

Qimarox®



Functional description
Prorunner mk1 – Product conveyor

Version 1.1 - 02/04/2020

Qimarox
Nobelstraat 43
3846 CE Harderwijk
The Netherlands

Tel: +31 341 436 700
Fax: +31 341 436 701
E-mail: info@qimarox.com
Internet: www.qimarox.com

Copyright © Qimarox B.V.

All rights reserved. No part of this publication may be reproduced, stored in a computer database or published in any form or in any way electronically, mechanically, by means of photocopying, recordings or in any manner without prior written permission from Qimarox.

Table of contents

1	About this manual	4
1.1	Introduction	4
1.2	Version history	4
1.3	Product documentation	4
1.4	Source language	4
1.5	Symbols used in the manual.....	5
1.6	Terminology list	5
1.7	Further support and information.....	5
2	Description	6
3	Operating principle	7
3.1	Start-up procedure	8
3.2	Determine in- and outfeed directions	8
3.3	Product infeed	8
3.4	Product outfeed.....	9
3.5	Minimum and maximum object length check.....	10
3.6	Minimum and maximum infeed time	10
3.7	Unknown object detection	11
3.8	No product detected.....	11
3.9	Manual operation	11
5.11	Fault codes.....	11
4	Appendix A - Sequential function chart	13

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 mk1 Product 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 mk1 v4.1 EN
Electrical drawings ¹	Electrical drawings Prmk1 v6.1

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 mk1
Product conveyor	Conveyor that can be mounted on the carrier of a Prorunner mk1; for example a Qimarox RDC1 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).

