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SIEMENS example software function blocks

PRORUNNER mk5 with encoder

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1   Version control

Tabel 01:   Version control

Revision	Date	Author	Order number	Reason for revision
1.0	19-10-2017	BJA	Q17150	Initial preparation of description
1.1	19-3-2018	BJA	Q18150	Amendment of description of operation & sensors - Prorunner mk5 Added conveyors - Infeed conveyor RDC2 - Infeed conveyor RDC4 - Outfeed conveyor RDC2 - Outfeed conveyor MBC4
1.2	27-7-2018	BJA	Q18150	Update with newest electrical drawings
4.0	29-10-2018	BJA	Q18150	Update encoder functionality and trace functions Update to V4.0 after internal discussions.
4.1	05-02-2019	BJA	Q19150	Update configuration of mk5 prorunner Added checklist for measurements configuration and motor nameplate Added outfeed conveyor RDC4
4.2	18-03-2020	GVI	Q19150	-Fixed minor issue in speed calculation. - Added support for Interrol Rollerdrive EC5000. - Software now outputs maintance status (Paragraph 6.10). - minor improvements in function description
4.3	07-12-2020	GVI	Q19150	-Updated to TIA v15.1 -Updated reference offset calculation due to change of reference sensor position - Fixed minor issue in empty mode -Minor improvements
4.4	29-04-2020	GVI	Q19150	-Improvement in calculation of infeed window -Added RDC3 in- and outfeed module example (still untested) -Added GC1 in- and outfeed module example (still untested)

4.5	08-12-2021	GVI/BJA	Q19150	- Updates after feedback from QS212382 (see changelogs for more info) - Merged Prmk5 standard and Prmk5 encoder version in 1 project - Added MBC4 infeed module example (still untested)
4.5.1	25-01-2022	GVI	Q19150	- Added description for MBC2 in the RDC2 part of the documentation and software

2   Table of contents

3   Introduction

Read this chapter carefully before commissioning the software for the Prorunner mk5.

3.1   Function of the document

This document attempts to clarify the functionality, operation and components of the Prorunner mk5 for the purpose of commissioning the software function blocks.

3.2   Target audience

This document is intended for technical staff/engineers with knowledge of SIEMENS PLC programming.

3.3   Configuration sheet

The Qimarox configuration sheet has an option to produce a PDF document containing all required settings (Example is showed below)

Prorunner mk5 v4.0

mk5 18XXXXX rev -

ENCODER SOFTWARE SETTINGS

Variable name	Value	Unit	Type
Prorunner.Model	False	-	Bool
Prorunner.Direction	False	-	Bool
Prorunner.ColomnHeight	4700	mm	Real
Prorunner.SupportHeight	72	mm	Real
Prorunner.GearRatio	120,63	-	Real
Prorunner.Speed	0,354	m/s	Real
Prorunner.Carriers	3	-	Int
Prorunner.InfeedLevels	1	-	Int
Prorunner.OutfeedLevels	1	-	Int
Encoder.PulsesPerRevolution	4	-	Int
Options.CarrierObjectDetection	False	-	Bool
Options.CarrierCheckPosition	0	mm	Real
Chain.MinimumLength	3023	mm	Real
Chain.MaximumLength	3073	mm	Real
Chain.TotalLength	8966	mm	Real
ObjectDimension.MaxHeight	400	mm	Real
ObjectDimension.MaxLength	600	mm	Real
ObjectDimension.MinLength	600	mm	Real
ObjectDimension.MaxWidth	400	mm	Real
Automatic.Speed	50,0	Hz	Int
Automatic.Acceleration	1500	ms	Int
Automatic.Deceleration	500	ms	Int
Infeed 1			
Module.Level	1	-	Int
Module.Height	800	mm	Real
Options.LowspeedPickup	False	-	Bool
Conveyor.Speed	0,52	m/s	Real
Conveyor.Length	750	mm	Int
Transport.CycleTime	2,18	s	Real
Transport.Speed	50	Hz	Int
Transport.Acceleration	260	ms	Int
Transport.Deceleration	260	ms	Int
Movement.CycleTime	0	s	Real
Movement.InfeedPosition	0	mm	Int
Movement.WaitingPosition	0	mm	Int
Movement.Speed	0	m/s	Real
Movement.HighSpeed	0	Hz	Int
Movement.LowSpeed	0	Hz	Int
Movement.Acceleration	0	ms	Int
Movement.Deceleration	0	ms	Int

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4   System description

This chapter describes the system description of the Prorunner mk5.
Please read this carefully to get a clear picture of what the software function block supports.

4.1   Basic operation of the Prorunner mk5

The position of the carriers of the Prorunner mk5 are tracked precisely by means of an encoder. With each pulse of the encoder, the positions of the carriers are updated with the calculated distance travelled per pulse.
Before you can work with the Prorunner, you must complete the initialisation procedure. This puts all infeed/outfeed modules in a safe/base position. After that, it is checked whether all carriers are present, and their position is determined again.

In automatic mode, Prorunner runs continuously, provided no input/output conveyor blocks the process.

As soon as a carrier enters the area of an infeed conveyor and the carrier is empty, the feeding in of an object can start; this is only done if there is an object present on the infeed conveyor. The Prorunner tells the infeed conveyor how much time is still available to start and complete the infeed process. If the available time is greater than the time required, the infeed may start. As soon as the infeed cycle starts the infeed conveyor will inform the Prorunner, this is done by handshake commands.

When the infeed run is completed, information is made available by the infeed conveyor. This information includes information relating to the desired discharge/outfeed level and other customer-specific information.
If the infeed cycle takes too long, the Prorunner will stop rotating.

1. Previous carrier is above object height

2. Object is ready

3. Start feeding in when next carrier is empty

4. Object picked up. Destination and information shall be linked to carrier.
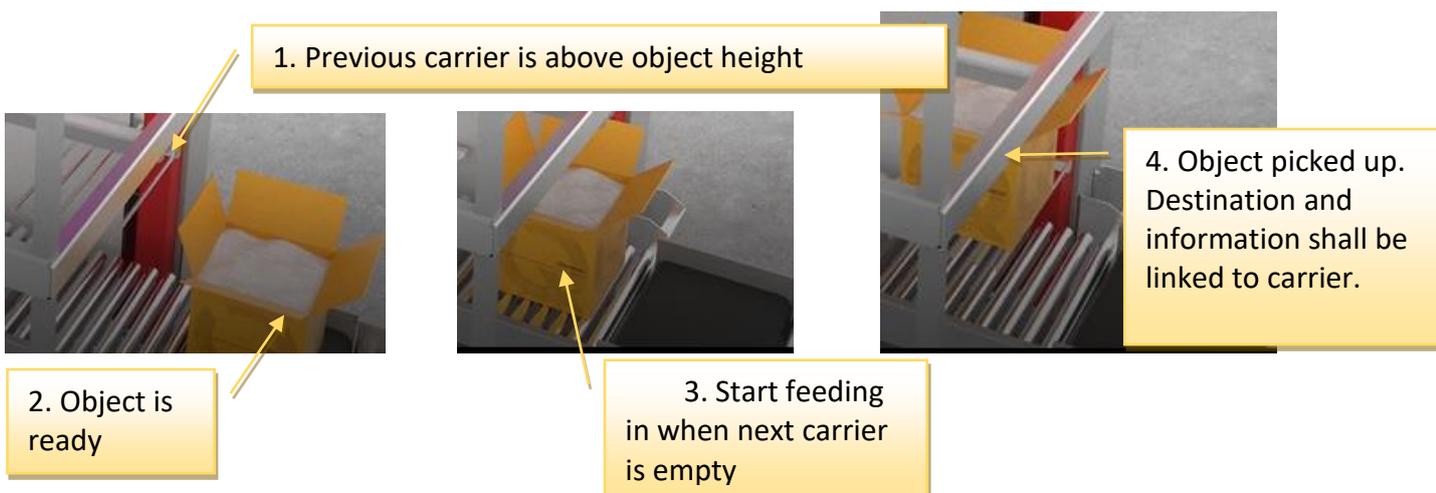
This information is pushed along by the Prorunner until the desired discharge level is reached and there, too, this information is made available by the Prorunner to the outfeed transport module.

