

Functional description
Prorunner mk9 – Pallet conveyor

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1 About this manual

1.1 Introduction

This document attempts to provide as clear as possible an insight into the functionality, operation and components of the Prorunner mk9 pallet conveyor for designing the software function blocks for the OEM / system integrator.

1.2 Version history

Version	Author	Description
V1.1	GVI	First version in standard lay-out

1.3 Product documentation

Document	Reference
Machine manual ¹	UM Prorunner mk9 v2.0 EN
Electrical drawings ¹	Electrical drawings PRmk9 v9.0 Stand alone

1.4 Source language

This manual was originally written in the English language.

¹ Generic information

1.5 Symbols used in the manual

The following symbols are used in this manual.



WARNING

Risk of serious injury to the user if the instructions are not accurately followed.



CAUTION

Risk of damage to the machine if the instructions are not accurately followed.



Note

To provide additional information to the user about a task or issue.

1.6 Terminology list

The table below explains common terms used in this manual.

Term	Definition
Machine	Prorunner mk9
Pallet conveyor	Conveyor that can be mounted on the carrier of a Prorunner mk9; for example a Qimarox PCr2 conveyor.
Upstream	Modules supplying the pallet conveyor with products (infeed sided).
Downstream	Modules that receive the products that are processed by the pallet conveyor (outfeed sided).

