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1 Introduction

1.1 Content of this Document

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

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



Note

For full information on the product, refer to the further documentation on the Internet at www.pepperl-fuchs.com.



Note

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

The documentation comprises the following parts:

- This document
- Datasheet

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

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

1.2 Target Group, Personnel

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

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

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

1.3 Symbols Used

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

Warning Messages

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

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



Danger!

This symbol indicates an imminent danger.

Non-observance will result in personal injury or death.



Warning!

This symbol indicates a possible fault or danger.

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



Caution!

This symbol indicates a possible fault.

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

Informative Symbols



Note

This symbol brings important information to your attention.



Action

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

1.4 Intended Use

The VAZ-2E2A-G20 ZPA1 motor control module is a field device for controlling one or two consecutive zones of an accumulation conveyor line. The motor control module has two electronic outputs for controlling a DC roller motor each as well as two sensor inputs for detecting conveyed product, e.g., via light barriers.

Read through this manual carefully. Before mounting, connecting, and operating the ZPA motor control module, be sure to familiarize yourself with the device.

Operate the ZPA motor control module only as described in this manual to ensure that the device and the systems connected to the device work correctly.

1.5 General safety instructions

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

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

It is dangerous for the user to make changes and/or repairs. Additionally, doing so voids the warranty and excludes the manufacturer from any liability. In the event of any serious errors, stop using the device. Secure the device against unintended operation. To have the device repaired, return it to your local Pepperl+Fuchs representative or your sales center.



Note

Disposal

Electronic waste is dangerous. When disposing of the equipment, observe the current statutory requirements in the relevant country of use and local regulations.

1.6 Declaration of Conformity

This product was developed and manufactured in line with the applicable European standards and directives.



Note

A declaration of conformity can be requested from the manufacturer.

The product manufacturer, Pepperl+Fuchs Group, 68307 Mannheim, Germany, has a certified quality assurance system that conforms to ISO 9001.

ISO9001

2 Product Description

2.1 Use and Application

Zero Pressure Accumulation (ZPA)

During zero pressure accumulation, conveyed product is moved along a conveyor line in a controlled manner and collisions between the conveyed product is prevented. For this purpose, a conveyor line is divided into several sections or zones.

Each zone has its own drive, which can be activated independently of the neighboring zones. At the end of each zone, a zone sensor is installed that detects the conveyed product.

The accumulation conveyor logic ensures that there is only ever one conveyed product present in a zone. Conveyed products can therefore only be conveyed to the downstream zone once there is no more conveyed product in that zone. As long as the downstream zone is occupied, the conveyed product is stopped when it reaches the zone sensor and thus accumulates irrespective of subsequent conveyed product.

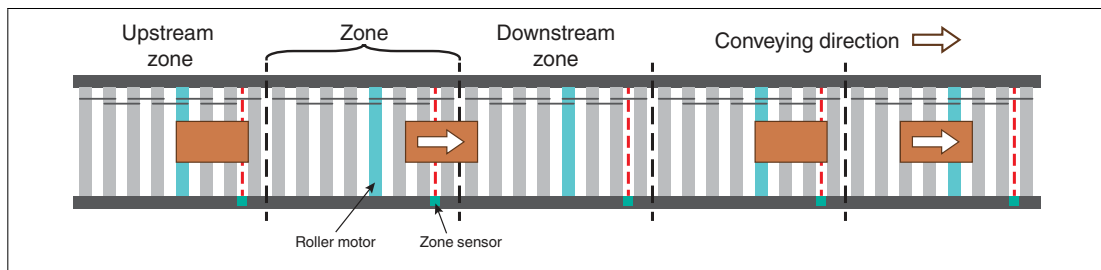


Figure 2.1 Conveying scenario for the example Standard ZPA operation mode

Benefits and Features of the ZPA Motor Control Module

The ZPA motor control module is easy to install and can be configured for a wide range of application situations. The main benefits and features of this module are:

- Compact housing for direct mounting in support profiles and cable ducts.
- Connection of the power supply using piercing technology via black AS-Interface flat cable.
- All other connections are implemented as connectors.
- Decentralized control: The field module contains the logic for zero pressure accumulation. A central control unit for the accumulation conveyor line is not required.
- Support for primary-secondary operation
- Control of two successive zones of an accumulation conveyor line using one module.
- Simple adjustment of the operating mode, the conveyor direction, the motor speed, and start/stop ramps via rotary switches.
- Display of status and diagnostic information via LEDs.
- Optimized for operation with DC roller motors type Interroll EC310.
- Support for conveyed product that is longer than one zone.
- Detection of accumulations leads to shutdown of the DC roller motors.

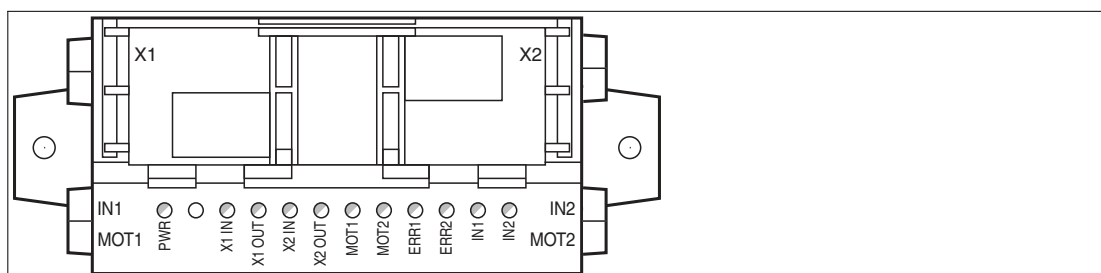


Figure 2.2

Function of the ZPA Motor Control Module

The ZPA motor control module is an intelligent field module that already contains the logic for zero pressure accumulation. It assumes the control of one or two consecutive zones powered by DC roller motors. The motors (MOT1, MOT2) and zone sensors (IN1, IN2) are connected directly with the ZPA motor control module for this purpose.

The ZPA motor control module has two separate zone controls. Both zone controls are logically coupled within the module. The access-side zone control can be deactivated within the module, so that the outgoing-side zone controls both DC roller motors as the primary zone. Only the sensor input (IN1 and IN2) of the primary zone is evaluated in this case.

A coupling with the neighboring zones is created via two interfaces for the zone coupling (X1, X2). This makes it possible to connect several ZPA motor control modules in series to create an accumulation conveyor line of any length.

The ZPA motor control module is powered via the black AS-Interface flat cable, which is connected using piercing technology without the need for tools. The ZPA motor control module is configured directly on the device using the three rotary switches (S1, S2, S3). In addition to various operating modes, the motor speed, the conveyor direction, and start and stop ramps can be configured.

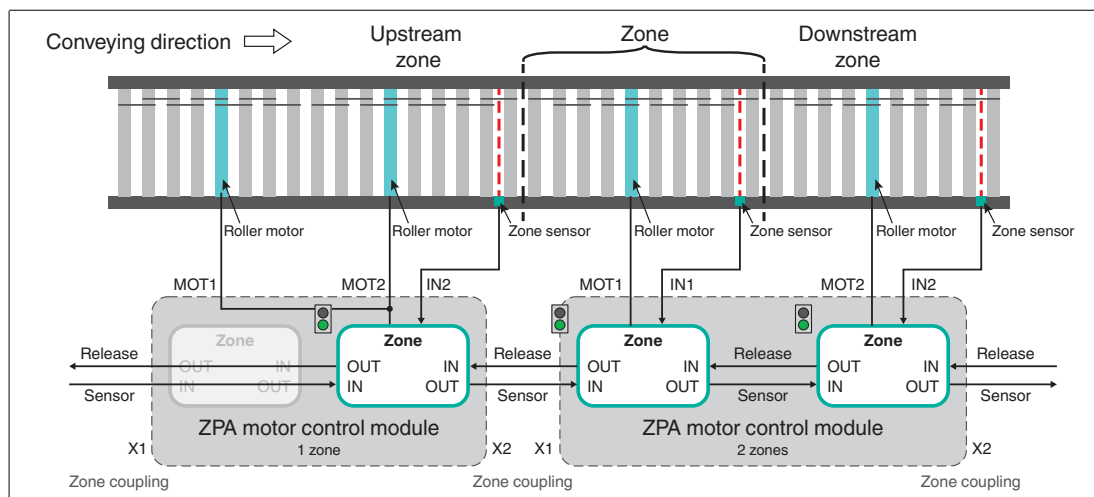


Figure 2.3

1-zone Operation/2-zone Operation

If the ZPA motor control module is to only control a single zone, the second zone logic must be manually deactivated in some operating modes. For this purpose, the rear zone in the conveyor direction is bypassed internally. The DC roller motor of this zone then runs synchronous to that of the zone in front (see previous figure). It can therefore support the other DC roller motor by driving the same zone and thereby doubling the drive power of that zone.

Zone coupling

The two interfaces for zone coupling (X1, X2) are used for receiving and transmitting information to and from neighboring zones. Additional ZPA motor control modules or other suitable communication partners can be connected via the zone coupling. The electrical signals are compatible with the standard 24 V IOs of a PLC. Conveyed product can therefore also be fed in and discharged at both ends of the accumulation conveyor line by a separate controller.

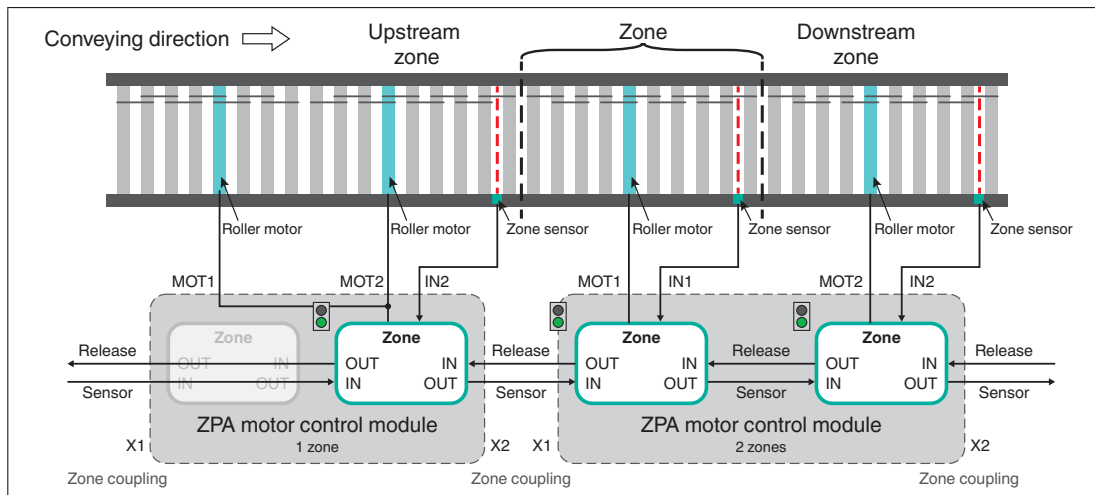


Figure 2.4

The interfaces for the zone coupling each consist of one signal input and one signal output. The meaning of the zone coupling signals depends on the selected conveyor direction and follows a simple principle:

Signal in the conveyor direction (zone sensor): A zone is communicating to the downstream zone whether conveyed product is located at its end. It therefore always corresponds to the signal of the zone sensor (e.g., light barrier).