1. New carrier enters area of outfeed module

1. Previous carrier has passed

2. Conveyor may start movement

3. Conveyor is ready

4. Transport object once carrier has passed
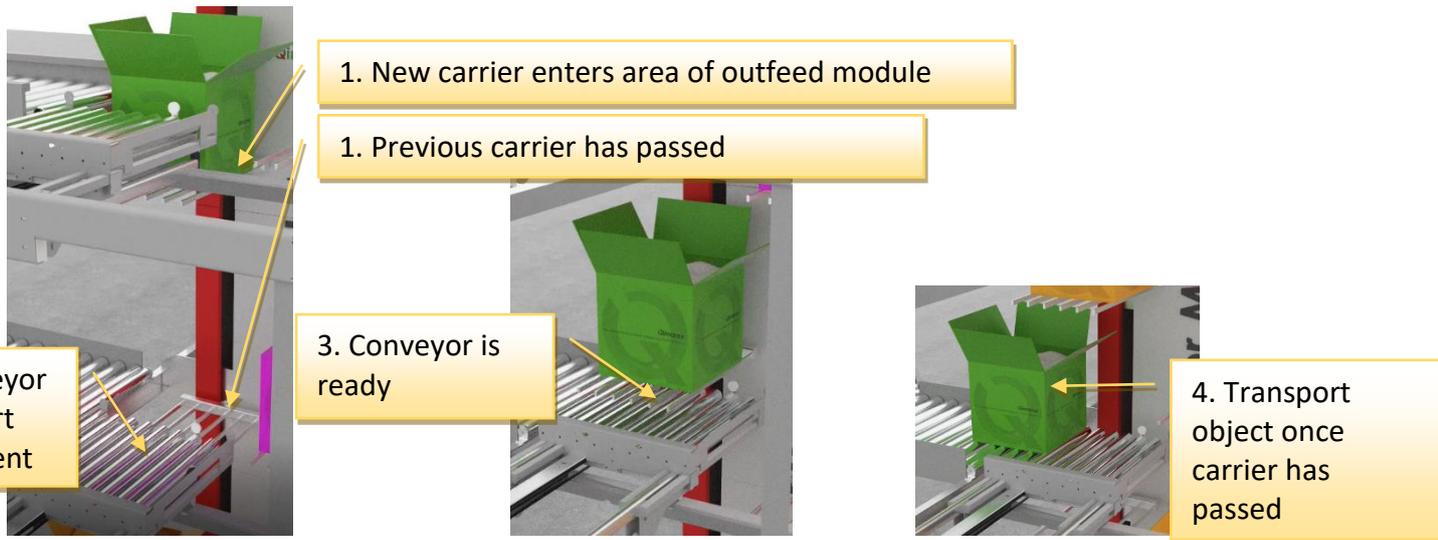
As soon as a carrier enters the area of an outfeed level, and the object on the carrier is also destined for this level, the available time will be shared by the Prorunner.
The outfeed transport module can start its cycle if the available time is greater than the required time. As soon as the outfeed transport module detects the object, it will make the information available to the downstream transport. The outfeed module will start feeding the object out. This must be completed before the next carrier enters the hazardous area, if its not completed the Prorunner will stop rotating.

4.2   Module description Prorunner mk5

The software is made up of modules.
There is the main module and at least 2 sub-modules, of which, 1 infeed module and 1 outfeed module. The main module can work with multiple infeed/outfeed modules.

Figuur 01:   Main module Prorunner mk5

The function of the main module (Prorunner mk5) is:
-    Moving the carriers
-    Keeping track of current position of carriers by means of an encoder
-    Handling communication with the sub-modules (infeed/outfeed conveyors)
-    Protecting the elevator drive Prorunner mk5 + carriers against serious damage

Figuur 02: Sub-module(s) Prorunner mk5

Fixed

Moveable
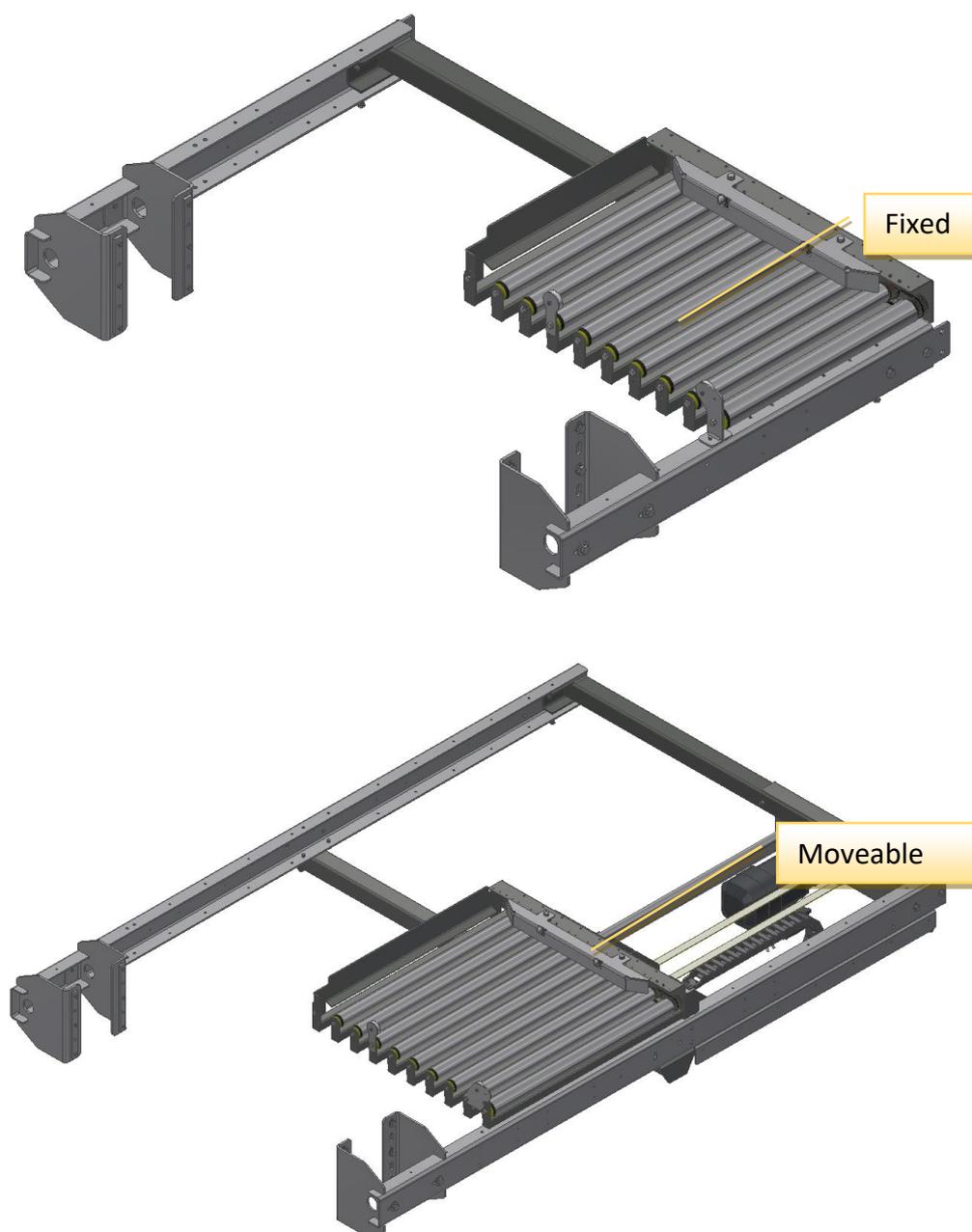
The function of the sub-module(s) (infeed/outfeed conveyors) is:
- Transporting object to desired position
- Handling communication with the main module
- Securing and monitoring its movements and conveyor runs
- Handling communication with upstream/downstream control systems / installations