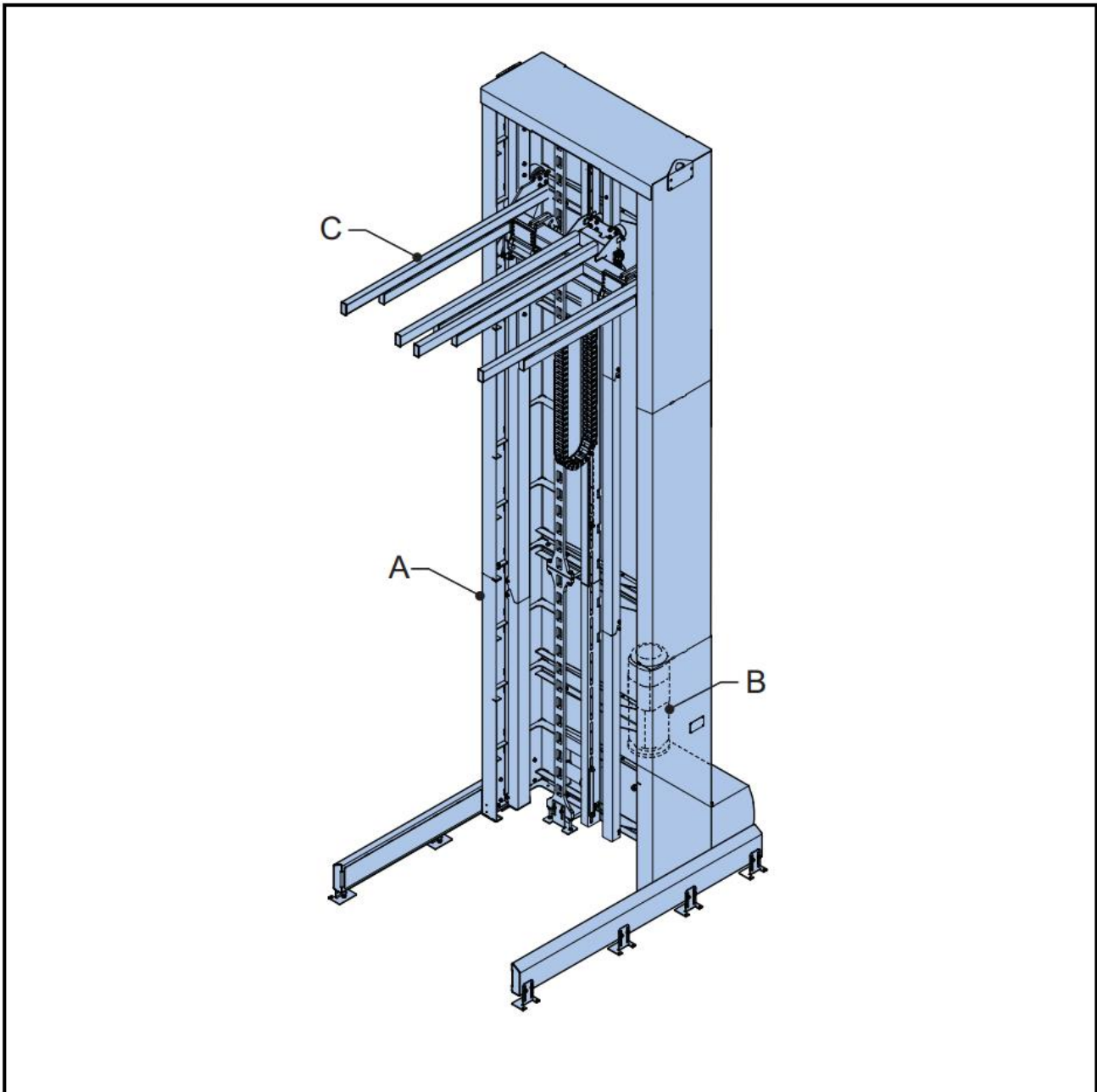
1.7 Further support and information

Qimarox can supply additional expertise and support services, for:

- Training
- Global support
- Service contracts

For more information please contact Qimarox.

