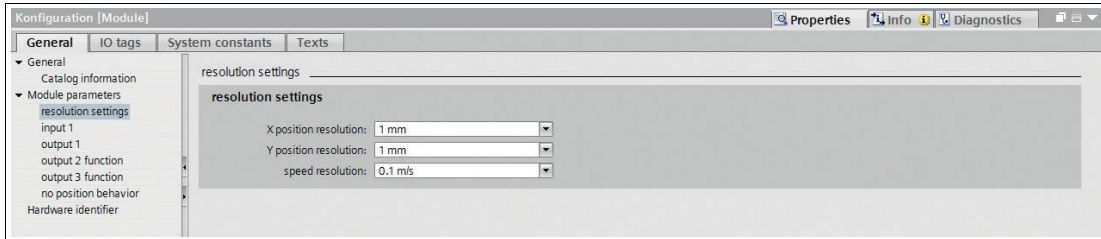

Figure 3.8   Default X position resolution settings

Behavior in the Event of a Missing Position

Define how the readers should respond if no position is detected. To do this, enter "0" as a fixed output value.
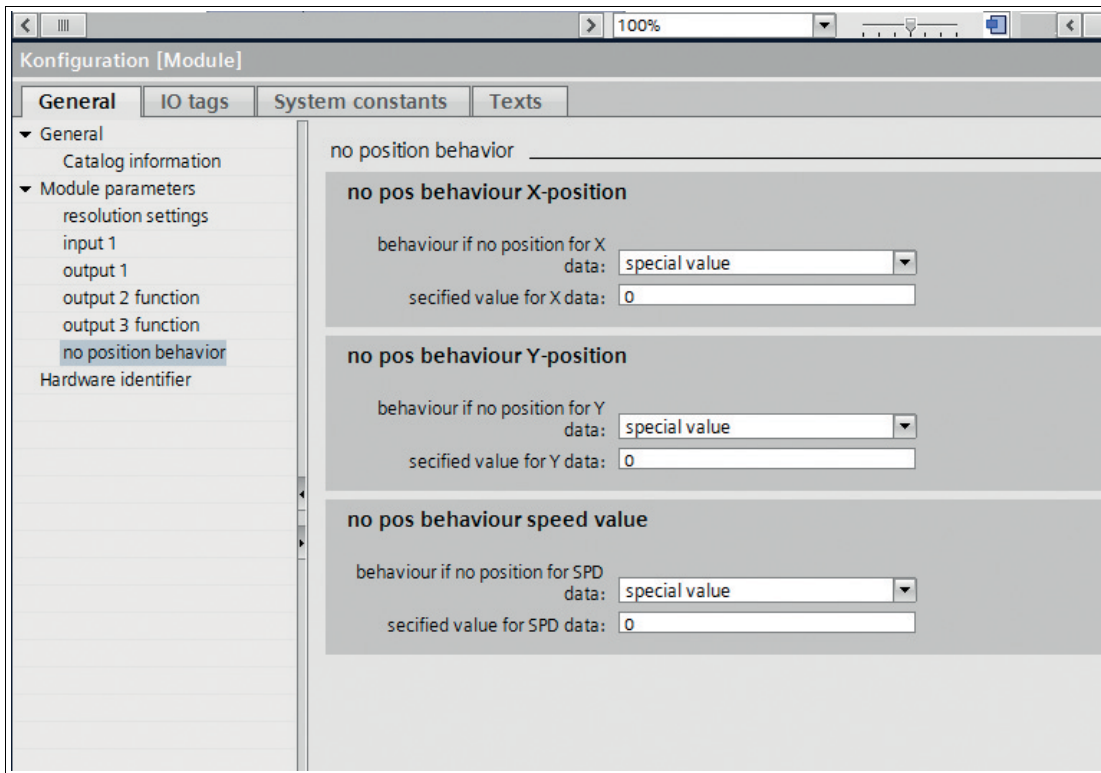

Figure 3.9   X position No Pos behavior

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4 Software

Basic Process

For the "Safe position detection" application, the F_SPOS program module processes the data from 2 readers. The status of the master reader is checked first during this process. If this status is free from errors (no errors and position detection OK), the position value of the master reader is written to the output value.