4.3 Level determination modules Prorunner mk5

Figuur 03: Level determination Prorunner mk5

Outfeed level 3

Infeed level 3

Outfeed level 2

Infeed level 2

Outfeed level 1

Infeed level 1
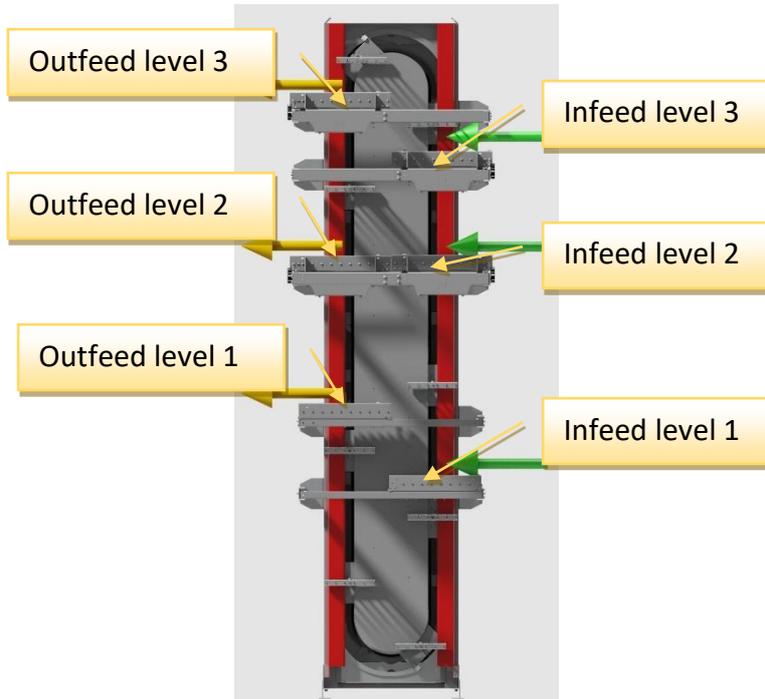
Infeed/outfeed modules must always be numbered from bottom to top.
Infeed modules are always on one side of the elevator and outfeed modules on the other side.
The transport side can be set for each module. In this case, the following can be set, as shown in the following figure:

4.4   Positioning of carriers Prorunner mk5

4.4.1   Encoder functionality

To track the position of all carriers Qimarox installs by default a 24VDC encoder from SEW type name; EI72.

This encoder gives 2 pulses per channel per motor rotation, so in total 4 pulses per motor rotation. We also use the rising/falling edge detection of the encoder pulses, so we have **8 pulses per motor rotation**.

We choose this encoder because these pulses can still be detected by a normal PLC input without the need of a special encoder / highspeed counter hardware. This frequency of the encoder is below 50Hz (20ms) on 1500 rpm.

If you like to use an encoder with higher resolution specifications, you are responsible for the position tracking and distance per pulse calculation!

A normal pulse train look like listed below;
This is an example of forward movement of the Prorunner
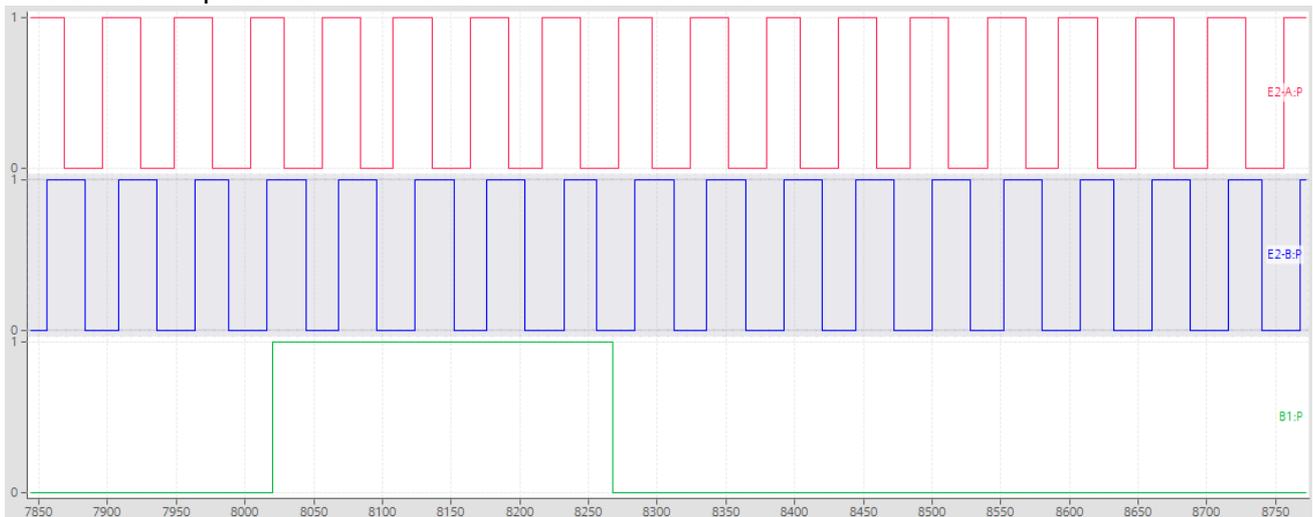
This is an example of backwards movement of the Prorunner
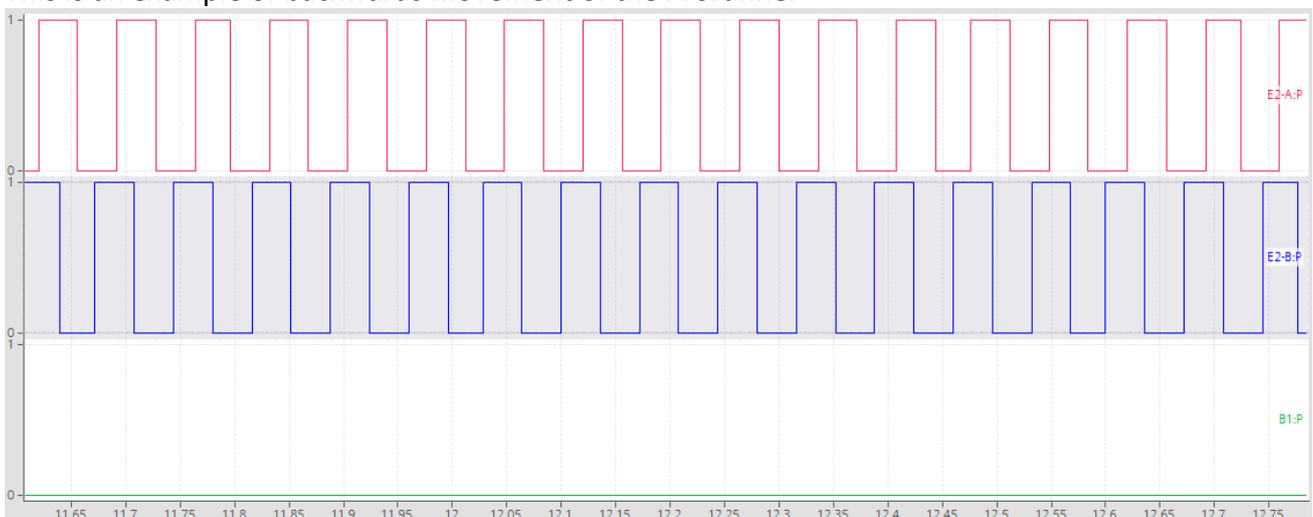
4.4.2 Carrier reference position

The following figure shows the position at which the carrier is aligned with a fixed (calculated) reference. When the reference sensor is triggered a fixed offset value is loaded in the carrier position.
The '0' position is at the heart of the lower chain wheel.
Each carrier is aligned once again after a complete cycle, so the position remains reliable.