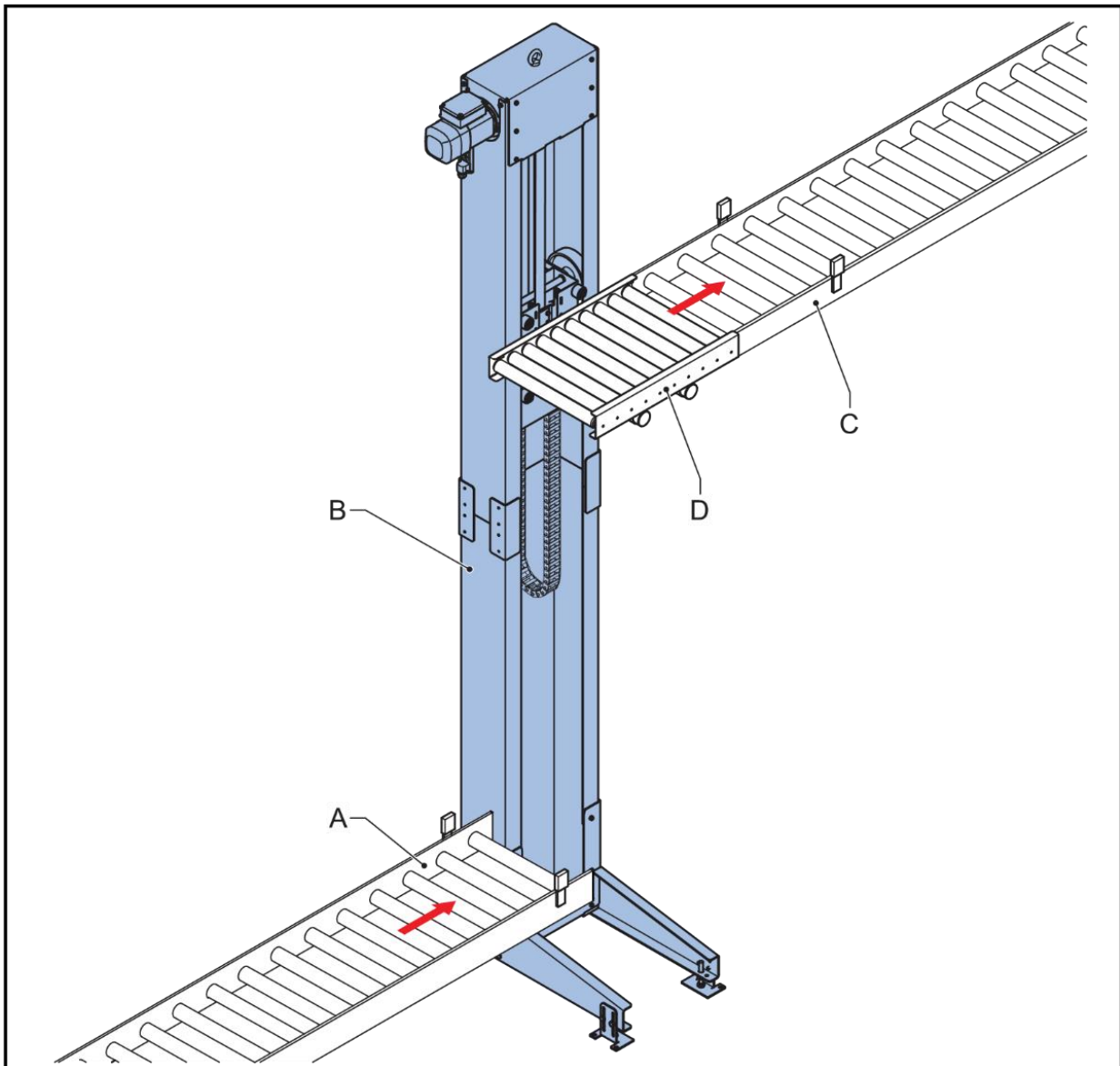
1.7 Further support and information

Qimarox can supply additional expertise and support services, for:

- Training
- Global support
- Service contracts

For more information please contact Qimarox.