Once the status of the control reader has been successfully checked, the F_SPOS program module calculates the difference between the position value of the master reader and that of the control reader. The program module compares the differential value with the mechanical distance between the two readers. If both values are the same within a defined tolerance, the status "Position safe" is output. If this is not the case, the F_SPOS program module issues the status "Code jump evaluation".

Another program module, F_SPOS_Codesprung, evaluates the safe position around code jumps. This program module is called up once for each code jump. F_SPOS_Codesprung is only activated if F_SPOS has issued the status "Code jump evaluation".

The F_SPOS_Codesprung program module then compares the position differential of the two readers with a value calculated from the size of the code jump and the distance between the readers. If both values are the same within a defined tolerance, the status "Position safe" is output.

A general "Position safe" message is generated through a logical "OR" link between the "Position safe" status values determined by the two program modules.

For details, see the "Safe position detection" and "Safe response to code jumps" block diagrams below.

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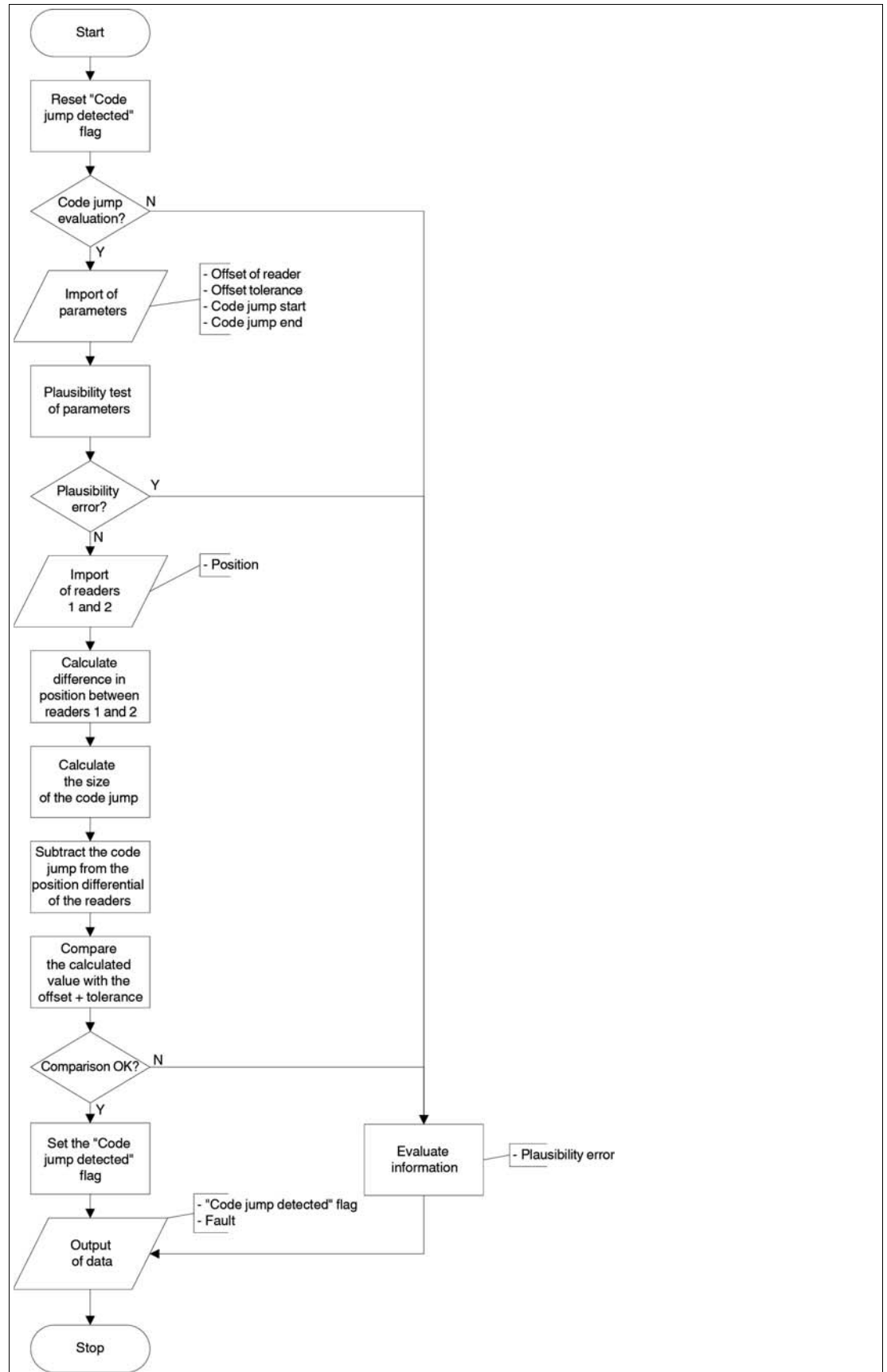Figure 4.1   Block diagram for safe position detection