2 Description

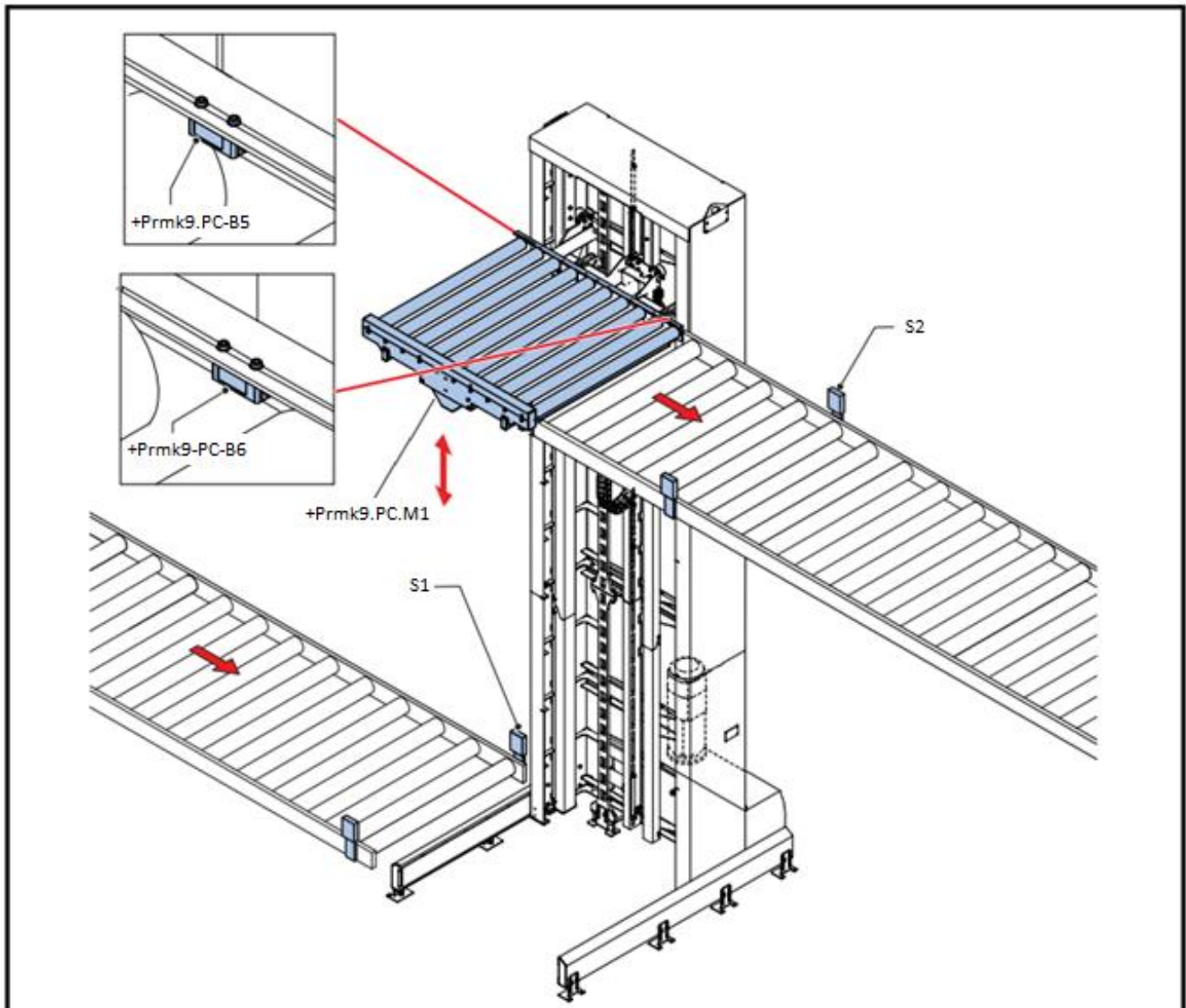


Figur 1 - Overview of the machine

The machine consists of a column, a moveable carrier and a drive section. The carrier is suspended by two flat belts which are wound up by a motor located in the drive section. The carrier is guided by wheels running over guiding profiles in the column. For safety reasons the machine is equipped with a mechanical locking device, preventing any downward movement of the carrier when the safety circuit is triggered.

- A. Column
- B. Drive
- C. Carrier (fixation for pallet conveyor)

3 Operating principle



Figuur 2 - Machine in a system

+Prmk9.PC-M1	Motor of pallet conveyor
+Prmk9.PC-B5	Carrier free detection 1
+Prmk9.PC-B6	Carrier free detection 2
+Prmk9.PC.B7	Product on conveyor (optional)
S1	Product ready on third-party feeding conveyor. (Waiting to feed in)
S2	Third-party supply conveyor starved (ready to accept item)

The product will wait at sensor S1 of the third-party feeding conveyor until the carrier is in position. After the Prorunner arrives at the infeed position, the object is fed in into the pallet conveyor and monitored by sensor +Prmk9.PC-B5.

The carrier can start to move again after an object has been transported into the pallet conveyor after the minimum infeed time has passed and both sensors (+Prmk9.PC-B5 and +Prmk9.PC-B6) are not active; meaning the object is completely on the carrier.

If sensor +Prmk9.PC-B6 becomes active before +Prmk9.PC-B5 becomes inactive, the object is too large or two objects are inserted at the same time. In this case, the pallet conveyor as well as the Prorunner must be stopped.

After the Prorunner arrives at outfeed position and sensor S2 is free, the transport of the object from the pallet conveyor to the discharge conveyor can be started. When sensor +Prmk9.PC-B6 is free after the minimum outfeed time has passed and sensor S2 is active; the pallet has left the pallet conveyor and transport is stopped.

The optional object present detection (+Prmk9.PC-B7) can be used to verify the presence of a product.

3.1 Start-up procedure

To start automatic operation, the program must first check whether the conveyor module is empty by letting the conveyor module run for a calculated time.

If the conveyor module receives a signal that the carrier has arrived at the bottom position, the conveyor module must start running forward for a calculated time. If +Prmk9.PC-B6 gets occupied a product is present on the conveyor, and the conveyor must start running in reverse for until +Prmk9.PC-B6 and +Prmk9.PC-B5 are not active. If nothing is detected the carrier is empty.

$$Startup\ time[ms] = \frac{(Conveyor\ length[mm] * 2)}{Conveyor\ velocity[m/s]}$$

If the conveyor module is equipped with the optional +Prmk9.PC-B7 object presence sensor the program will skip this step and use this sensor to determine if an object is present.

This start-up procedure must be performed in the following situations:

- First start after switching on the machine;
- After a fault;
- After the Prorunner loses status position.

3.2 Determine in- and outfeed directions

To determine in which way the conveyor has to run and which sensor signals to expect, the software of the conveyor module must retrieve the in- or outfeed direction from the Prorunner module by means of handshaking or scanning the stepper of the Prorunner module.

3.3 Product infeed

The product on the third-party supply conveyor is monitored by the program of the upstream installation (S1). If the conveyor module is ready to receive the object a signal must be presented to the Prorunner module by means of handshaking or running through a stepper.

Conditions for signalling the Prorunner to start the infeed process:

- No object present on the conveyor module;
- Carrier is at infeed level;
- Upstream installation (S1) has an object present.

The Prorunner equipment module will now communicate a ready to receive signal upstream, the conveyor will start, and the software will start the feeding in process when +Prmk9.PC-B5 or +Prmk9.PC-B6 (depending on the infeed direction) detects movement.