Signal against the conveyor direction (release signal): A zone is communicating to the upstream zone whether conveyed product may enter. It thus represents the release signal. The release signal is determined by the accumulation conveyor logic and also set if no conveyed product has yet reached the zone sensor of the upstream zone.

The logic in the ZPA motor control modules expects the release signal to last until the conveyed product has left the zone. If the release signal is withdrawn before the conveyed product has left the zone, the motor is stopped until the release signal is set again.

This results in the following signal sequences:

The dashed lines show the situation in which the downstream zone withdraws the release signal for a short period of time. In this case, the DC roller motor is stopped immediately without any run-on time.

1. Conveyed product reaches the zone sensor before the release signal is set.

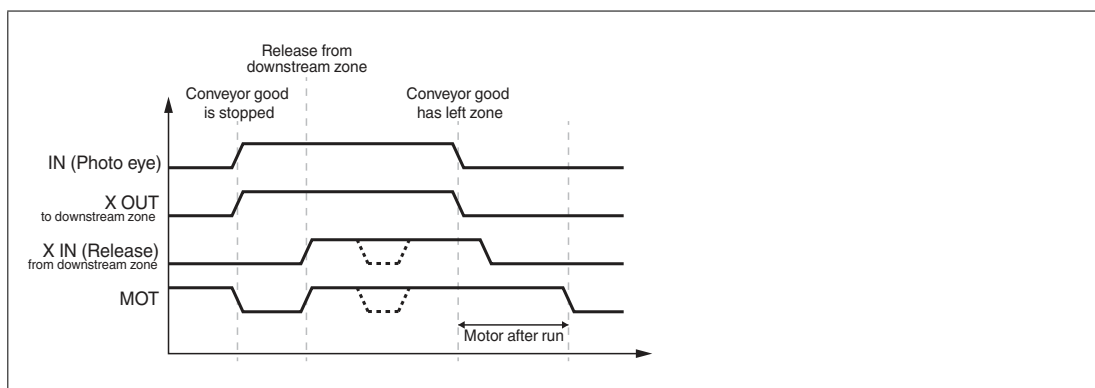


Figure 2.5

2. Release signal is set before the conveyed product reaches the zone sensor.

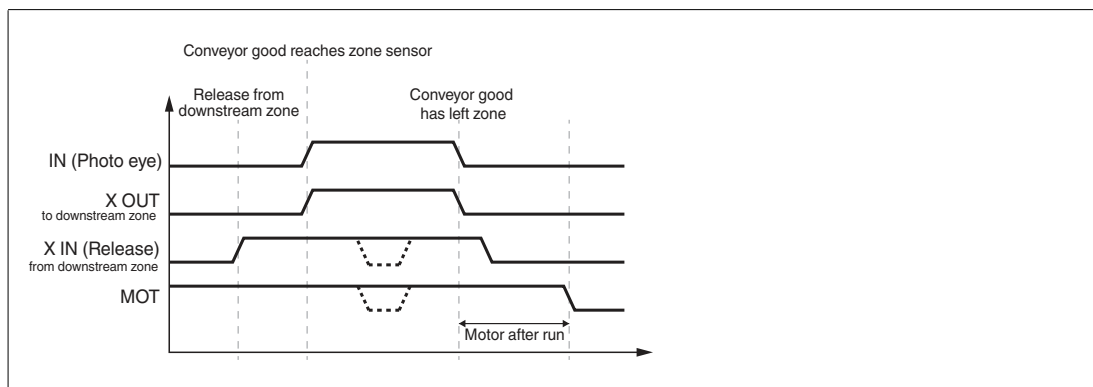


Figure 2.6

Since the ZPA motor control module can control two consecutive zones simultaneously, the zone coupling of these two zones is performed internally. The zone coupling to the upstream and downstream zones is routed via connections X1 and X2.

2.2 Operating Modes of the ZPA Motor Control Module

2.2.1 Overview

The ZPA motor control module has multiple operating modes that realize different accumulation conveyor logics. All operate zone coupling as per the preceding description and are therefore fully compatible with each other. The only exception to this rule are the two operating modes "direct control" and "direction control." These operating modes do not execute logic and are used for direct control of the connected DC roller motors via the zone coupling interfaces.

For the operation of only one zone, the mode for 1-zone operation must be selected in the case of some operating modes. Different time conditions detect accumulations on the conveyor line and shut down the DC roller motors if one or more conveyed products are stuck. All operating modes support the handling of conveyed product that is longer than the actual zone.

2.2.2 Standard ZPA

Conveyed product must have completely left the zone before the next conveyed product may enter. As soon as the outgoing conveyed product is no longer detected by the zone sensor, the release signal is set. This operating mode thereby realizes zero pressure accumulation with single accumulation and single release. It ensures a strict separation of the conveyed product while maintaining the maximum safety distance.

The following example describes the sequence in the operating mode "Standard ZPA":

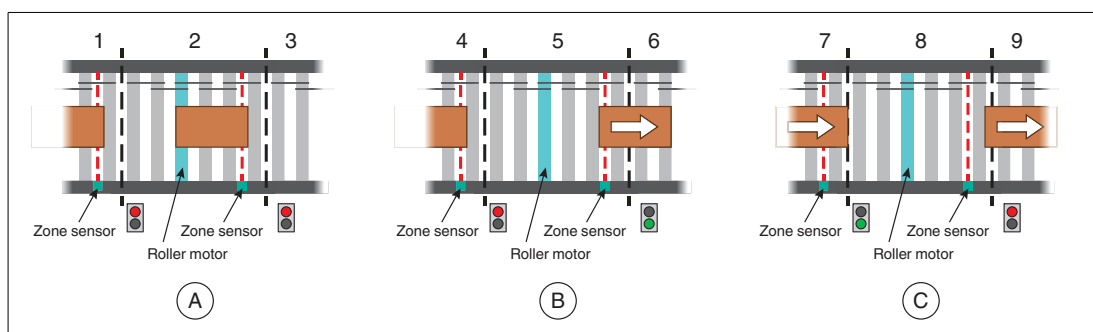


Figure 2.7

- Step A: Zone (2) has accumulated its conveyed product because downstream zone (3) has not set its release signal (red light). Because zone (2) is occupied, it also does not issue a release to upstream zone (1).
- Step B: Downstream zone (6) has set the release signal (green light) and the conveyed product is conveyed to the next zone (6). Because the conveyed product has not yet left the zone sensor (5), zone (5) does not issue a release to upstream zone (4).

- Step C: The conveyed product has left the zone sensor. Therefore, zone (8) sets the release signal for upstream zone (7) to allow the next conveyed product to be transported. Downstream zone (9) has now completely accepted the conveyed product and prohibits further product from entering by withdrawing the release.

The following time conditions are used in the operating mode "Standard ZPA" (see Chapter "Operating Behavior"):

- Leaving time
- Entry time
- Transportation time
- Motor run-on time
- Switch-on delay
- Search time

Please note that this operating mode distinguishes between 1-zone operation and 2-zone operation and separate settings exist for both operating modes.

2.2.3 Enhanced ZPA

This operating mode implements zero pressure accumulation with block accumulation or block release. A zone will let the following conveyed product enter once the conveyed product located in that zone receives the release signal to leave the zone. This reduces the safety distance between the conveyed product and increases the throughput. If the foremost zone of such an accumulation conveyor line receives a release signal, the signal will be forwarded directly to the zones behind it. All accumulated conveyed product will be simultaneously transported to the next zone. However, in case of block release, it is always ensured that only one further conveyed product is conveyed into the zone. This conveyed product must then advance all the way to the zone sensor before the next conveyed product may be conveyed.

The following example describes the sequence in the operating mode "Enhanced ZPA."

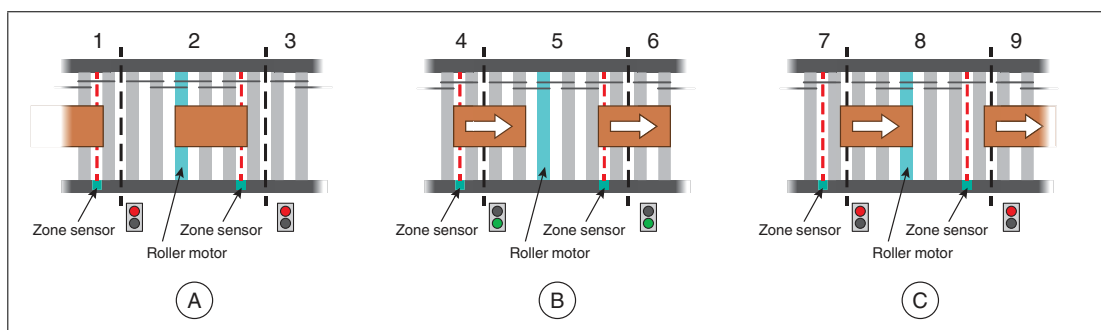


Figure 2.8

- Step A: Zone (2) has accumulated its conveyed product because downstream zone (3) has not set its release signal (red light). Because zone (2) is occupied, it also does not issue a release to upstream zone (1).
- Step B: Downstream zone (6) has set the release signal (green light) and the conveyed product is conveyed to the next zone (6). At the same time, the release signal is forwarded to upstream zone (4) and the following conveyed product is conveyed to zone (5). The conveyed product starts up at the same time.
- Step C: The previous conveyed product has departed zone (8), so downstream zone (9) withdraws its release. The following conveyed product has also already left upstream zone (7). Zone (8) moves the conveyed product to its zone sensor while it prevents other conveyed product from entering by resetting the release.

The following time conditions are used in the operating mode "Enhanced ZPA" (see Chapter "Operating Behavior"):

- Leaving time
- Entry time
- Transportation time
- Motor run-on time
- Switch-on delay
- Search time
- Release delay

Please note that this operating mode distinguishes between 1-zone operation and 2-zone operation and separate settings exist for both operating modes.

2.2.4 Transportation

In this operating mode, a zone forwards the release signal directly to the zones behind it. At the same time, the release signal also switches on the zone motor. The release is not set independently. Therefore, only a block release is carried out, which does not cause the conveyed product to be separated.

Connecting a zone sensor is optional in this operating mode. If a zone sensor is connected, the logic can detect accumulations and shut down the zone DC roller motor, if necessary. If the downstream zone is operating in a different mode, the zone sensor must be connected so that its status can be forwarded via the zone coupling.

The following example describes the sequence in the operating mode "Transportation":

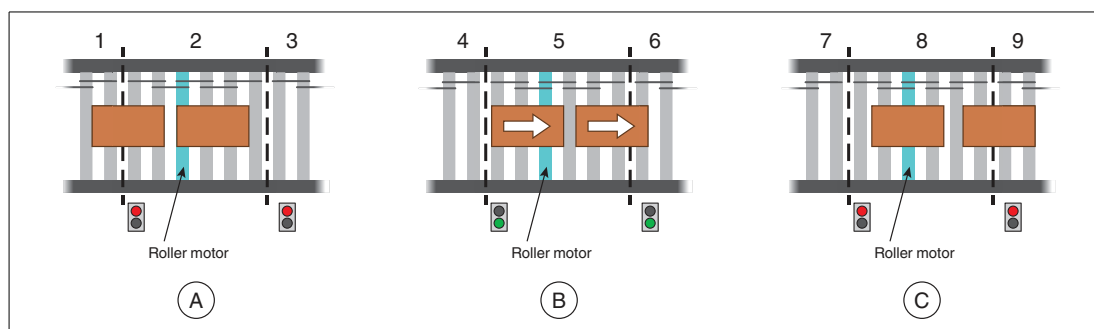


Figure 2.9

- Step A: Downstream zone (3) has not set its release signal (red light). Zone (2) therefore also does not set its release signal, meaning that the DC roller motor does not rotate.
- Step B: Downstream zone (6) has set the release signal (green light). Zone (5) immediately forwards the release signal to its upstream zone (4) and switches on its DC roller motor. The conveyed product starts up at the same time.
- Step C: Downstream zone (9) has reset its release signal. Zone (8) immediately resets its release signal and shuts down the DC roller motor.