Figuur 04: Carrier reference position

Direction of rotation

Direction of rotation

Infeed module

Reference position by sensor

'0' position carriers
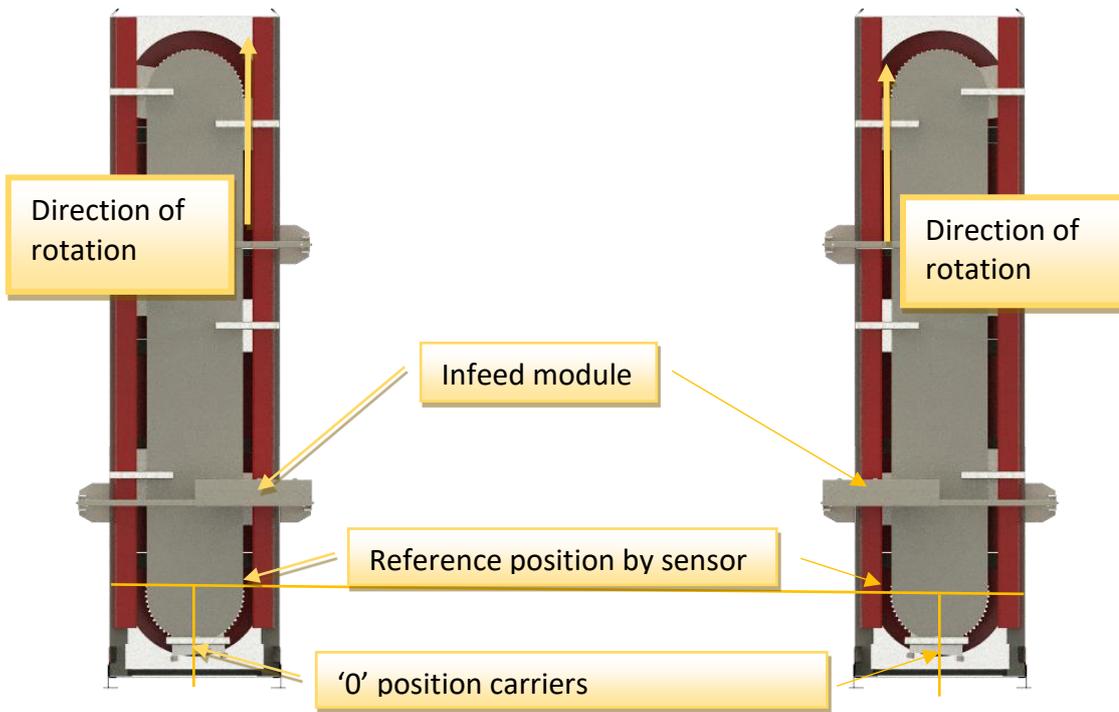
4.4.3 Carrier in area of infeed module

The following figure can be used to determine whether a carrier is within the area of the infeed module.
If a previous carrier is past the highest product point, the next carrier is made available to the infeed module, only when it is empty.

Figuur 05: Carrier in area of infeed module

Minimum spacing between carriers

Area previous carrier passed highest product

Carrier in area, ready for infeed
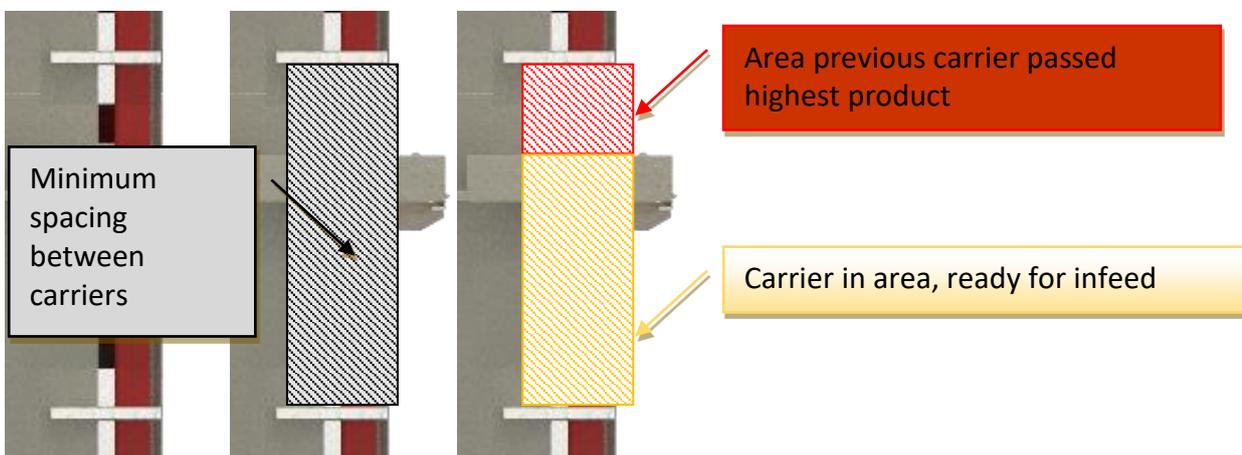
4.4.4   Carrier in area of outfeed module

 The following figure can be used to determine whether a carrier is within the area of the outfeed module.
If a carrier is past the outfeed module then information has been transferred
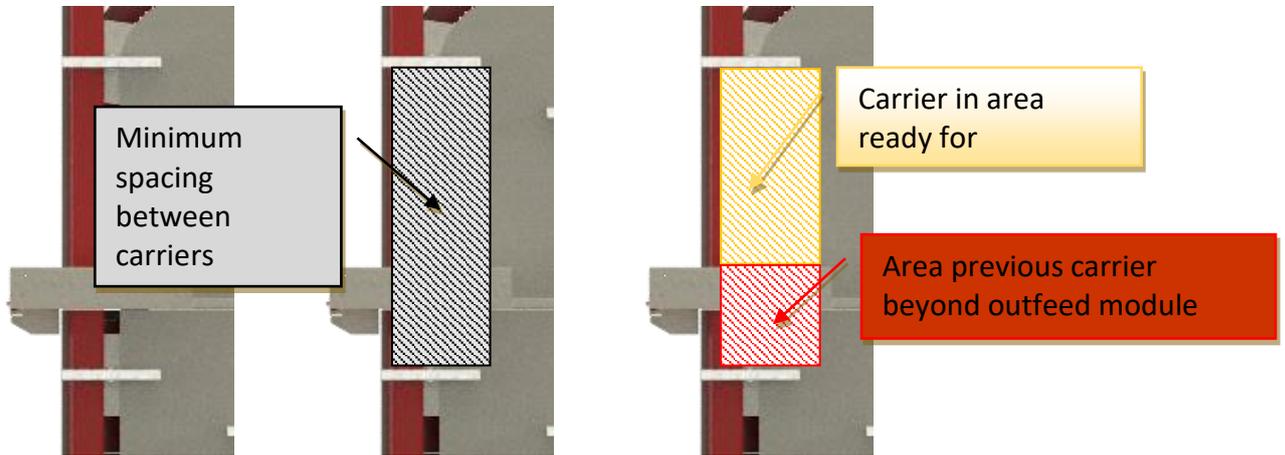
4.4.5   Carrier in the area stop in the event of faults/blockages

If a carrier enters the hazardous area at an infeed/outfeed module and there is a blockage/fault, the carrier must stop. Stopping already happens in the yellow area so that the red area remains free. This allows the Prorunner mk5 to make a controlled stop.
These areas apply to both manual and automatic mode.
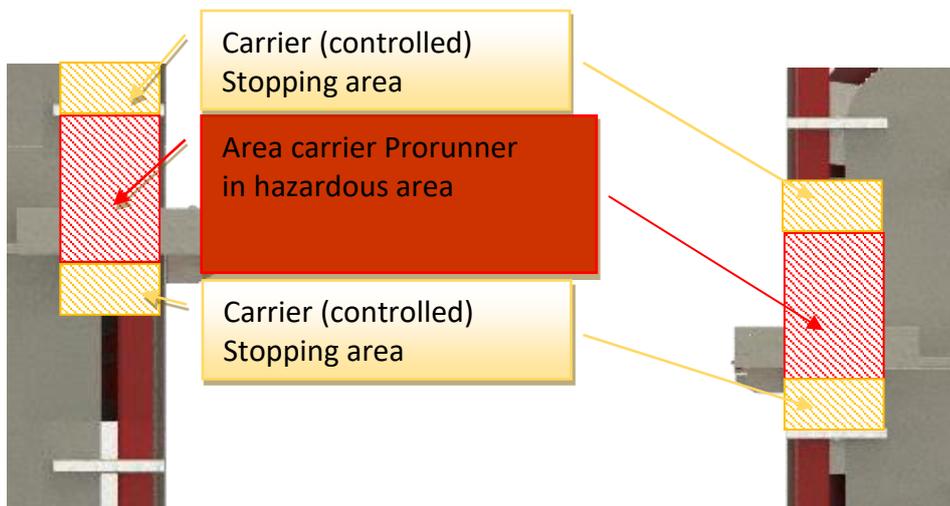
If the PRORUNNER mk5 is blocked by a sub-module, Feedback of the following information is shown; The level number, carrier number is and whether this has been done in manual or automatic mode.