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Figure 4.2   Block diagram for a safe response to code jumps

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Calling Up the Program Modules

F_SPOS program module: Safe position detection

As an initial step, call up the program module for safe position detection in the safety program on your control panel.
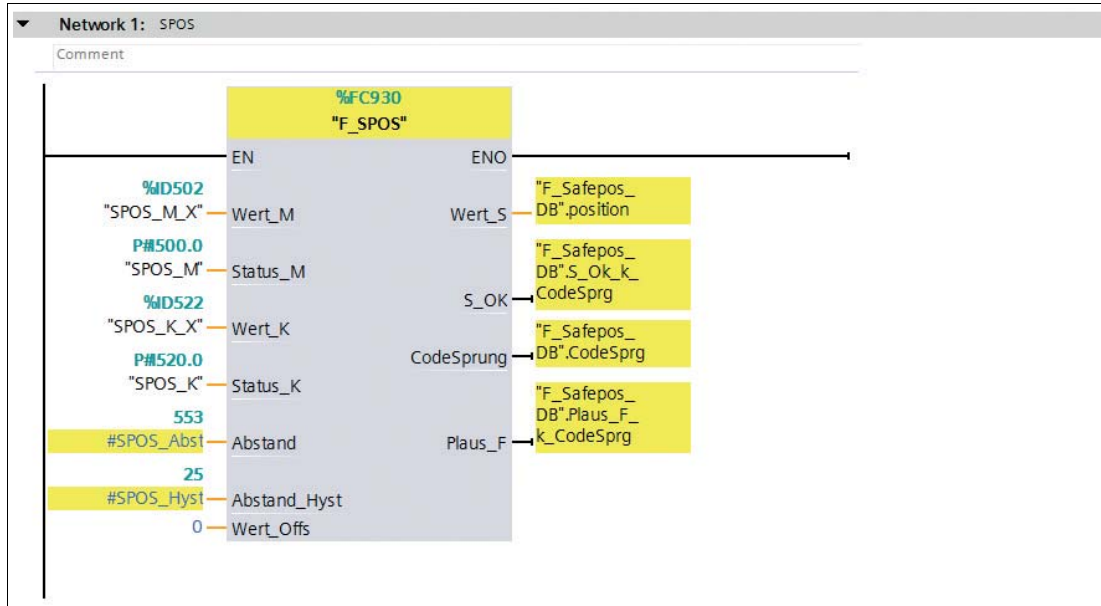

Figure 4.3   Calling up the F_SPOS component

The parameters for the F_SPOS program module must be configured as follows:

Inputs

Wert_M	DINT	Position value of the master reader
Status_M	UDT_PF_SPOS_STATUS	Status of the master reader as UDT at the hardware address for the status
Wert_K	DINT	Position value of the control reader
Status_K	UDT_PF_SPOS_STATUS	Status of the control reader as UDT at the hardware address for the status
Abstand	DINT	Mechanical distance between the master reader and control reader in mm (max. 5000 mm)
Abstand_Hyst	DINT	Permissible tolerance of the reader distance in mm (max. 30 mm)
Wert_Offs	DINT	Offset for the position output value; for compensating mechanical differences in mm (max. +/- 10 mm)

Reader distance and hysteresis

In practical terms, the distance is determined from the difference between the two measured values from the master reader and control reader. The Abstand_Hyst hysteresis is the compensation needed in case the readers move mechanically, e.g. in curves.