The following time condition is used in the operating mode "Transportation" (see Chapter "Operating Behavior"):

- Leaving time (only if a zone sensor is connected)

This operating mode can be used without restriction in 1-zone and 2-zone operation. For this reason, there is no option for a separate switchover.

2.2.5 Long Zone - Single Zone

This operating mode is designed specifically for the operation of a zone in a range of Standard zones or Enhanced ZPA zones that is significantly longer than the surrounding zones. A longer zone like this would negatively affect the throughput of the entire conveyor line because the distance between the conveyed product is primarily determined by the zone length. This is why conveyed product is not separated in this case, which might cause the distance between the conveyed product to increase.

If there is a release signal, it is forwarded directly to the zones behind that zone and the DC roller motor of the zone is switched on (block release). If there is no conveyed product in front of the zone sensor, the zone will independently set the release signal to allow more conveyed product to enter. If no conveyed product has been detected for a certain period of time, the zone will shut down its DC roller motor. It will start its DC roller motor again if the status of the upstream zone sensor changes and conveyed product is conveyed into the zone.

The following example describes the sequence in the operating mode "Long Zone":

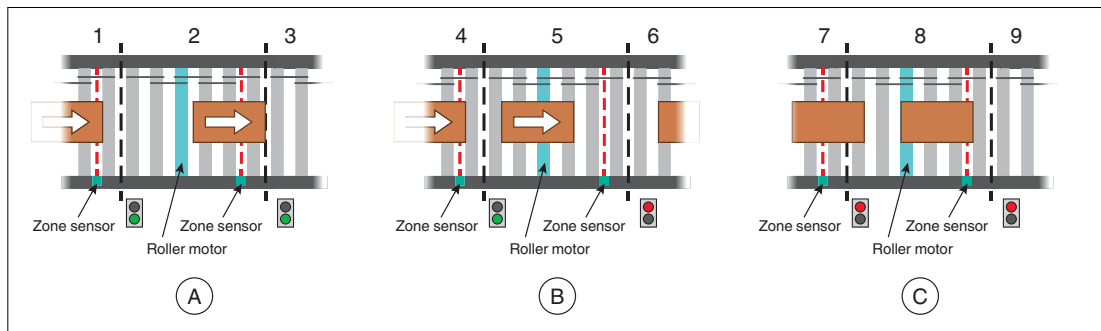


Figure 2.10

- Step A: Downstream zone (3) has set its release signal (green light). Zone (2) immediately forwards it to its upstream zone (1) and conveys its conveyed product to the next zone (3).
- Step B: Downstream zone (6) has reset its release signal (red light). Because no product has arrived in front of the zone sensor in zone (5) yet, it will retain its release and move the conveyed product to its final position. The subsequent conveyed product (4) can enter freely.
- Step C: The conveyed product has reached the zone sensor (8). Because the downstream zone (9) is still not issuing a release signal, zone (7) stops the conveyed product and resets its release signal to also stop the subsequent conveyed product.

The following time conditions are used in the operating mode "Long Zone" (see Chapter "Operating Behavior"):

- Leaving time
- Switch-on delay
- Idle mode delay

This operating mode always works in 1-zone operation, meaning that the DC roller motor of the rear zone is synchronized with that of the front zone and the rear zone sensor has no function.

2.2.6

Direct Control

In this operating mode, the DC roller motors connected to the ZPA motor control module can be controlled using external signals. In this way, the ZPA control module can, for example, be connected directly to a PLC that follows its own logic for controlling the DC roller motors. The control signals are transferred via the inputs of the respective zone coupling interfaces. The outputs of the two zone coupling interfaces indicate the status of the zone sensors.

Connection	Signal	Meaning
X1	IN	Control signal for DC roller motor at MOT1 <ul style="list-style-type: none"> • Low: Motor is at a standstill • High: Motor is running
X1	OUT	Signal for zone sensor at IN1 <ul style="list-style-type: none"> • Low: No conveyed product detected • High: Conveyed product detected
X2	IN	Control signal for DC roller motor at MOT2 <ul style="list-style-type: none"> • Low: Motor is at a standstill • High: Motor is running
X2	OUT	Signal of zone sensor at IN2 <ul style="list-style-type: none"> • Low: No conveyed product detected • High: Conveyed product detected

Table 2.1

2.2.7 Direction Control

This operating mode supplements the "Direct Control" operating mode with the option of reversing the direction of rotation of the connected DC roller motors via an external signal. One input controls both DC motor rollers while the other input reverses their configured direction of rotation.

The "Direction Control" operating mode will be supported from firmware version V.26.

Connection	Signal	Meaning
X1	IN	Control signal for DC roller motors at MOT1 and MOT2 <ul style="list-style-type: none"> • Low: Motor is at a standstill • High: Motor is running
X1	OUT	Signal for zone sensor at IN1 <ul style="list-style-type: none"> • Low: No conveyed product detected • High: Conveyed product detected
X2	IN	Direction reversal for DC roller motors at MOT1 and MOT2 <ul style="list-style-type: none"> • Low: Motors rotate in the direction configured via S2 • High: Motors rotate in the opposite direction to that configured via S2
X2	OUT	Signal of zone sensor at IN2 <ul style="list-style-type: none"> • Low: No conveyed product detected • High: Conveyed product detected

Table 2.2

2.2.8 Secondary

In this operating mode, the ZPA motor control module works as a secondary module to a downstream primary module. Both motors of the secondary module are switched synchronously to the motors of the primary module. The zone of the primary module is extended by the zone of the secondary module. The signals of the backward zone coupling of the primary module are transmitted to the upstream zone by the secondary module. The zone sensors of the secondary module have no function in this operating mode and do not need to be connected.

All operating modes of the ZPA motor control module except "Direct Control" and "Direction Control" can be used as the primary module. No special settings are required on the primary module. Switching to the primary module takes place automatically as soon as the upstream ZPA motor control module has been configured as a secondary module.

Any number of secondary modules can be operated with one primary module. Each secondary module corresponds to a ZPA motor control module. The connected secondary modules increase the zone length that the primary module controls. The following time conditions for the primary module and the connected secondary modules are added together. Up to 4 secondary modules are taken into account.

1. Search time
2. Transportation time
3. Idle mode delay

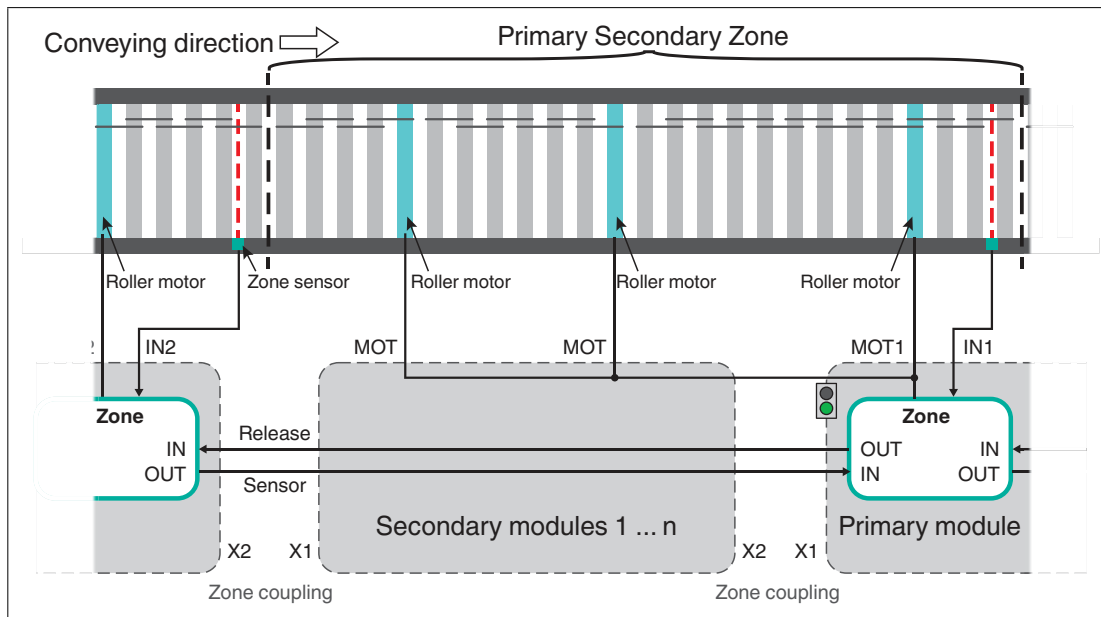


Figure 2.11

Please note that the zone couplings between the primary module and secondary modules operate in secondary mode and therefore do not carry any PLC-compatible zone coupling signals. If the zone coupling of a secondary module is not connected to a compatible primary module, the corresponding LED "X1 IN" or "X2 IN" flashes and the ZPA motor control module has no function.

The "Secondary" operating mode is supported from firmware version V.28 (primary/secondary module).

2.3 Indicators and Operating Elements

2.3.1 LED Indicators

Overview

The LEDs on the ZPA motor control module display the following information:

- Firmware version (only immediately after switching on),
- Setting of the rotary switch (only immediately after switching on),
- Status of the power supply,
- Switching states of the connected zone sensors,
- Operating/fault state of the connected DC roller motors,
- States of the zone coupling signals.

While the ZPA motor control module is starting up, the LEDs indicate the firmware version and the setting of the rotary switches using flash codes (binary code; least significant byte is on the right).

The meaning of the individual zone coupling signals depends on the conveyor direction and how the ZPA motor control module is connected. (See Chapter "Use and Application", Section "Zone Coupling").

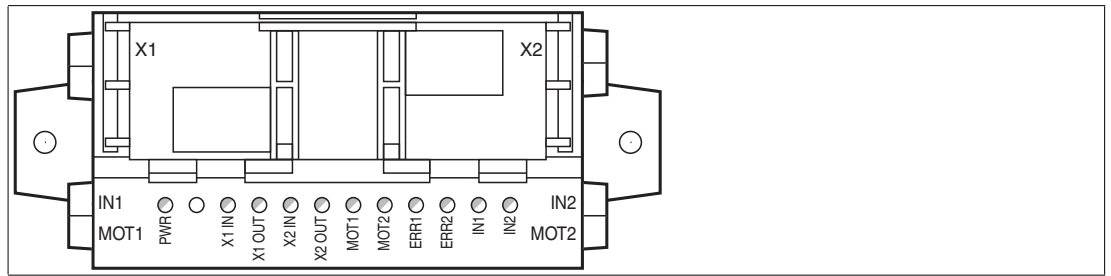


Figure 2.12

LED Behavior after Switch-On

In case of an invalid configuration or an invalid operating mode, the four left LEDs X1 ...X2 OUT will flash simultaneously.