4.4.6   Carrier in data transfer area

As soon as the carrier passes the infeed module (yellow area) and the infeed module has an object ready, the Prorunner will take over information from the infeed module
Information:
- Destination level number
- Source level number
- Installation-dependent information (Optional, to be determined per installation)

Carrier in area of data transfer
&
Command object picked up (if present)

Area carrier still in area infeed module

Direction of rotation
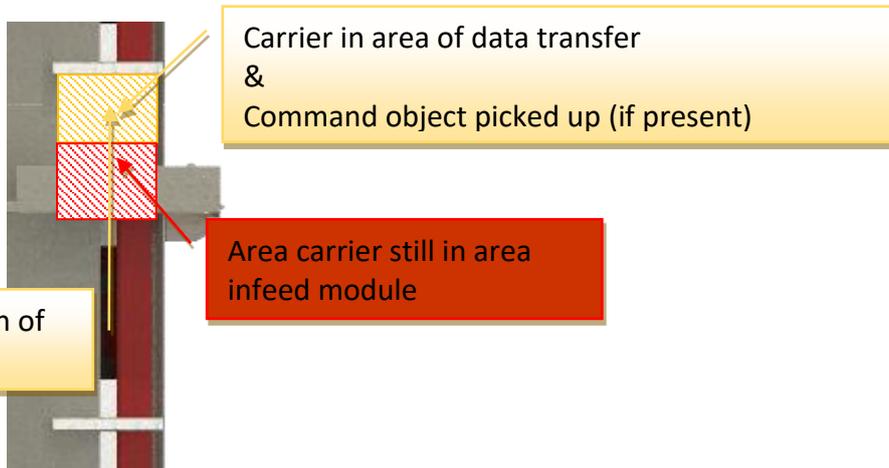
As soon as the carrier has deposited/dropped an object onto the outfeed module, information is transferred when it has passed the outfeed module.
As soon as the outfeed module has copied the information, which is indicated by the communication interface, the Prorunner will delete the information.

Data transfer:
- Destination level number
- Source level number
- Installation-dependent information (Optional, to be determined per installation)

Direction of rotation

Area carrier still in area outfeed module

Carrier in area of data transfer
&
Command object deposited/dropped (if present)
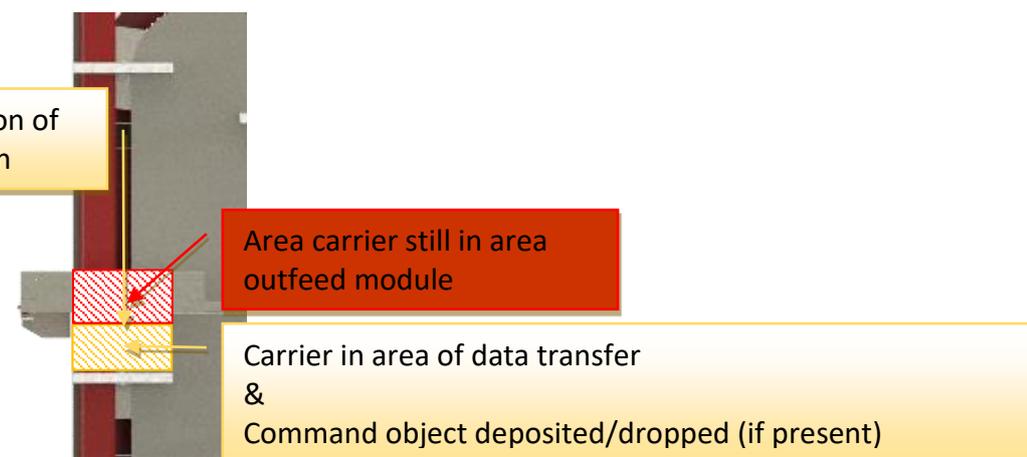
These areas work in both automatic mode and manual mode!

4.5   Starting conveyor run Prorunner mk5

Starting a conveyor run, through the infeed/outfeed sub-modules, depends on the carrier availability of both the Prorunner mk5 and the status of the sub-module. Below it is explained for each module how the availability is determined.

4.5.1   Transport by infeed module

If the infeed module has an object available, it notifies the PRORUNNER mk5 of this by means of the communication interface. Once the previous carrier is past the point of highest object, the remaining length/area of the carrier in the area of the infeed module is determined.
An available time is calculated using this remaining spacing between carrier and infeed module.
If the time required for the entire infeed procedure is less than the available time, the infeed procedure may be started.

Minimum spacing between carriers
&
Carrier in area of infeed module

Previous carrier past highest product

Carrier in area available for infeed module (Provided no object present)
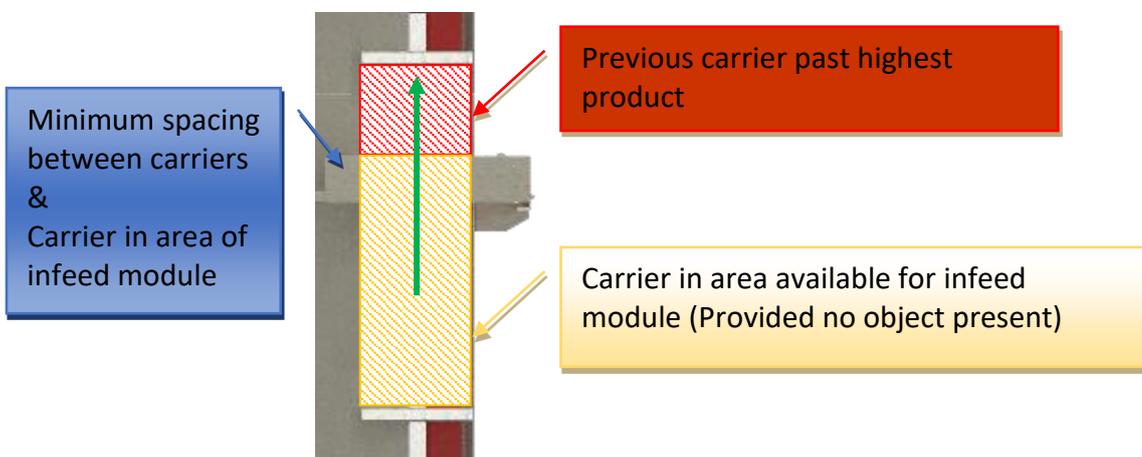
Example:
Minimum length between carriers: 1500mm
Maximum height objects: 400mm
Height of infeed module: 2000mm
Carrier position: 900mm
Speed Prorunner: 0.5m/s

Carrier Prorunner in infeed module area:
Carrier position: < Height of infeed module + Maximum height objects
&
Carrier position > Height of infeed module – (Maximum height objects + Minimum length between carriers)

Available time:
(Height of infeed module – Carrier position) / Speed Prorunner:
2000 – 900 = 1100 / 0,5 = <u>2.2s</u>

The available time decreases when the Prorunner moves, until it falls below the required time.
On the next page you can find a trace overview of the availability time recorded on a testing module.
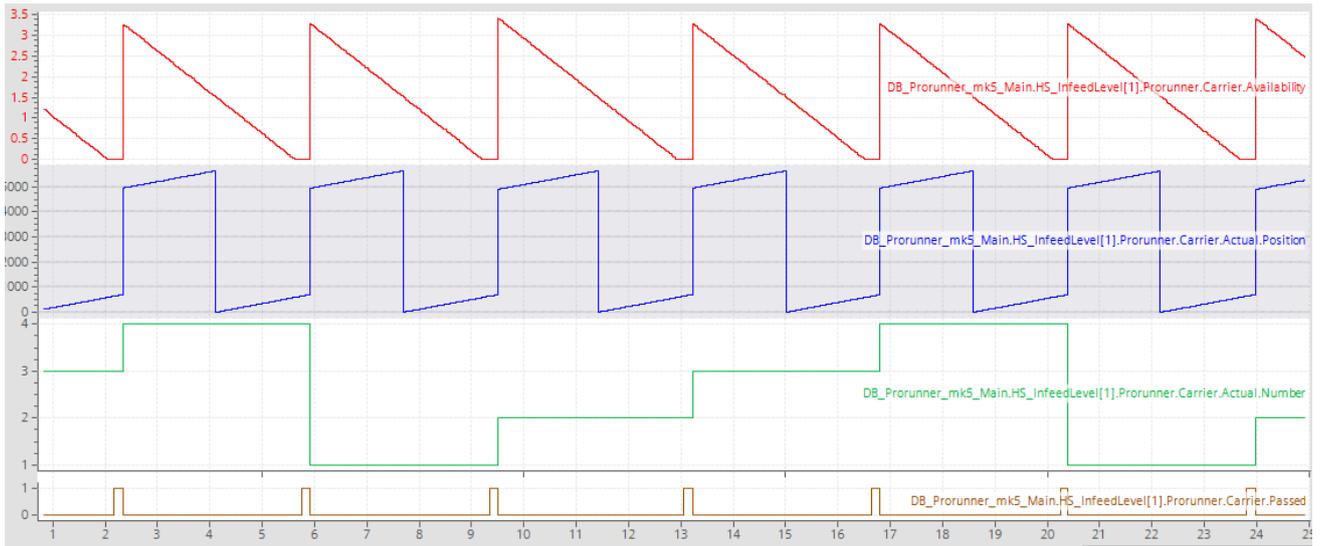
Red line   = Available time
Blue line   = Position of carriers
Green line = Carrier number
Brown line = Carrier passed infeed module

4.5.2 Transport by outfeed module

If the carrier has an object available for the relevant outfeed module, the Prorunner communicates this through the communication interface to the outfeed module. Once the previous carrier is past the point of the highest object, the remaining length/area of the carrier within the area of the outfeed module is determined.