During the process of feeding in, the following safeguards must monitor the infeed process:

- Maximum infeed time (paragraph 5.6);
- Unknown object detection (paragraph 5.7).

To enable the infeed of a pallet, the minimum infeed time has to be used as a “blinding time” (paragraph 5.5) before the software will use sensors +Prmk9.PC-B5 and +Prmk9.PC-B6 to verify that a pallet is present. If the sensor that started the feeding in process (+Prmk9.PC-B5 or +Prmk9.PC-B6 depending on the infeed direction) is not covered after the blinding time; the object has entered the pallet conveyor and the infeed process has stopped.



Note

Keep in mind to use an on/off-delay time (~25ms) on the photocell sensors to prevent blinking of the photocell sensor.

3.4 Product outfeed

The product on the third-party supply conveyor is monitored by the program of the downstream installation (S2). When an product is present on the product conveyor it will wait until the Prorunner module gives clearance to start feeding out the product that is present on the conveyor.

Conditions for starting the outfeed process:

- Prorunner is at outfeed level;
- Downstream installation is ready;
- Product is present on conveyor.

During the process of feeding out, the following safeguards will start running after the +Prmk9.PC-B5 or +Prmk9.PC-B6 are triggered (depending on the outfeed direction):

- Maximum outfeed time (paragraph 5.6);
- Unknown object detection (paragraph 5.7).

To enable the outfeed of a pallet, the minimum outfeed time has to be used as a “blinding time” (paragraph 5.5) before the software will use sensor +Prmk9.PC-B5 and +Prmk9.PC-B6 to verify that the product has left the product conveyor. If the sensor that started the feeding out process (+Prmk9.PC-B5 or +Prmk9.PC-B6 depending on the outfeed direction) is not covered anymore after the blinding time, and the downstream signal S2 is active; the product has left the carrier and the feeding out process has stopped.

**Note**

Keep in mind to use an on/off-delay time (~25ms) on the photocell sensors to prevent blinking of the photocell sensor.

3.5 Minimum in-/outfeed time (Blinding time)

During the in-/outfeed process the software must use a minimum infeed time before checking the status of the photocell sensors +Prmk9.PC-B5 and +Prmk9.PC-B6. This is necessary because at certain positions the photocell sensor can look through the pallet and give false positives.

This calculated minimum infeed time is determined by the following three factors:

1. Pallet length [mm];
2. Conveyor velocity [m/s];
3. Margin minimum time [90%];

$$\text{Minimum in/outfeed time[ms]} = \frac{(\text{Pallet length})}{(\text{Conveyor velocity})} * (\text{Margin})$$

3.6 Maximum in- and outfeed time

The maximum time it takes to complete the in- or outfeed of the pallet must be monitored. If the in- or outfeed process exceeds these time limits the conveyor module must generate a fault and stop immediately.

The minimum and maximum outfeed time is calculated by the following three factors:

1. Pallet length [mm];
2. Conveyor velocity [m/s];
3. Margin maximum time [110%].

$$\text{Maximum in/outfeed time[ms]} = \frac{(\text{Pallet length})}{(\text{Conveyor velocity})} * (\text{Margin})$$

3.7 Unknown object detection

During the whole program cycle the program must know when to expect certain triggering of the sensors. If an unexpected triggering is detected, the program must recognize this as a unknown object and generate an fault.

Example 1 – Left side infeed, and conveyor is feeding in

Sensor +Prmk9.PC-B6 is triggered. Because the infeed is from the left side the sensor never can be triggered during this step. The infeed is successful if the product stops between both sensors and leave the sensor uncovered

Example 2 –Prorunner is moving to outfeed level (conveyor is waiting)

Sensor +Prmk9.PC-B5 or +Prmk9.PC-B6 is triggered. During transport both sensors may never be covered/triggered.

3.8 No product detected

This function is only possible if the conveyor is equipped with the optional +Prmk9.PC-B6 sensor that detects if a product is present on the pallet conveyor. After the product has successfully entered the transport conveyor, this sensor will verify that the product is really present. If the sensor +Prmk9.PC-B6 is uncovered after feeding in or transport to the outfeed level, the program must generate an alarm.

3.9 Manual operation

The conveyor may be moved forward and reverse by hand. During this manual operation the carrier free sensors may not be occupied to prevent falling objects.