While the ZPA motor control module is starting up, the LEDs indicate the firmware version and the setting of the rotary switches S1 ... S3 in four steps using flash codes. The LEDs provide the information in binary form. The least significant byte is on the right.

The two left LEDs X1 IN and X1 OUT indicate the respective step from 0 ... 3. The steps designate the type of information.

The remaining LEDs indicate the corresponding values for the steps, such as the setting of a rotary switch.

Each step is displayed for 1 s. After 4 s, all the steps have been displayed.

Step	Information displayed
0	Firmware version
1	S1 setting: Motor speed
2	S2 setting: Start/stop ramp and direction of rotation
3	S3 setting: Operating mode



Note

Motor Fuses Are Safety Fuses

For protection against short circuits, each DC roller motor is secured with its own safety fuse with a 5 A rated current. The fuses are not interchangeable. If a fuse is faulty, the module must be replaced.

LEDs for PWR, MOT1, MOT2, ERR1, ERR2, IN1, IN2

LED	Color	Description
PWR	Green	<ul style="list-style-type: none"> On = Power supply is OK Off = Power supply is not OK
MOT1	Yellow	Operating status of DC roller motor 1: <ul style="list-style-type: none"> On = Motor is active Off = Motor is at a standstill or running down as per set start/stop ramp
MOT2	Yellow	Operating status of DC roller motor 2: <ul style="list-style-type: none"> On = Motor is active Off = Motor is at a standstill or running down as per set start/stop ramp
ERR1	Yellow	Fault status of DC roller motor 1: <ul style="list-style-type: none"> On = Motor fault or no motor connected Flashing = Motor fuse 1 of the motor control module is faulty Off = No motor fault

LED	Color	Description
ERR2	Yellow	Fault status of DC roller motor 2: <ul style="list-style-type: none"> On = Motor fault or no motor connected Flashing = Motor fuse 2 of the motor control module is faulty Off = No motor fault
IN1		Switch state of zone sensor 1: <ul style="list-style-type: none"> On = Zone sensor has detected conveyed product (high level) Off = Zone sensor has not detected any conveyed product (low level)
IN2		Switch state of zone sensor 2: <ul style="list-style-type: none"> On = Zone sensor has detected conveyed product (high level) Off = Zone sensor has not detected any conveyed product (low level)

Table 2.3

Status LEDs for zone coupling: Conveyor direction from left to right

LED	Color	Description
X1 IN	Yellow	Input from interface 1: Status of zone sensor of upstream zone <ul style="list-style-type: none"> On = Zone sensor has detected conveyed product (high level) Off = Zone sensor has not detected any conveyed product (low level)
X1 OUT	Yellow	Output from interface 1: Release signal for upstream zone <ul style="list-style-type: none"> On = Release signal for upstream zone has been set (high level) Off = Release signal for upstream zone has not been set (low level)
X2 IN	Yellow	Input from interface 2: Release signal from downstream zone <ul style="list-style-type: none"> On = Release signal from downstream zone has been set (high level) Off = Release signal from downstream zone has not been set (low level)
X2 OUT	Yellow	Output from interface 2: Status of zone sensor at IN2 <ul style="list-style-type: none"> On = Zone sensor has detected conveyed product (high level) Off = Zone sensor has not detected any conveyed product (low level)

Table 2.4

Status LEDs for zone coupling: Conveyor direction from right to left

LED	Color	Description
X1 IN	Yellow	Input from interface 1: Release signal from downstream zone <ul style="list-style-type: none"> On = Release signal from downstream zone has been set (high level) Off = Release signal from downstream zone has not been set (low level)
X1 OUT	Yellow	Output from interface 1: Status of zone sensor at IN1 <ul style="list-style-type: none"> On = Zone sensor has detected conveyed product (high level) Off = Zone sensor has not detected any conveyed product (low level)
X2 IN	Yellow	Input from interface 2: Status of zone sensor of upstream zone <ul style="list-style-type: none"> On = Zone sensor has detected conveyed product (high level) Off = Zone sensor has not detected any conveyed product (low level)
X2 OUT	Yellow	Output from interface 2: Release signal for upstream zone <ul style="list-style-type: none"> On = Release signal for upstream zone has been set (high level) Off = Release signal for upstream zone has not been set (low level)

Table 2.5

2.3.2 Rotary Switches for Configuration

On the back of the device, there are three rotary switches for configuring

- Motor speed via S1
- Start/stop ramp and direction of rotation via S2
- Operating mode via S3

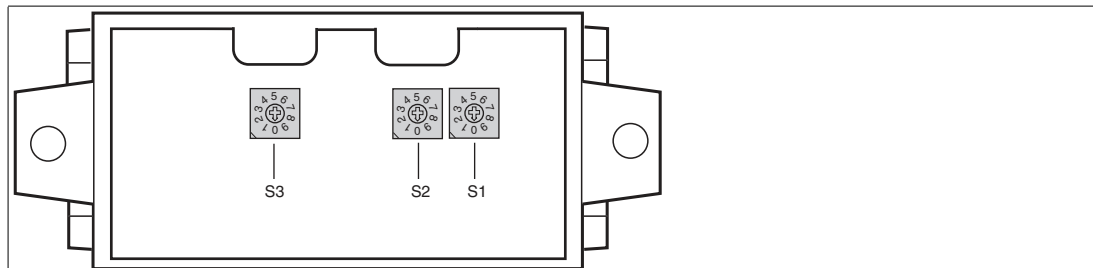


Figure 2.13



Note

Configuration Requires the Power Supply to Be Switched Off/On

The settings of the rotary switches are applied when the ZPA motor control module is switched on. When a change is made to the configuration, you will need to shut down the power supply to the ZPA motor control module and then switch it on again.

S1: Motor speed

Switch setting	Speed signal U_s
0	3.96 V
1	4.78 V
2	5.61 V
3	6.44 V
4	8.50 V
5	9.63 V
6	10.00 V
7	7.26 V
8	Reserved
9	Reserved

Table 2.6

S2: Start/stop ramp and direction of rotation

You can use rotary switch S2 to set the direction of rotation of the connected DC roller motors (conveyor direction) and configure a start/stop ramp for the acceleration at the same time.

Five start/stop ramps can be configured for each direction of rotation. The slope of the acceleration is constant and independent of the set maximum speed.

The ramp duration defines the time from stationary to maximum speed ($U_s = 10\text{ V}$), or from maximum speed to stationary. When the set motor speed is lower, the ramp duration is shorter as well.

The following diagram shows the start behavior of the start/stop ramp using the example of the setting "1000 ms."

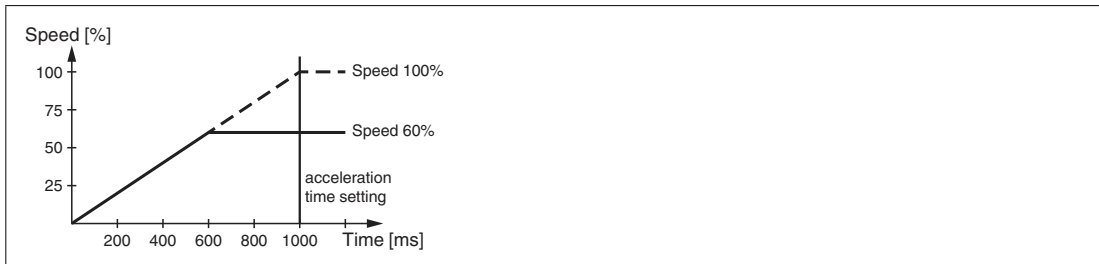


Figure 2.14

The direction of rotation setting defines not only the direction of rotation of the connected DC roller motors but also which of the two zones is the "downstream zone" and which is the "upstream zone." In this way, the conveyor direction is also defined.

For clockwise direction of rotation, the left zone (IN1, MOT1) is the "upstream zone."

For counterclockwise direction of rotation, the right zone (IN2, MOT2) is the "upstream zone."

- Switch position 0 ... 5: Clockwise direction of rotation (conveyor direction from left to right), $U_D = \text{High}$
- Switch position 6 ... 9: Counterclockwise direction of rotation (conveyor direction from right to left), $U_D = \text{Low}$

Switch setting	Ramp duration	Direction of rotation
0	0 ms	clockwise
1	500 ms	clockwise
2	1000 ms	clockwise
3	1500 ms	clockwise
4	3000 ms	clockwise
5	0 ms	counterclockwise
6	500 ms	counterclockwise
7	1000 ms	counterclockwise
8	1500 ms	counterclockwise
9	3000 ms	counterclockwise

S3: Operating mode

Depending on the application, you can select one of eight different operating modes for 1-zone control or 2-zone control. For 1-zone control (Single Zone), the inactive zone synchronizes its motor output with the active zone.

Switch setting	Operation Mode	1-/2-zone operation
0	Standard ZPA	2-zone operation
1	Enhanced ZPA	2-zone operation
2	Standard ZPA—Single Zone	1-zone operation
3	Enhanced ZPA—Single Zone	1-zone operation
4	Transportation	1-zone operation and 2-zone operation
5	Long Zone—Single Zone	1-zone operation
6	Direct Control	1-zone operation and 2-zone operation
7	Direction Control	1-zone operation
8	Secondary	1-zone operation
9	Reserved	-

Table 2.7

2.4 Interfaces and Connections

Connections: Inputs/Outputs

The sensors and motors are connected to the ZPA motor control module via cables with round M8 connectors:

- Sensors: socket, 4-pin
- Motors: socket, 5-pin

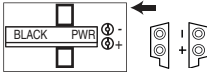


The signals for zone coupling are connected to the ZPA motor control module via cables with round M12 connectors.

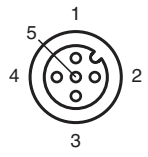
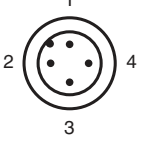
The exact meaning of the inputs and outputs of the signals for zone coupling depends on the connection of the ZPA motor control module (see Chapter "Use and Application," Section "Zone Coupling").

Power Supply

The power supply of the ZPA motor control module is provided using piercing technology with an AS-Interface flat cable via the PWR contacts of the ZPA motor control module.

Connector Assignment

Connection	Connector	Connector type/assignment
PWR		Power supply: black AS-Interface flat cable (2 x 1.5 mm ²) Two pins for piercing technology -: Negative power supply pole +: Positive power supply pole
IN1, IN2: sensor		Input: LF004-GS1-A in accordance with IEC/EN 61076-2-104 M8, 4-pin, socket, cap nut, coding A Matching female connector: LM004-Gx1-A or similar 1: IN+ sensor supply 2: Not used 3: IN- sensor supply GND 4: IN sensor signal
MOT1, MOT2: motor		Motor: NF005-SS1-B in accordance with IEC/EN 61076-2-104 M8, 5-pin, socket, snap-locking, coding B Matching female connector: NM005-Sx1-B or similar 1: MOT+ motor supply 2: DIR direction of rotation 3: MOT- motor supply GND 4: ERROR input for motor fault 5: SPEED speed signal (default value)

Connection	Connector	Connector type/assignment
X1: Zone coupling, interface 1		<p>X1 Zone coupling M12 round plug connector in accordance with IEC/EN 61076-1-101 M12, 4-pin, socket, screw-locking, coding A</p> <p>1: X1 IN input signal 2: X1 IN- input GND 3: X1 OUT output signal 4: X1 OUT- output GND 5: Not assigned</p>
X2: Zone coupling, interface 2		<p>X2 Zone coupling M12 round plug connector in accordance with IEC/EN 61076-1-101 M12, 4-pin, plug, screw-locking, coding A</p> <p>1: X2 OUT output signal 2: X2 OUT- output GND 3: X2 IN output signal 4: X2 IN- input GND</p>

3 Installation

3.1 Safety Information



Caution!