An available time is calculated using this remaining length.

This time does not limit the outfeed module. If an object on the carrier must go to this level, the carrier will wait for the safe position above the outfeed module if it is not yet ready.

The available time only shows whether the outfeed module can complete its procedure/cycle without stopping the Prorunner.

Minimum length between carriers & Carrier in outfeed module area

Carrier in area available for outfeed module.

Previous carrier beyond outfeed module and beyond data transfer area
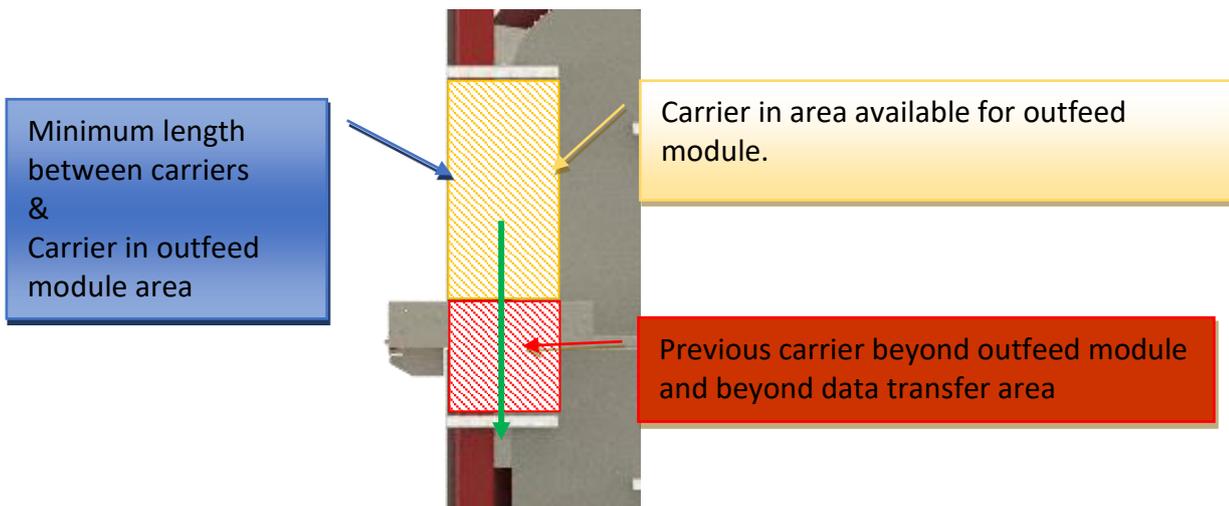
Example:

Minimum length between carriers: 1500mm
Data transfer area: 300mm
Height of infeed module: 8000mm
Carrier position: 6800mm
Speed Prorunner: 0.5m/s

Carrier Prorunner in infeed module area:
Carrier position > Height of infeed module – (Data transfer area – Minimum length between carriers)
&
Carrier position < Height of infeed module + Data transfer area

Available time:
(Height outfeed module – Carrier position) / Speed Prorunner
8000 – 6800 = 1200 / 0.5 = <u>2.4s</u>

The available time decreases when the Prorunner moves.
On the next page you can find a trace overview of the availability time recorded on a testing module.
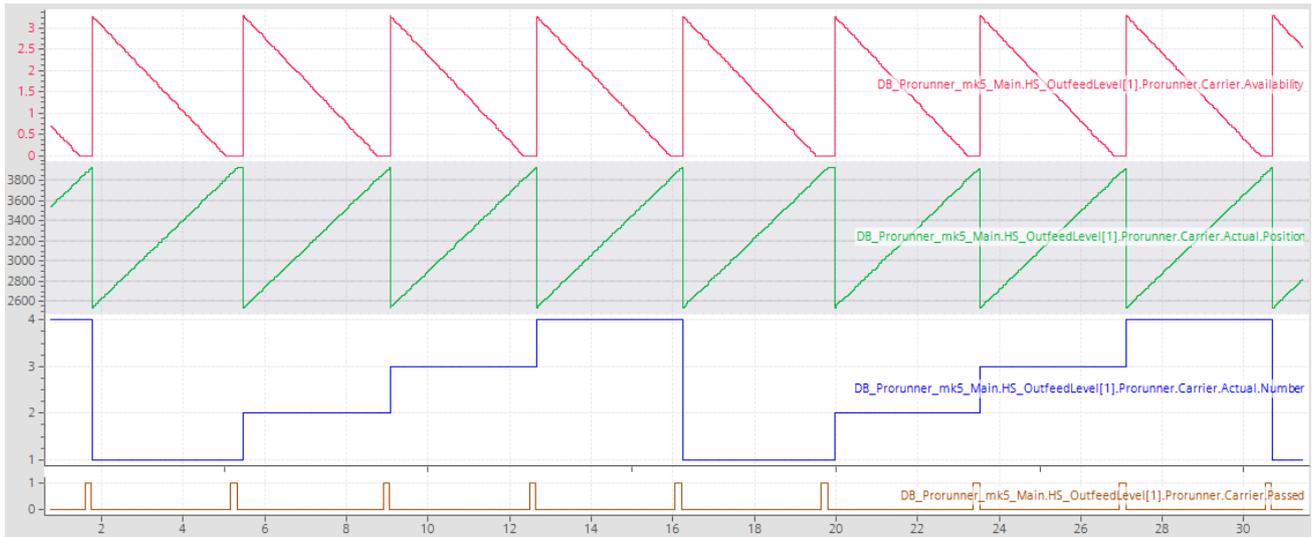
Red line = Available time
Green line = Position of carriers
Blue line = Carrier number
Brown line = Carrier passed infeed module

4.6   Initialisation Prorunner mk5

To bring the Prorunner mk5 to the basic position and to ensure that the position of all carriers is reliable, an initialisation procedure must be started.

The initialisation must be carried out:
- Prorunner is switched on.
- Prorunner encoder has proven to be unreliable. Possibilities: Mechanical obstructions, pulses missed, incorrect follow-up of encoder pulses, distance between carriers does not correspond to configuration.

During initialisation, all transport conveyors must be empty and in a safe position. This is checked before the Prorunner can start to run.
Only the fixed outfeed conveyor (level 1) can be used to transport any remaining products out of the system.

4.6.1 Flowchart initialisation Prorunner mk5

START SITUATION PRORUNNER

InitialisationMode = TRUE

Initialisation.Ready = FALSE

START INITIALISATION PROCEDURE

Initialisation procedure infeed modules

Initialisation procedure outfeed modules

Alarm / Time-out

Alarm / Time-out

Alarm / Time-out

Check presence of objects & go to wait positon

Nee

Nee

Check presence of objects & go to wait positon

Empty & on wait position

Empty & on wait position

Ja

Ja

Initialisation procedure Prorunner mk5

Rotation of carriers

Reference sensor detection

No < configuration

Check chain length between carriers

..Abnormality → Alarm..

Good

Amount of carriers

..No > configuration → Alarm..

Equal to configuration & Total chain length reached

Initialisation procedure completed

Initialisation procedure Prorunner mk5

V1.0 – BJA – 13/9/2017
V1.1 – BJA – 19/3/2018

4.7   Communication modules Prorunner mk5

To achieve a smooth operation, the main module and sub-modules must communicate with each other. This is done by means of a communication interface.

See the below for the communication overview.