- When moving forward, the sensors +Prmk9.PC-B6 must not be occupied;
- When moving reverse, the sensors +Prmk9.PC-B5 must not be occupied.

5.11 Fault codes

In case of a fault, the software function block issues should output a fault code and message to inform the operator. Below is the list of faults that must be generated with explanation/effect and solution. Certain faults are only possible after selecting/activating certain options. Malfunctions will block or stop automatic operation in all cases. If all reset conditions are met and the user gives the reset command, the fault will disappear. The latter does not apply to faults that can solve themselves.

Tabel 1 - Fault list pallet conveyor

Bit	Description / Cause	Effect	Solution
0	Infeed of object takes too long. Object seems to be blocked during transport	Automatic operation is not possible. Conveyor module is quickly stopped (Quickstop)	Remove objects or move them to the correct position on the conveyor. Give the reset command to reset the fault. Reset command is accepted if +Prmk9.PC-B7 is occupied and B5 is unoccupied, or if +Prmk9.PC-B5 + +Prmk9.PC-B6 are both unoccupied
1	Infeed of object takes too short. Object seems to be blocked during transport	Automatic operation is not possible. Conveyor module is quickly stopped (Quickstop)	Remove objects or move them to the correct position on the conveyor. Give the reset command to reset the fault. Reset command is accepted if B6 is occupied and +Prmk9.PC-B5 is unoccupied, or if +Prmk9.PC-B5 + +Prmk9.PC-B6 are both unoccupied
2	An unknown object was detected on by one of the conveyor sensors because an unexpected triggering	Automatic operation is not possible. Conveyor module is quickly stopped (Quickstop)	Remove objects or move them to the correct position on the conveyor. Give the reset command to reset the fault. Reset command is accepted when both +Prmk9.PC-B5 & +Prmk9.PC-B6 are free/unblocked
3	Length check outfeed conveyor. Sensor +Prmk9.PC-B5 or +Prmk9.PC-B6 is not occupied long enough. (depending on in-/outfeed direction)	Automatic operation is not possible. Conveyor module is quickly stopped (Quickstop)	Remove objects or move them to the correct position on the conveyor. Give the reset command to reset the fault. Reset command is accepted when both +Prmk9.PC-B5 & +Prmk9.PC-B6 are free/unblocked
4	Length check outfeed conveyor. Sensor +Prmk9.PC-B5 or +Prmk9.PC-B6 is occupied too long. (depending on in-/outfeed direction)	Automatic operation is not possible. Conveyor module is quickly stopped (Quickstop)	Remove objects or move them to the correct position on the conveyor. Give the reset command to reset the fault. Reset command is accepted when both +Prmk9.PC-B5 & +Prmk9.PC-B6 are free/unblocked
5	Object should be present on carrier but is not detected by the optional Sensor +Prmk9.PC-B7	Automatic operation is not possible. Conveyor module is quickly stopped (Quickstop)	Remove objects or move them to the correct position on the conveyor. Give the reset command to reset the fault. Reset command is accepted when both +Prmk9.PC-B5 & +Prmk9.PC-B6 are free/unblocked
6	Start-up procedure takes too long	Automatic operation is not possible. Conveyor module is quickly stopped (Quickstop)	Check Prorunner for blockages; if no obstructions are detected. Give the reset command to reset the fault.
7	Movement of conveyor/drive/motor is blocked. The conveyor will no longer move. (inverter returns fault code	Automatic operation is not possible. Conveyor module is quickly stopped (Quickstop)	Check Prorunner for blockages; if no obstructions are detected, check operation/adjustment of sensors. Give the reset command to reset the fault.
8	Outfeed of object takes too long. Object seems to be blocked during transport	Automatic operation is not possible. Conveyor module is quickly stopped (Quickstop)	Remove objects or move them to the correct position on the conveyor. Give the reset command to reset the fault. Reset command is accepted when both +Prmk9.PC-B5 & +Prmk9.PC-B6 are free/unblocked
9	Outfeed of object takes too short. Object seems to be blocked during transport	Automatic operation is not possible. Conveyor module is quickly stopped (Quickstop)	Remove objects or move them to the correct position on the conveyor. Give the reset command to reset the fault. Reset command is accepted when both +Prmk9.PC-B5 & +Prmk9.PC-B6 are free/unblocked

4 Appendix A - Sequential function chart