Risk of short circuit

Carrying out work while the system is energized may result in damage to the device.

- Always disconnect the supply voltage before carrying out work on the device.
- Only connect the device to the supply voltage once all work has been completed.

3.2 Preparation



Unpacking the Device

1. Check the packaging and contents for damage.
↳ In the event of damage, inform the shipping company and notify the supplier.
2. Check the package contents against your order and the shipping documents to ensure that all items are present and correct.
↳ Should you have any questions, direct them to Pepperl+Fuchs.
3. Retain the original packaging in case the device is to be stored or shipped again at a later date.

3.3 Mounting



Note

Note the Mounting Direction of the ZPA Motor Control Module

The ZPA motor control module is designed to be mounted between two conveyor zones. The mounting direction is such that the LEDs always point downward and the hinged cable guide upward. This ensures the correct assignment of the connected zones (right zone -> right-side connection, left zone -> left-side connection).

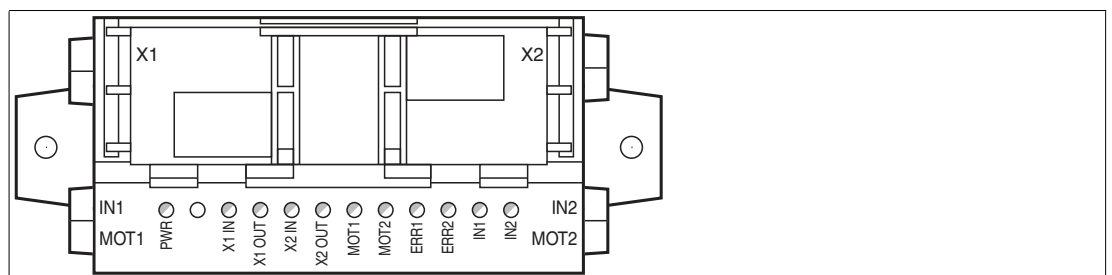
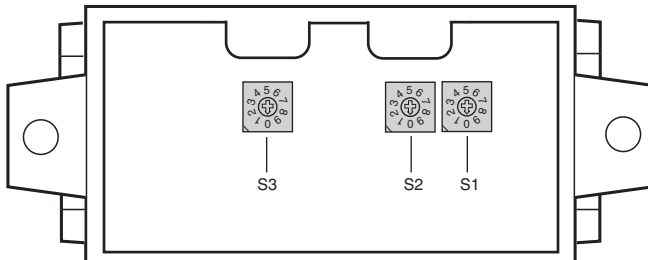


Figure 3.1



1. Set the rotary switches S1...S3 as per their desired application. (see Chapter "Product Description", Subsection "Indicators and Operating Elements").



3.4 Power Supply Connection

The power supply is connected to the ZPA motor control module via a black AS-Interface flat cable. The permissible supply voltage is 18 V ... 30 V.

The electric connection between the ZPA motor control module and flat cables is established via two metal pins using piercing technology. The flat cable is routed through a hinged cable guide. When closed, the cable guide is locked using a locking bracket and can be opened again without the need for tools.

The profiled flat cable has a narrow upper side (with a visibly offset profile edge) and a wide under side (profile edge not visible). The cable guide allows the flat cable to be inserted on both sides, for flexible connection of flat cables already laid in cable ducts. However, you must make sure that the profile edge always points to the motor control module. Mechanical reverse polarity protection prevents complete closure of the cable guide if the flat cable is inserted incorrectly.

Caution!



If a flat cable is inserted incorrectly, the ZPA motor control module will not work.

If the flat cable is inserted in the cable guide in the wrong direction, the voltage is inverted. The ZPA motor control module will not work. However, internal electrical reverse polarity protection protects it against breakage.



Connecting Flat Cables on the Narrow Side

The profile edge is visible from above.

1. Open the cable guide. To do this, push the locking bracket (1) slightly to one side.
2. Insert the black flat cable with the profile edge (2) to the ZPA motor control module into the upper duct (see module tag "PWR").
3. Make sure that the profile edge of the flat cable is under the respective reverse polarity protection (3).
4. Close the cable guide. It must engage securely in the locking bracket (1).

↳ The metal pins contact the cores of the flat cable.

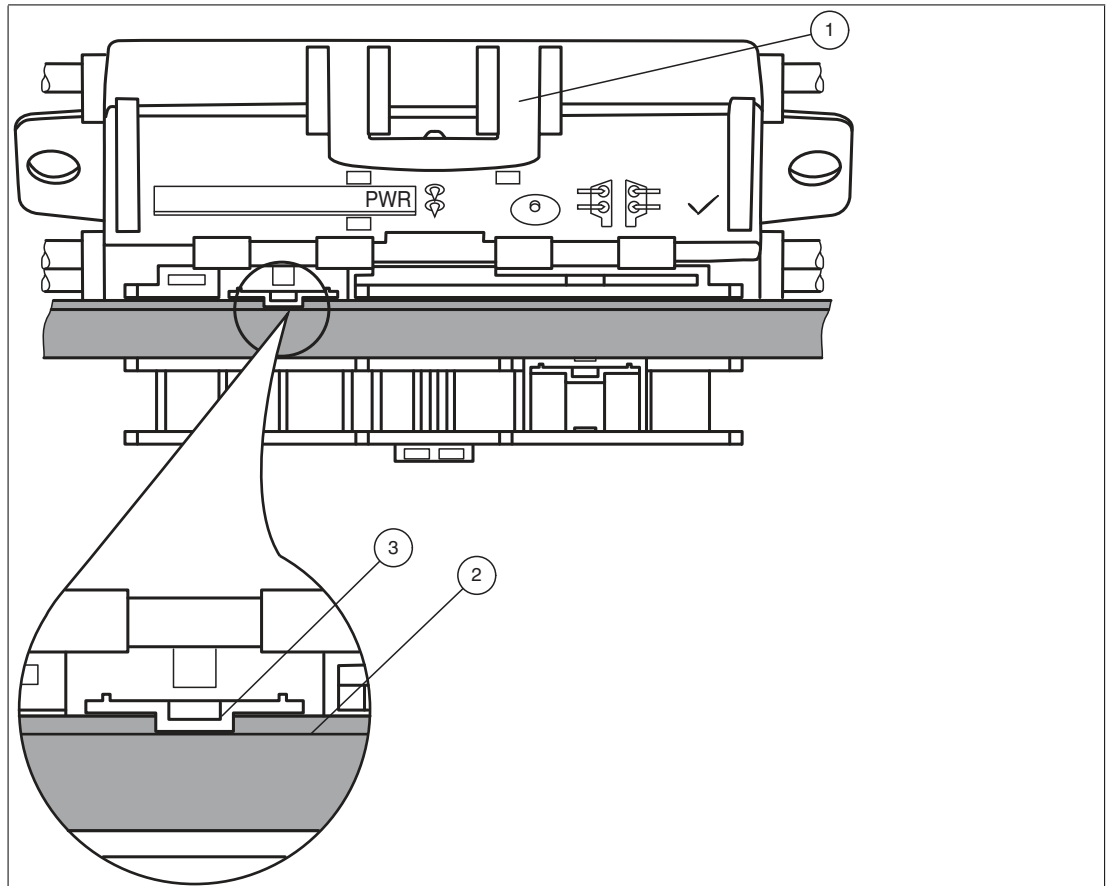


Figure 3.2 Connecting flat cables on the narrow side



Connecting Flat Cables on the Wide Side

The profile edge is not visible from above. For orientation purposes in the figure below, the edge is shown as a hidden edge drawn with a dotted line.

1. Open the cable guide. To do this, push the locking bracket (1) slightly to one side.
2. Insert the black flat cable with the profile edge (2) to the ZPA motor control module into the upper duct (see module tag "PWR").
↳ The profile edge (2) of the flat cable is above the reverse polarity protection.
3. Close the cable guide. It must engage securely in the locking bracket (1).
↳ The metal pins contact the cores of the flat cable.

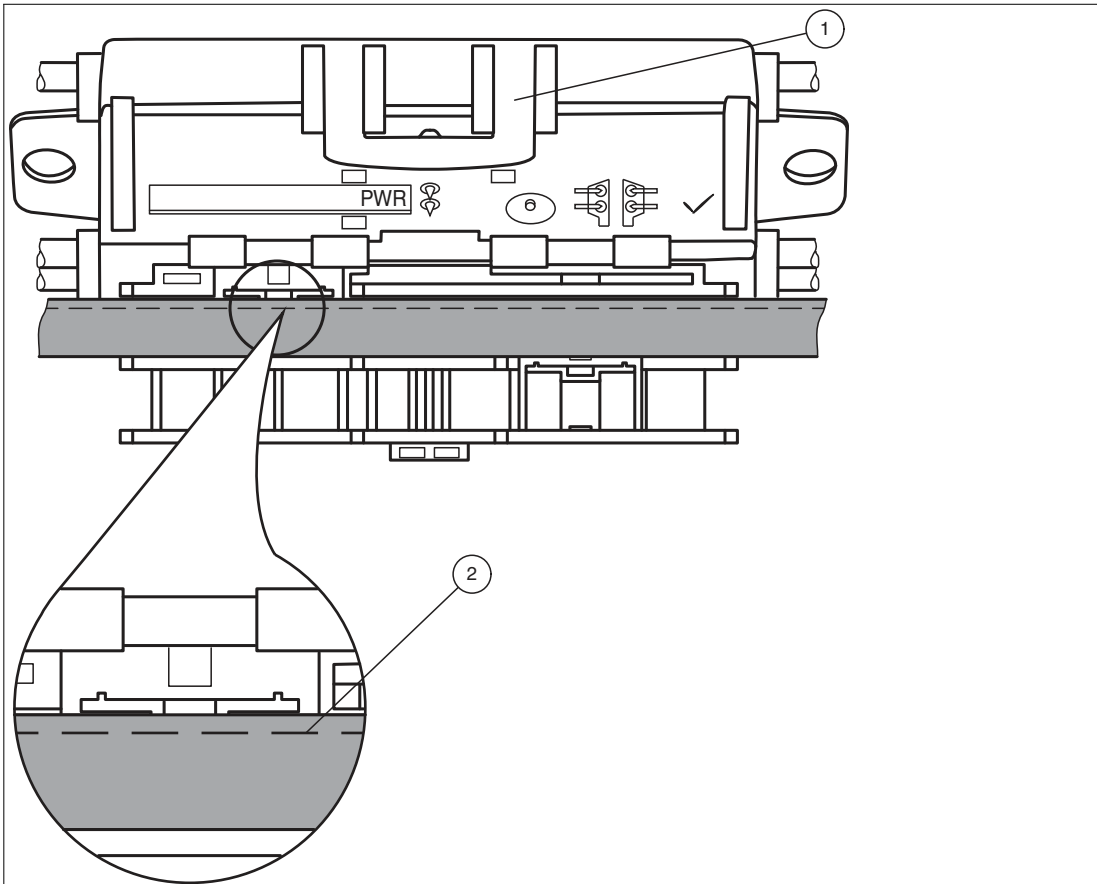


Figure 3.3 Connecting flat cables on the wide side (profile edge as dotted line)

Flat Cable Inserted Incorrectly

The figure below shows an incorrectly inserted flat cable. The profile edge (2) does not point to the motor control module; the flat cable is therefore inserted with reverse polarity. The flat cable is located on the reverse polarity protection (1) with a curvature, which means that the cable guide cannot be closed completely (mechanical reverse polarity protection).