The main module communicates with the encoder and sub-modules.
There is a separate software block for the encoder. For the encoder it is important that this is called within certain time limits, otherwise there is a possibility that pulses will be missed. A separate time task is reserved for this, which ensures that the encoder is called every 2 ms.
Communication runs in both directions between the main module and sub-modules in order to determine when objects can be fed in and whether outfeed modules are ready to be received. Different commands are used to monitor whether sub-modules complete everything within time limits; if not, the main module is stopped.

A sub-module also communicates with the downstream transport system in order to infeed/outfeed products in a controlled way. This communication also determines which destination an object has, and it is possible to send information with it.

4.7.1   Flow chart communication Prorunner mk5

Communication overview Prorunner mk5

V1.0 – BJA – 13/09/2017
V1.1 – BJA – 19/03/2018
V1.2 – BJA – 05/02/2019
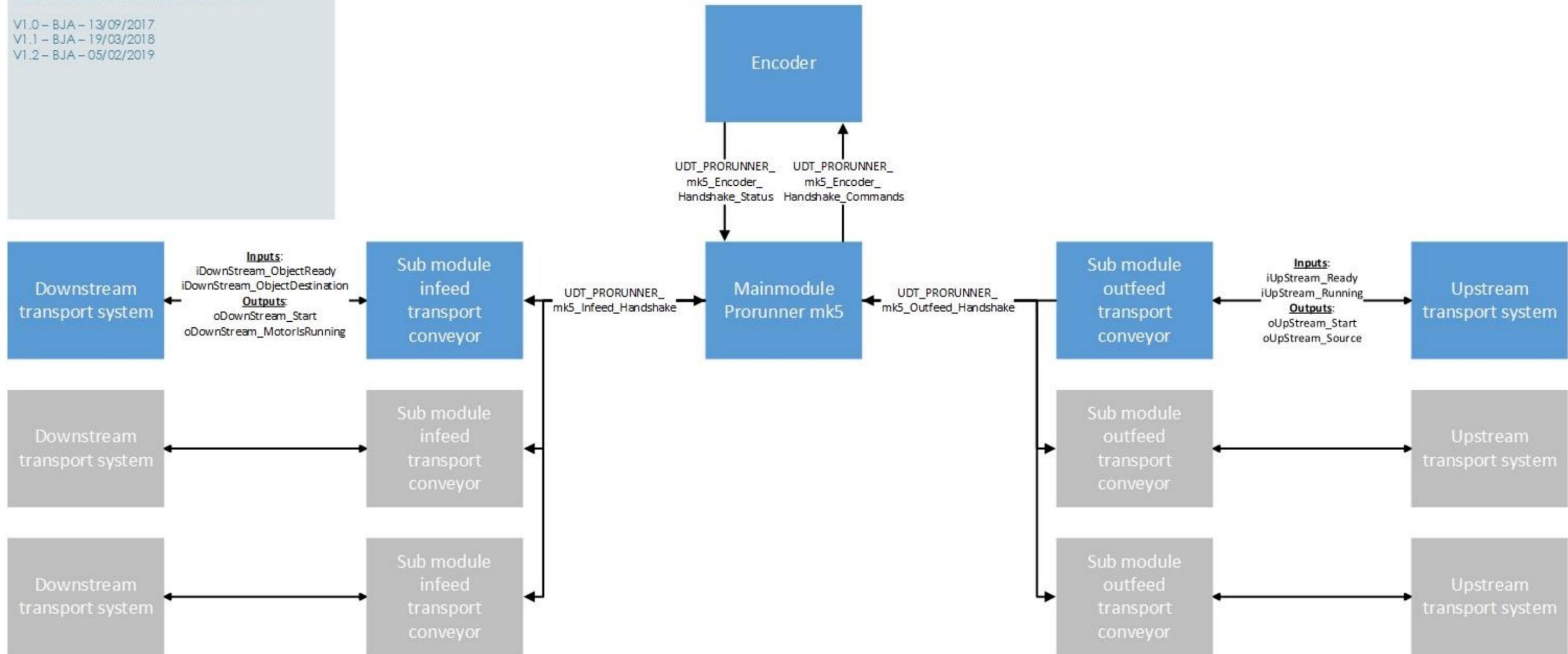
4.8   Chain stretch Prorunner mk5

The chain type used for the mk5 is subject to a chain stretch. This is caused by wear on the chain bearings causing play which results in chain elongation.

To compensate for this, it is determined what the actual distance of a complete cycle is and what the initial total chain length was.
This will produce a chain stretch as a percentage.

Example:
Chain length is originally 6 carriers x 1500mm chain length in between = 9000mm
The encoder counts the actual distance of a complete cycle = 9100mm

Percentage = (9100/9000 – 1/) * 100 = 1.11% stretch

This percentage is offset against the distance travelled per encoder pulse.
With this, the complete round that is made will again correspond to the initial total chain length.

The chain stretch percentage is only calculated when 10 complete rounds have been run. The calculated percentage is the average of these 10 rounds.

Warning is created when chain stretch reaches > 2,5%
Alarm is created when chain stretch reaches > 5%

5   Hardware configuration

This chapter describes the hardware used to program/test the software function block.

5.1   Supported PLC types

Tabel 02:   PLC types

Type	PLC	Article number	Firmware version	Required cycle time
S7-1200	CPU 1212C DC/DC/DC	6ES7 212-1AE40-0XB0	V4.2	7-8 ms. (10 Max.)
S7-1500	CPU 1513-1 PN	6ES7 513-1AL01-0AB0	V2.1	1-2 ms. (6 Max.)

We recommend a standalone 1200 PLC, where the PLC is assigned to the Prorunner installation. This to make sure no fluctuations in cycle time can cause

5.2   Cycle time

The required cycle time (see table above) was tested with a setup of 6 racks with 3 infeed modules and 3 outfeed modules. This time will increase with a configuration of more carriers and sub-modules and decrease with less.

5.3   TIA Portal version

The software is made in TIA Portal V14 + SP1. This is the minimum version that is needed.
V14 + SP1 supports the use of SCL networks in a LAD function block.

6 Function block main module Prorunner mk5

Figuur 06: Function block main module
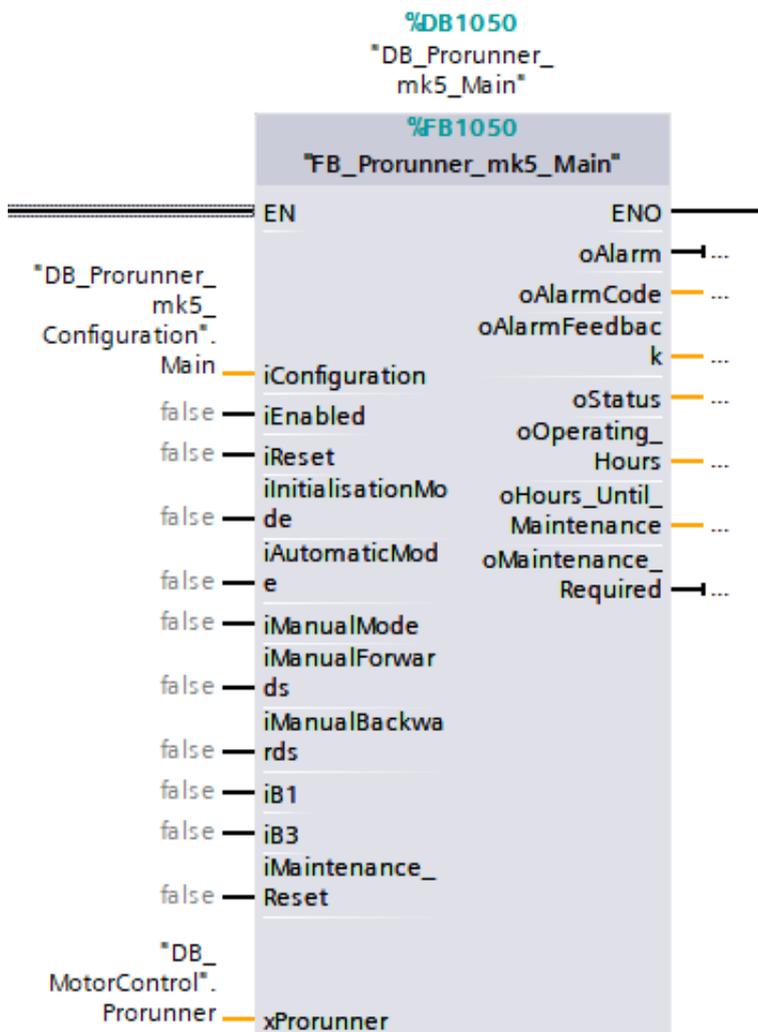
With this software block the main module is called that works as described in Chapter 2.