2 Description

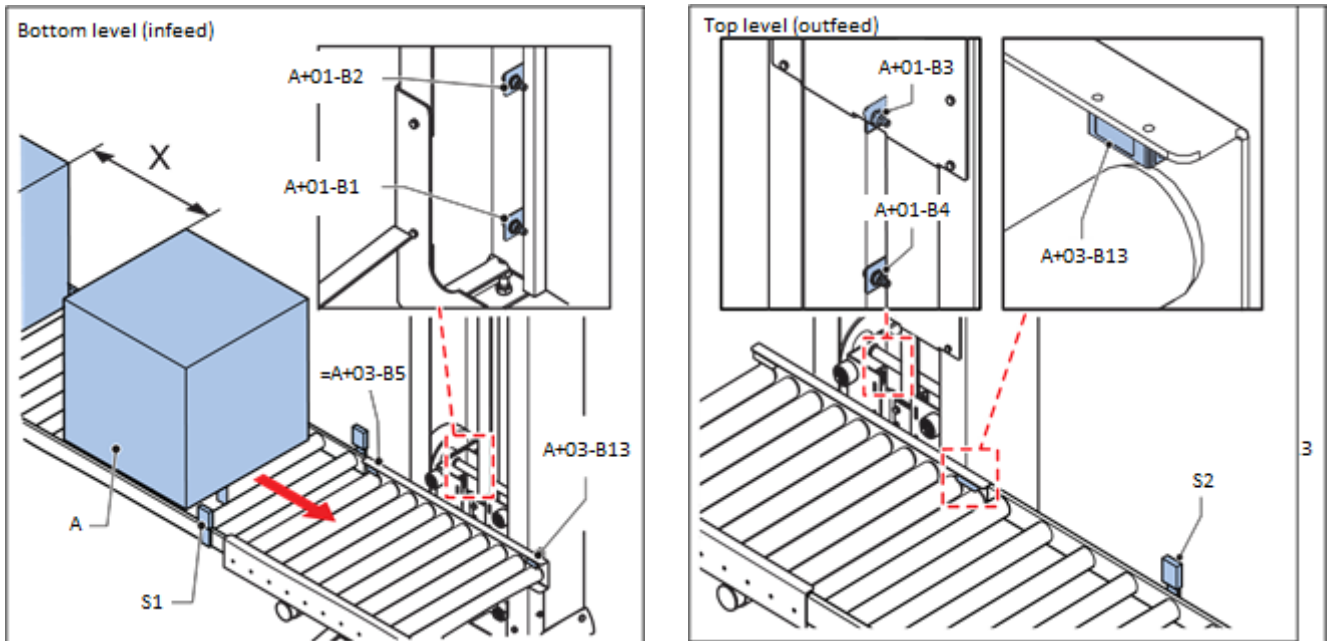


Figuur 1 - Overview of the machine in a system

- A. Third-party feeding conveyor (not supplied by Qimarox)
- B. Prorunner mk1 vertical conveyor
- C. Third-party discharge conveyor (not supplied by Qimarox)
- D. Prorunner product conveyor

The Prorunner is designed to vertically transport a product from one level to another. The machine consists of a column, a moveable carrier and a motor. The carrier is suspended by a belt which is driven by the motor. The carrier moves through the column of the machine. The product conveyor module allows products to feed in and -out.

3 Operating principle



Figur 2 – Components overview

=A+03-B5	Carrier free detection 1
=A+03-B13	Carrier free detection 2
=A+03-B6	Object present detection (optional)
S1	Product ready on third-party feeding conveyor. (Waiting to feed in)
S2	Third-party discharge conveyor starved (ready to accept object)

The product (A) 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 product conveyor and monitored by sensor =A+03-B5.

The carrier can start to move again after an object has been transported into the product conveyor and both sensors (=A+03-B5 and =A+03-B13) are not active; meaning the object is completely on the carrier.

If sensor =A+03-B13 becomes active before =A+03-B5 becomes inactive, the object is too large or two objects are inserted at the same time. In this case, the product 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 product conveyor to the discharge conveyor can be started. When sensor =A+03-B13 is free, the transport is stopped.

The optional object present detection (=A+03-B6) can be used to verify the presence of an object, and to stop the object in the middle of the conveyor.

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 =A+03-B13 gets occupied a product is present on the conveyor, and the conveyor must start running in reverse for a calculated time to re-center the object to the middle point of the conveyor. If nothing is detected the carrier is empty.

$$\text{Startup time}[ms] = \frac{(\text{Conveyor length} * 3)}{\text{Conveyor velocity}}$$

$$\text{recenter object time}[ms] = \frac{(\text{Conveyor length} - (\text{Max object length} / 2) - \text{Margin})}{\text{Conveyor velocity}}$$

If the conveyor module is equipped with the optional =A+03-B6 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 supply conveyor of third parties is monitored by the program of the upstream installation (S1). If the conveyor module is starved (ready to receive 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:

- Conveyor module is starved (ready to receive object):
 - 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 starved (ready to receive object) signal upstream, the conveyor starts to run, and the software will start the feeding in process when =A+03-B5 or =A+03-13 (depending on the infeed direction) detects movement.

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

- Minimum length check (paragraph 3.5);
- Maximum length check (paragraph 3.5);
- Minimum infeed time (paragraph 3.6);
- Maximum infeed time (paragraph 3.6).

If the sensor that started the feeding in process (=A+03-B5 or =A+03-B13 depending on the infeed direction) is not covered anymore the object has entered the carrier 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 object 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;
- Object is present on conveyor.

During the process of feeding out, the following safeguards will start running after the =A+03-B5 or =A+03-B13 are triggered (depending on the outfeed direction):

- Minimum outfeed time (paragraph 5.7);
- Maximum outfeed time (paragraph 5.7).

If the sensor that started the feeding out process (=A+03-B5 or =A+03-B13 depending on the outfeed direction) is not covered anymore the object has left the carrier and the feeding out process has stopped. Keep in mind to use on/off-delay time (~25ms) on the sensor to prevent the blinking of the photocell sensor.