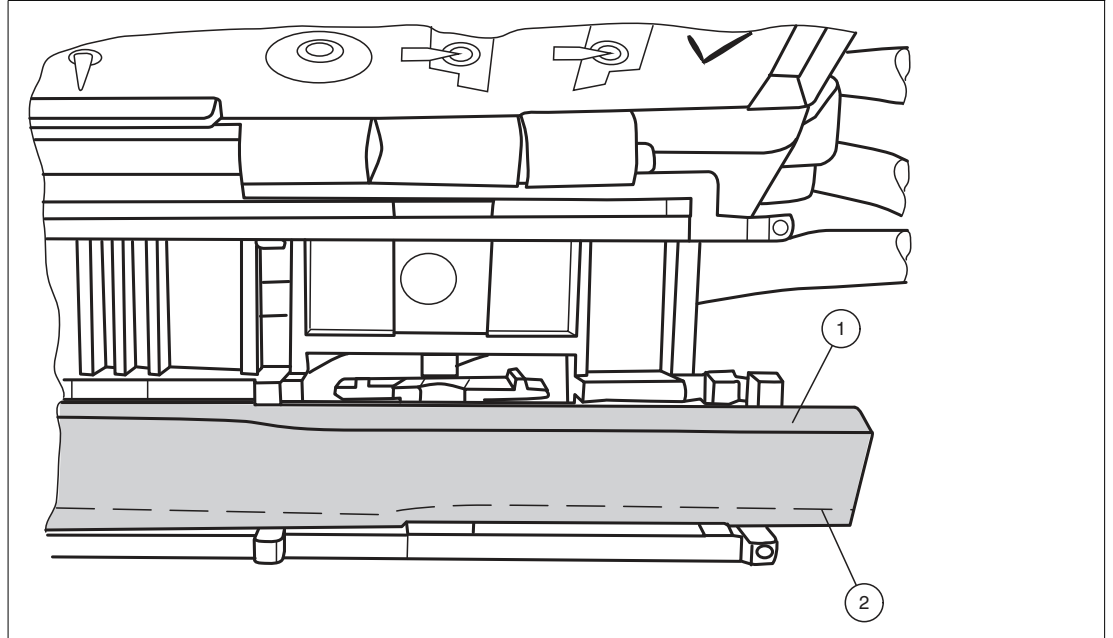


Figure 3.4 Flat cable inserted incorrectly (profile edge as dotted line)

3.5

Special Requirements when Connecting to a PLC

The electrical signals from the zone coupling interfaces are compatible with the standard 24 V IOs of a PLC.

- The inputs (X1 IN, X2 IN) are galvanically isolated. Therefore, there are no special requirements for the connection of other potentials.
- The outputs (X1 OUT, X2 OUT) are powered directly by the power supply of the ZPA motor control module. Therefore, there is a risk of ground loops when connecting to other potentials



Caution!

Malfunions with ground loops

Because the outputs of the ZPA motor control module are not galvanically isolated, equalization currents could flow through their ground lines. Therefore, connect the zone coupling outputs (X1 OUT, X2 OUT) only to galvanically isolated, current-consuming inputs of a PLC input/output card.

A common ground of the PLC input/output card may be connected to other ZPA motor control modules, but not to their power supply.

If the specified rules are not followed, malfunctions may occur in the interconnected components.

3.6 Connecting Motors, Sensors, and Zone Coupling

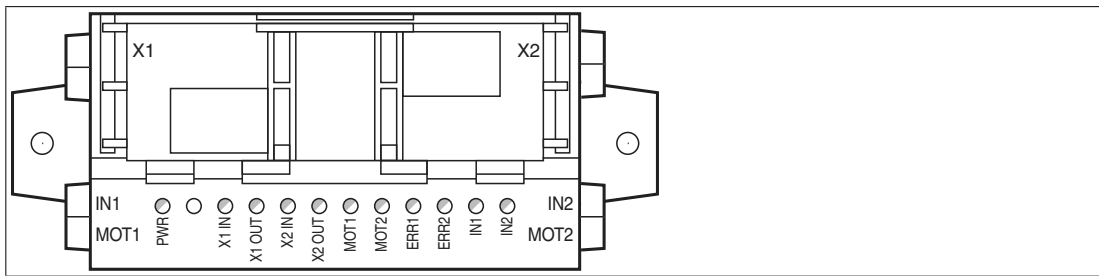


Figure 3.5

Note

The connection of DC roller motors and zone sensors to the ZPA motor control module depends on the circumstances of the zones to be controlled. There are a variety of connection scenarios depending on whether you want to control one or two zones or when changing the mounting side on the conveyor line. These scenarios are described in the following sections.

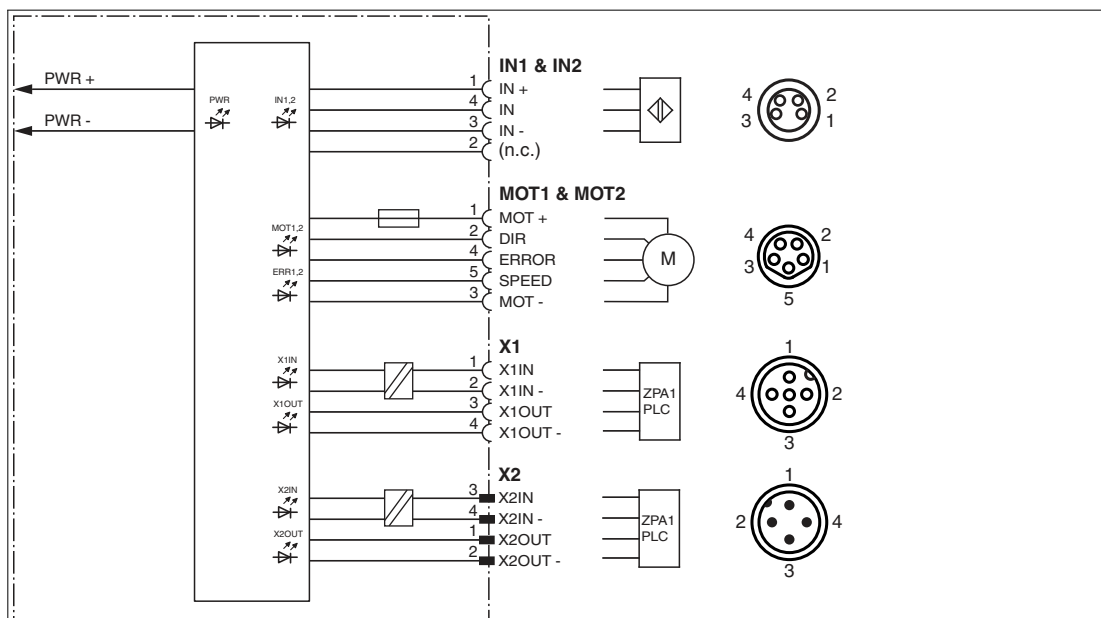


Figure 3.6 Connection wiring diagram for motors, sensors, and zone coupling

Note

Note the Mounting Direction of the ZPA Motor Control Module

The ZPA motor control module is designed to be mounted between two conveyor zones. The mounting direction is such that the LEDs always point downward and the hinged cable guide upward. This ensures the correct assignment of the connected zones (right zone -> right-side connection, left zone -> left-side connection). The mounting side on the conveyor line may need to be changed due to curves or structural restrictions. In this case, special adapter cables are required that cross the signal lines. (See Accessories section of datasheet). When changing the mounting side, the direction of rotation at S2 must also be changed.

Standard Connection of the ZPA Motor Control Module (2-Zone Operation)

The ZPA motor control module is designed to control two consecutive zones.

The ZPA motor control module is mounted between the two zones. The connection lines of the DC roller motors and zone sensors are connected to the respective side of the ZPA motor control module near the zone.

The zone coupling signals are connected to the ZPA motor control modules or other communication partners of the zone upstream and downstream of the two control zones (Zone 1, Zone 2).

Conveyor Direction from Left to Right (Clockwise Rotation)

Interface zone coupling	Description	Behavior
X1 IN	Output signal from the zone sensor of the upstream zone	<ul style="list-style-type: none"> Low level: No conveyed product detected High level: Conveyed product detected
X2 OUT	Output signal of the zone sensor at IN2	
X1 OUT	Release signal for upstream zone	<ul style="list-style-type: none"> Low level: No release High level: Release
X2 IN	Release signal from downstream zone	

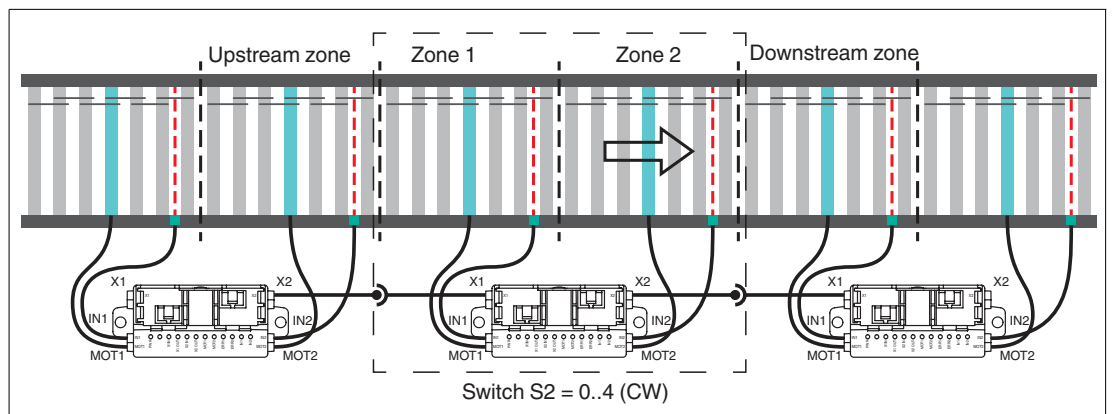


Figure 3.7 Conveying direction from left to right (clockwise)

Conveyor Direction from Right to Left (Counterclockwise Rotation)

Interface zone coupling I/O	Description	Behavior
X2 IN	Zone sensor of upstream zone	<ul style="list-style-type: none"> Low level: No conveyed product detected High level: Conveyed product detected
X1 OUT	Output signal of the zone sensor at IN1	
X1 IN	Release signal from downstream zone	<ul style="list-style-type: none"> Low level: No release High level: Release
X2 OUT	Release signal for upstream zone	

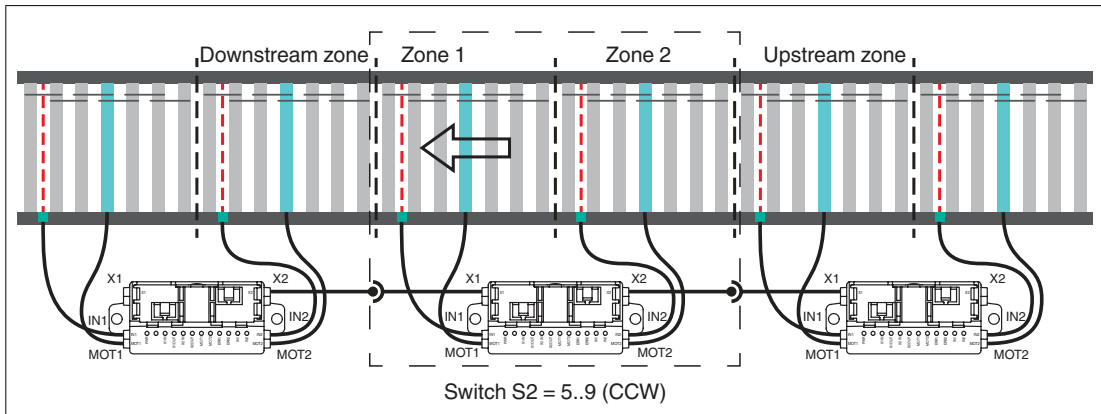


Figure 3.8 Conveying direction from right to left (counterclockwise)



1. Connect the connection lines of the motors, zone sensors, and the zone coupling signals according to the connection wiring diagram and the conveyor direction.