Wert_Offs position offset

The Wert_Offs position offset is only to be considered as such; only one value is used in the user program. The reference point for the means of transport is somewhere on the mounting point and allows accurate "calibration" up to +/- 10 mm.

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Outputs

Wert_S	DINT	Output position (position of master reader + Wert_Offs)
S_OK	BOOL	Position is safe
CodeSprung	BOOL	Code jump has been detected; calls up the modules for the code jump evaluation
Plaus_F	BOOL	Plausibility error; the parameters "Abstand", "Abstand_Hyst", or "Wert_Offs" are outside of the defined limit values

CodeSprung output

The CodeSprung output is the direct counterpart to the S_OK parameter. This output activates the functions to control actual code jumps that exist.

F_SPOS_Codesprung program module: Safe position monitoring in case of code jumps

The F_SPOS_Codesprung program module can only be used together with the F_SPOS program module. The program module must be programmed once for each code jump. The F_SPOS_Codesprung program module is only activated if F_SPOS has output the "CodeSprung" status.

As this output is only set if the status of the reader is OK, it is no longer possible to query statuses within this program module.

The jumps can be entered in F_SPOS_Codesprung. Depending on demand, the data structure of the program module must be extended in order to do this. The last valid position before the code jump and the first valid position after the code jump must always be entered during this process.

The code jump must always be > 20 mm as a minimum.

The size of the code jump itself is not limited and can cover the entire range.

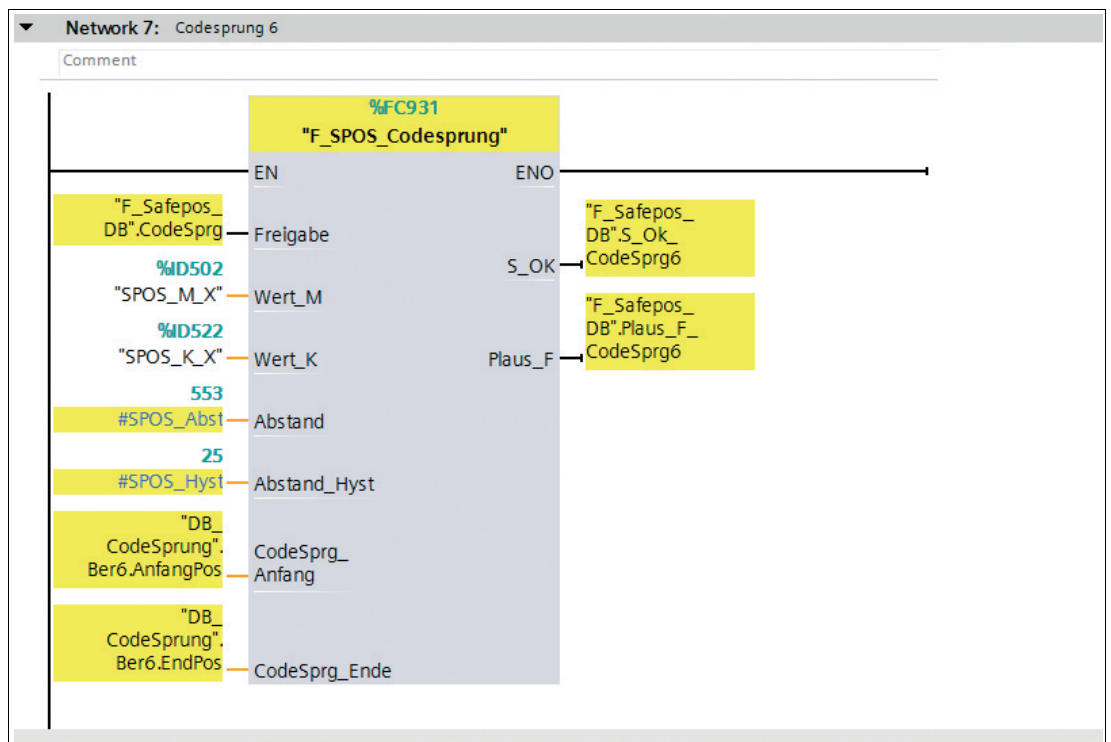A code jump can only be configured within the distance between the two readers.