**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 and maximum object length check

During the feeding in of the product the program must monitor the length when =A+03-B5 or =A+03-B13 is covered. If this elapsed time is not between this window an unknown object or multiple products have entered the conveyor and the conveyor module must generate an alarm.

The length check is determined by the following three factors:

1. Length of longest and shortest product [mm];
2. Speed of conveyor track [m/s];
3. Safety margin minimum length [80%];
4. Safety margin maximum length [120%].

$$\text{Minimum length check[ms]} = \frac{(\text{Minimum Object Length})}{\text{Conveyor velocity}} * (\text{Margin})$$

$$\text{Maximum length check[ms]} = \frac{(\text{Maximum Object Length})}{\text{Conveyor velocity}} * (\text{Margin})$$

3.6 Minimum and maximum infeed time

During the infeed of the product the program must also monitor the minimum and maximum infeed time until the product has entered the middle point of the transport conveyor. This means that sensor =A+03-B5 plus =A+03-B13 are unoccupied and A+03-B6 is occupied.



Note

If the conveyor isn't equipped with the object presence detection, this safety mechanism will not work.

If the product has entered the conveyor outside this time window, an unknown object has entered the product conveyor and the Prorunner must generate an fault. This time is determined by the following two factors:

1. Conveyor length [mm];
2. Object length [mm];
3. Conveyor velocity [m/s];
4. Margin maximum time [140%];
5. Margin minimum time [50%].

$$\text{Maximum time} = \frac{((\text{Conveyor length} + \text{minimum object length}) / 2)}{\text{Conveyor velocity}} * (\text{Margin})$$

$$\text{Minimum time} = \frac{((\text{Conveyor length} + \text{maximum object length}) / 2)}{\text{Conveyor velocity}} * (\text{Margin})$$

3.7 Unknown object detection

During the whole program cycle the program must know when to expect certain movements on the sensors. If an unexpected movement is detected, the program must recognize this as a unknown object and generate an alarm. Vertical movement of the Prorunner must be stopped during this alarm.

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

Sensor =A+03-B13 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 – Left side infeed, and Prorunner is moving to outfeed level (conveyor is waiting)

Sensor =A+03-B5 or =A+03-B13 is triggered. During transport both sensors may never be covered.

3.8 No product detected

This function is only possible if the conveyor is equipped with the optional =A+03-B6 sensor that detects an object on the middle point of the conveyor. After the product has successfully entered the transport conveyor this sensor will verify that the product is really on the conveyor. If the sensor =A+03-B6 is uncovered after feeding in or transport to the outfeed level, the program will 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 =A+03-B13 must not be occupied;
- When moving in reverse, the sensors =A+03-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 product conveyor

Bit	Description / Cause	Effect	Solution
1	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 =A+03-B6 is occupied and B5 is unoccupied, or if B5 + B13 are both unoccupied
2	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 =A+03-B6 is occupied and =A+03-B5 is unoccupied, or if =A+03-B5 + =A+03-B13 are both unoccupied
3	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 =A+03-B5 & =A+03-B13 are free/unblocked
4	Length check conveyor. Sensor =A+03-B5 or =A+03-B13 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 =A+03-B5 & =A+03-B13 are free/unblocked
5	Length check conveyor. Sensor =A+03-B5 or =A+03-B13 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 =A+03-B5 & =A+03-B13 are free/unblocked
6	Object should be present on carrier but is not detected by the optional Sensor =A+03-B6	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 =A+03-B5 & =A+03-B13 are free/unblocked
7	Startup 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.
8	Movement of conveyor/drive/motor is blocked. The conveyor will no longer move. (Drivecontrol returns an error)	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.
9	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 =A+03-B5 & =A+03-B13 are free/unblocked
10	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 =A+03-B5 & =A+03-B13 are free/unblocked

4 Appendix A - Sequential function chart