Caution!

Malfunctions due to incorrect assignment of connections

When connecting the ZPA motor control module, you should never form connection loops as shown in the following figure. The incorrect assignment of connections will create false logical connections between the zones. This can lead to malfunctions of the ZPA motor control module.

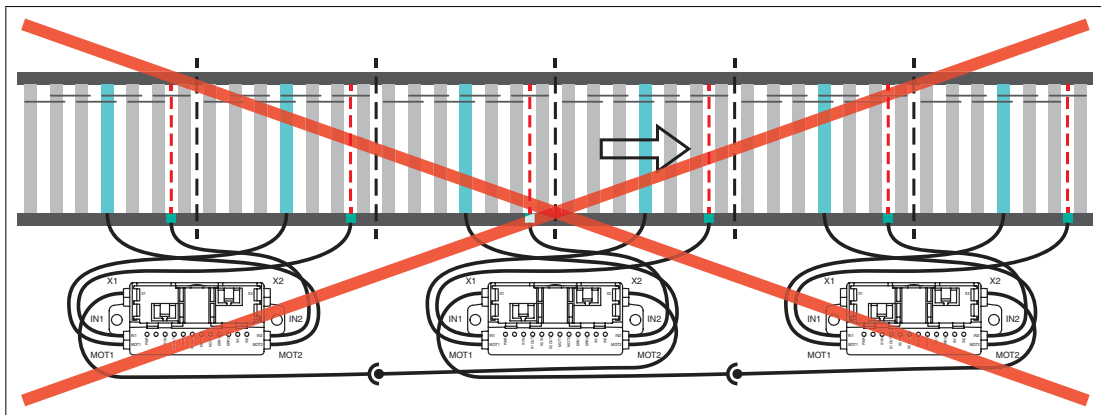


Figure 3.9 Incorrect connection

Standard Connection of the ZPA Motor Control Module (1-Zone Operation)

In 1-zone operation, the ZPA motor control module controls only one zone. Its zone sensor is always connected to the input "IN..." at the front in the conveyor direction. Both motor connections are switched synchronously in 1-zone operation. The second motor connection can be connected to another motor that drives the same zone and thus doubles the drive power of this zone.

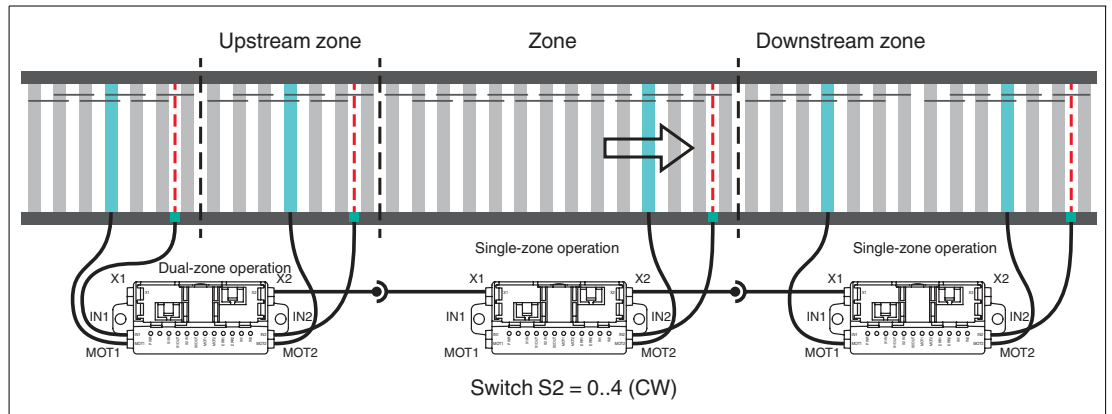


Figure 3.10 Conveying direction from left to right (clockwise)

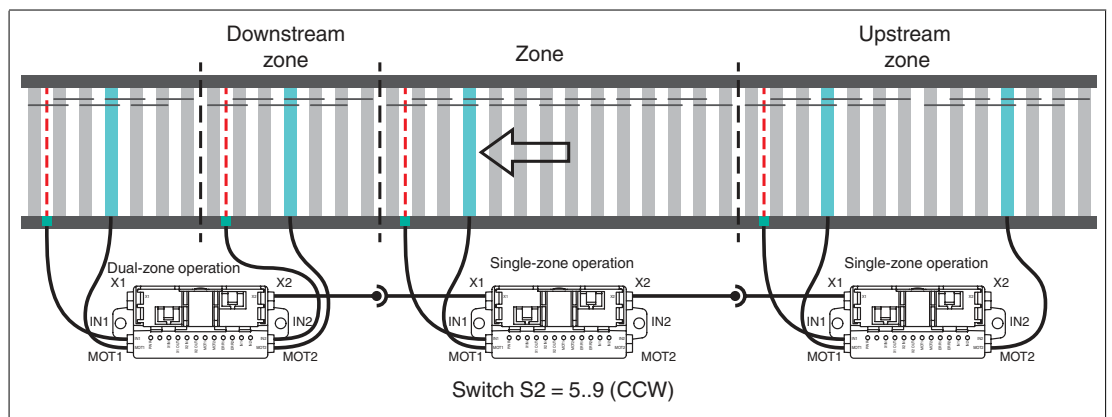


Figure 3.11 Conveying direction from right to left (counterclockwise)



1. Connect the connection lines of the motors, zone sensors, and the zone coupling signals according to the connection wiring diagram and the conveyor direction.

Connecting the ZPA Motor Control Module when Changing the Mounting Side on the Conveyor Line



Note

The mounting side on the conveyor line may need to be changed due to curves or structural restrictions. The mounting direction of the ZPA motor control modules remains the same even when changing sides. At the zone coupling, two identical interfaces X1 and X2 meet. To connect them, you will need a crossover adapter cable. These adapter cables are available as accessories. For more details, please refer to the "Accessories" section in the datasheet.

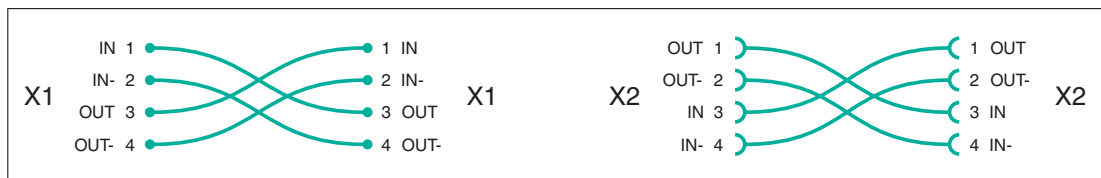


Figure 3.12 Crossover adapter cables

X1 Adapter cable M12 plug to M12 plug

X2 Adapter cable M12 socket to M12 socket

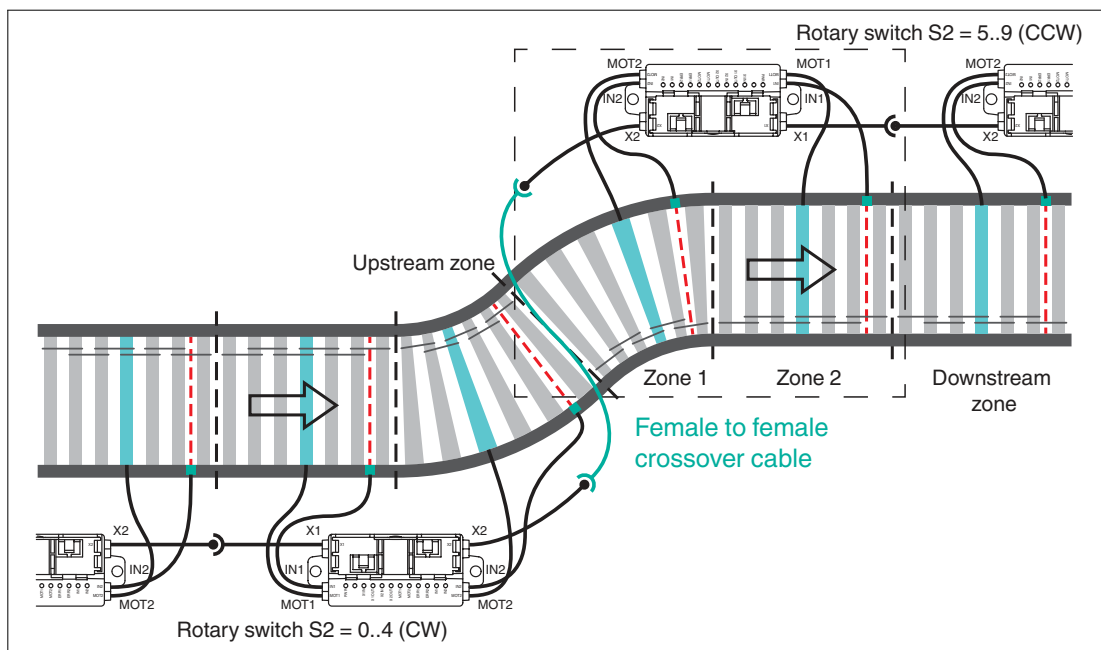


Figure 3.13 Conveyor direction from left to right (clockwise)



1. Connect the connection lines of the motors, zone sensors, and the zone coupling signals according to the connection wiring diagram.

4 Operating Behavior

4.1 Switch-On Behavior

In the operating modes "Standard ZPA," "Enhanced ZPA," and "Long Zone," the ZPA motor control module waits for the duration of the switch-on delay after the power supply is switched on before it is ready for operation. The only exception is the output of the status of the zone sensor at the relevant interface for zone coupling (X1 or X2). This signal is present 1 s after switch-on.