Figure 4.4   Calling up F_SPOS_Codesprung component

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The parameters for the program module must be configured as follows:

Inputs

Freigabe	BOOL	Release of the function; the main function is activated using the "CodeSprung" output
Wert_M	DINT	Position value of the master reader
Wert_K	DINT	Position value of the control reader
Abstand	DINT	Mechanical distance between the master reader and control reader in mm (max. 5000 mm)
Abstand_Hyst	DINT	Permissible tolerance of the reader distance in mm (max. 30 mm)
CodeSprg_Anfang	DINT	Last code position before the code jump; in the example, activated with the value from DB. The numerical value can also be entered directly
CodeSprg_Ende	DINT	First code position after the code jump; in the example, activated with the value from DB. The numerical value can also be entered directly

Reader distance and hysteresis

In practical terms, the distance is determined from the difference between the two measured values from the master reader and control reader. The Abstand_Hyst hysteresis is the compensation needed in case the readers move mechanically, e.g. in curves.

Outputs

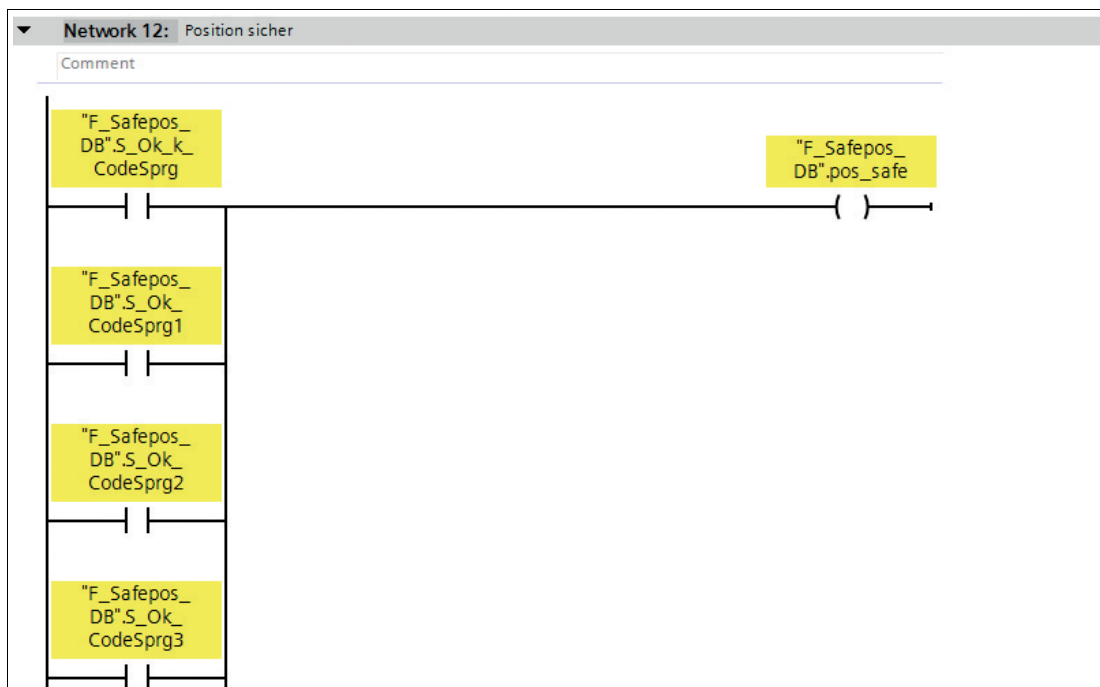|		
S_OK	BOOL	Position is safe
Plaus_F	BOOL	Plausibility error; the parameters "Abstand", "Abstand_Hyst", or "Wert_Offs" are outside of the defined limit values

Use of Safe Signals

Figure 4.5   Network of position safe "F_Safepos_"

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The "Position safe" status is generated through an "OR" link between the "Position safe" outputs from the F_SPOS and F_SPOS_Codesprung program modules. The position value output by the F_SPOS program module is only to be considered safe together with this information.

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