After the switch-on delay, the ZPA motor control modules of the individual zones start searching for conveyed product that might be lying undetected between the zone sensors. The search ends as soon as conveyed product is detected at the zone sensor or once the search time has passed. The switch-on delay randomly delays the start of the search for a ZPA motor control module. This is done to prevent current peaks caused by the simultaneous activation of the DC roller motors at all ZPA motor control modules whose zone sensor did not detect any conveyed product.

While the ZPA motor control module is starting up, the LEDs indicate the firmware version and the setting of the rotary switches using flash codes. Details can be found in the Chapter "Indicators and Operating Elements."

4.2 Switch-On Delay

The switch-on delay is the time that a zone waits after startup before resuming normal operation. The time is randomly selected in the range 2 ... 5 s by the ZPA motor control module.

4.3 Search Time

Search time = 4 s

If there is no conveyed product in front of the zone sensor after startup or if conveyed product was unexpectedly removed from the zone sensor during normal operation, the search time will begin.

During this time, the zone will search for conveyed product that might lie undetected between its sensor and the upstream zone sensor. For this purpose, it switches the motor on and waits for conveyed product to reach the zone sensor. Once the search time has passed, the zone will assume that it is empty and continue with normal operation.

In the operating mode "Standard ZPA," the release signal is set during the search time only if conveyed product is located in front of the zone sensor of the upstream zone. Because the zone is not able to detect whether the conveyed product is still completely in the upstream zone or partially extends into the zone itself, it sets the release.

In the operating mode "Enhanced ZPA," the release signal is always set during the search time to ensure a rapid startup of the conveyor line. If conveyed product is detected at the zone sensor during the search time, the zone will continue normal operation. After the conveyed product has been conveyed out, the zone begins to search again to make sure that no conveyed product remains undetected between the zone sensors.

4.4 Leaving time

Leaving time = 8 s

The leaving time is the time it takes for conveyed product located in front of the zone sensor to move away from this sensor after the motor has been switched on.

If the conveyed product requires longer than the leaving time, the zone will assume that there is an accumulation. It shuts down its motor and resets the release signal. The zone will resume normal operation once the blocked conveyed product is manually removed from the zone sensor. Immediately after that, the search time begins again.

4.5 Entry Time

Entry time = 8 s

The entry time is the time required by conveyed product to leave the upstream zone and therefore its zone sensor after the release signal is set.

If the conveyed product requires longer than the entry time, the zone will shut down its motor and wait for the conveyed product to disappear from the upstream zone or appear in front of its zone sensor.

4.6 Transportation Time

Transportation time = 8 s

The transportation time is the time it takes for conveyed product to reach the next zone sensor after leaving the upstream zone sensor.

If the conveyed product takes longer than the transportation time for this step, the zone will assume that it is empty and continue with normal operation.

4.7 Motor Run-On Time

Motor run-on time = 2 s

Once conveyed product has left the zone sensor of a zone, the motor run-on time begins. It ensures that the motor will continue to run so that the conveyed product can completely leave the zone. Furthermore, it reduces the constant switching on and off of the motors if conveyed products are following each other closely. Subsequent conveyed product can be received during that time without shutting down the motor.

4.8 Release Delay

Release delay = 0.1 s

In the operating mode "Enhanced ZPA," the direct forwarding of release signals is delayed by this period of time if conveyed product has been stopped before the zone sensor and subsequent conveyed product has not yet partially entered the zone.

The release delay is used to avoid power spikes that would result from the simultaneous startup of accumulated conveyed product.

4.9 Idle Mode Delay

Idle mode delay = 10 s

The idle mode delay is the time that a zone will wait on incoming conveyed product in the operating mode "long zone" with the motor running. After this time, the motors will shut down but the release signal remains set. The time will begin again if the status of the upstream zone sensor changes.

5 Manual Intervention in the Conveying Process

5.1 Manual Feeding of Conveyed Product

It is always possible to manually feed conveyed product. When doing so, it is assumed that the conveyed product is placed in front of a zone sensor.

5.2 Manual Removal of Conveyed Product

It is possible to manually remove conveyed product from the accumulation conveyor line at any time.

The zone logic distinguishes between the following cases:

Manual Removal with DC Roller Motor Running

During the removal of conveyed product, the zone whose sensor the product would have reached next waits for the duration of the transportation time (see Chapter "Operating Behavior") for the conveyed product to arrive. After this time, the zone will assume that it is empty and continue with normal operation.

Manual Removal with DC Roller Motor Not Running

The conveyed product is located in front of a zone sensor. The zone detects the manual removal at the zone sensor. The zone switches on its DC roller motor and starts searching for conveyed product to ensure that the product was not simply pushed back and is now located undetected between the zone sensors.

After the search time (see Chapter "Operating Behavior") has passed, the zone will return to normal operation.

5.3 Manual Stop/Release

The zone coupling between the individual ZPA motor control modules can easily be used to stop and resume conveyance. For this purpose, a suitable two-pin switch is inserted into the zone coupling between two ZPA motor control modules, which separates the two input lines and output lines from each other. An open switch ensures that the two zones connected via the zone coupling can no longer receive control signals from each other and therefore can no longer exchange conveyed product.

Manual Stop

As soon as the switch is opened, the release signal no longer reaches the upstream zone, meaning that this upstream zone does not allow any more conveyed product to be conveyed to the next zone. Furthermore, the sensor signal no longer reaches the downstream zone, which in turn no longer attempts to receive the conveyed product.

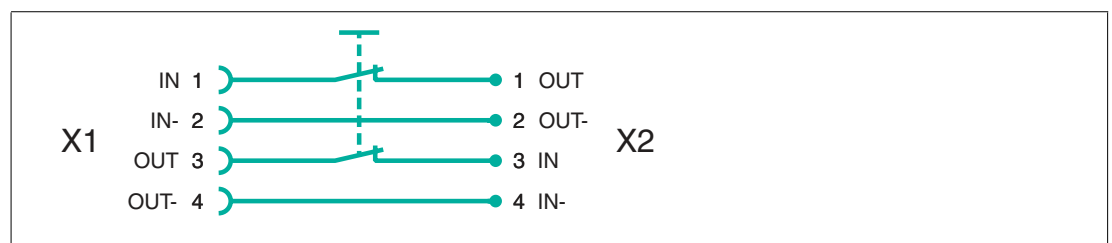


Figure 5.1

Manual Release

When the switch is closed, the release signal of the downstream zone reaches the upstream zone once again (as long as activated by the downstream zone). The upstream zone can pass on any conveyed product present to the downstream zone. At the same time, the sensor signal also reaches the downstream zone, so that it receives information about the incoming conveyed product and activates its DC roller motor accordingly.

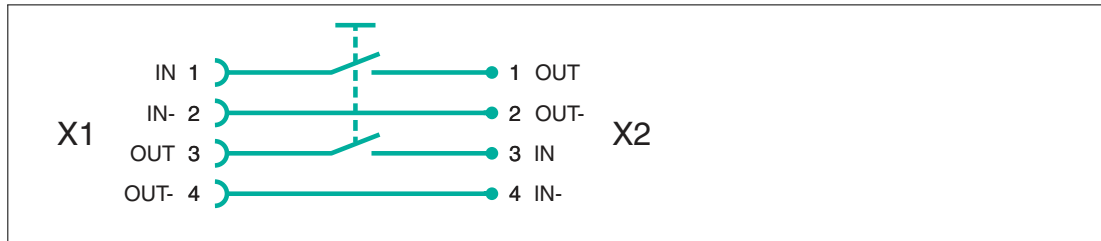


Figure 5.2

5.4 Manually Correcting Accumulations

When the conveyor line is in operation, one or more conveyed products may become blocked, resulting in an undesired accumulation.

If conveyed product takes too long to leave the zone sensor (see leaving time/entry time), the zone logic detects an accumulation and automatically shuts down the DC roller motor. To resume normal operation, the cause of the accumulation must be eliminated and the blocked conveyed product in front of the zone sensor must be removed. Ideally, simply slide the conveyed product away from the detection range of the sensor in the conveyor direction.

The zone logic will detect that the accumulation has been resolved and will continue with normal operation.

6 Troubleshooting

6.1 What to Do in the Event of a Fault

In case of a fault, use the checklist to determine whether a fault with the ZPA motor control module can be remedied.

If none of the information specified in the checklist solves the problem, in the event of queries contact Pepperl+Fuchs via your sales office. Have the type designation and firmware version of the product ready.

In the following checklist, "x" represents the channel for the LED descriptions and can be either "1" or "2".

Checklist

Fault	Possible cause	Remedy
No LED is lit.	The power supply is not connected or is connected with reverse polarity.	Check the connection of the power supply.
ZPA motor control module is not working, the four yellow LEDs (X1 IN ... X2 OUT) are flashing.	An invalid (reserved) operating mode has been selected.	Use rotary switch S3 to select a valid operating mode. After the correction, you must disconnect the power supply for a short period of time to implement the change.
DC roller motor is not running, even though the relevant LED "MOTx" is lit and the associated LED "ERRx" is not lit.	An invalid speed setting has been selected.	Set a valid speed using rotary switch S1. After the correction, you must disconnect the power supply for a short period of time to implement the change.
DC roller motor is not running, even though the relevant LED "MOTx" is lit. The associated LED "ERRx" lights up permanently.	The DC roller motor reports a fault, for example due to blocking or the DC roller motor is not connected correctly.	Check the connection of the DC roller motor. You may have to briefly disconnect the power supply of the module to reset the fault in the DC roller motor.
DC roller motor is not running, even though the relevant LED "MOTx" is lit. The associated LED "ERRx" is flashing.	The internal safety fuse of the module for the DC roller motor is faulty, for example due to overcurrent.	Replace the ZPA motor control module. Check the current consumption of the DC roller motor causing the problem before the next commissioning.
The conveyed product is not detected in a zone. The relevant LED "INx" of the zone is not lit.	The corresponding zone sensor is faulty or not connected correctly.	Check that the zone sensor is connected correctly. Check that the zone sensor is functioning correctly.
The conveyed product does not exit the zone. The zone is not receiving a release signal from the downstream zone. The associated LED "X1 IN"/"X2 IN" is not lit.	The zone coupling signal lines are not connected correctly. The logical zone interconnection is not correct.	Make sure that the zone coupling to the downstream zone is connected correctly and the downstream zone sets the release signal (associated LED "X1 OUT"/"X2 OUT" of the zone coupling is lit). Check the setting of the conveyor direction on the corresponding ZPA motor control modules.

Fault	Possible cause	Remedy
The zone does not switch the relevant DC roller motor on in case of incoming conveyed product or the zone is not receiving a signal from the zone sensor of the upstream zone. The associated LED "X1 IN"/"X2 IN" is not lit.	The zone coupling signal lines are not connected correctly. The zone sensor of the upstream zone is not connected correctly. The logical zone interconnection is not correct.	Make sure that the zone coupling to the upstream zone is connected correctly and the upstream zone sets the sensor signal (associated LED "X1 OUT"/"X2 OUT" of the zone coupling is lit).
ZPA motor control module has no function, LED "X1 IN" or "X2 IN" flashes.	Secondary mode is selected, but the subsequent zone is not working as a primary module.	Set an operating mode in the subsequent ZPA motor control module that supports operation as a primary module. All operating modes except Direct Control and Direction Control support operation as a primary module. Check the conveying direction setting. Make sure that the firmware version of the primary module is V.28 or higher.

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