6.1   Function block specifications

Block name:	FB_PRORUNNER_mk5_Main
Block number:	FB1050
Version:	V4.2
Required PLC blocks:	TON_TIMER
Required PLC data types:	UDT_MotorControl
	UDT_Prorunner_mk5_Carrier
	UDT_Prorunner_mk5_Encoder_Configuration
	UDT_Prorunner_mk5_Encoder_Handshake_Command
	UDT_Prorunner_mk5_Encoder_Handshake_Status
	UDT_Prorunner_mk5_Infeed_Handshake
	UDT_Prorunner_mk5_Outfeed_Handshake
Function block call	Cyclical (OB1)
Optimised block access	Yes/~~No~~
Programming language	LAD, SCL
STEP7 version	TIA Portal V14 + SP1

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6.2 Flow chart Functionality main module
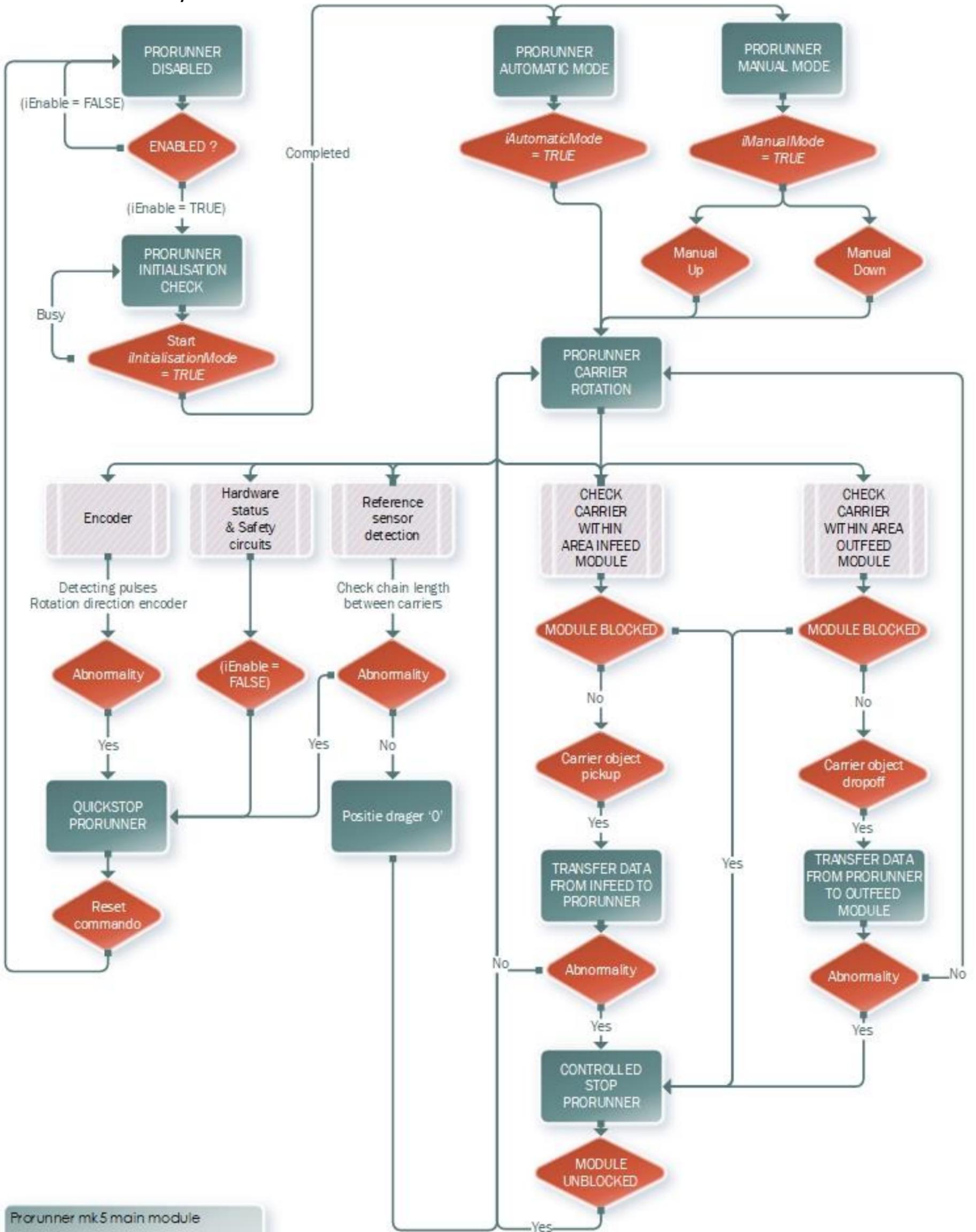
Prorunner mk5 main module

V1.0 – BJA – 18/9/2017
V1.1 – BJA – 19/3/2018

6.3   Components main module Prorunner mk5

Figuur 07: Components Prorunner mk5 (Main module)
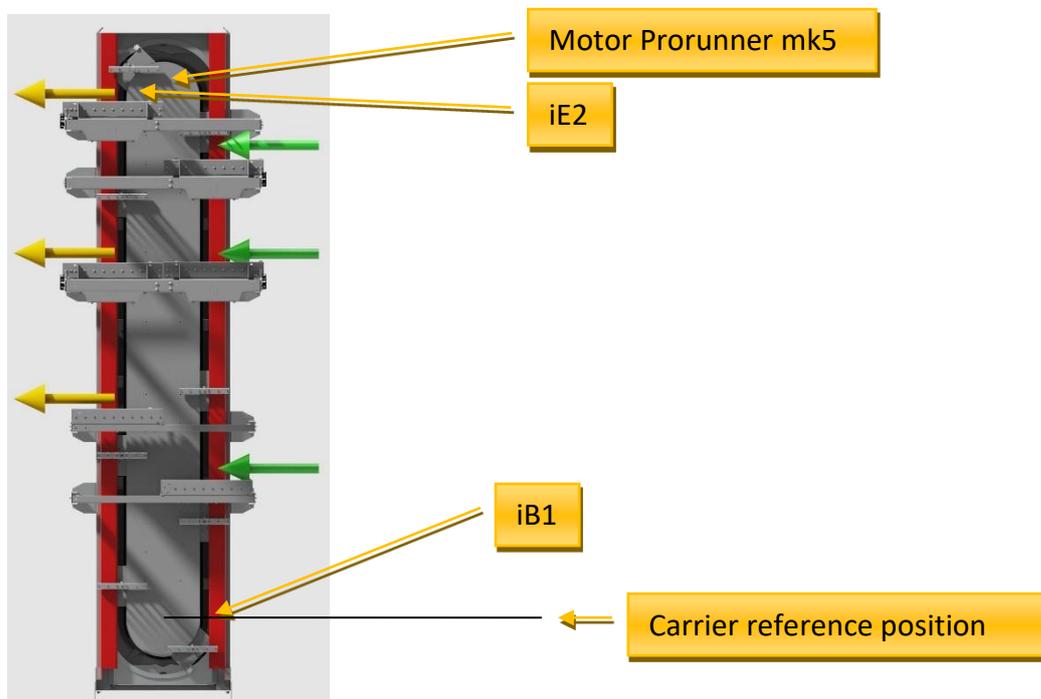
Tabel 03:   Components main module

Code		Type
iB1	Sensor Zero / basic position carrier (Position dependent on primary direction of rotation)	IME18-08BPSZC0K
E2	Encoder main module Prorunner	EI72 build in from SEW
iB3	Sensor/ photocell: Product position monitoring. This photocell monitors whether the product has completely entered the infeed roller conveyor.	GL6-P4211 C42-2

6.4 Configuration main module Prorunner mk5

The configuration consists of one UDT → UDT_Prorunner_mk5_Encoder_Configuration.
Everything can/will be determined from the Qimarox configuration sheet.
We strongly recommend using the PDF configuration sheets provided by Qimarox for this.

Tabel 04: Configuration main module

Naming	Data type	Unit	Description
Prorunner.Type	Bool	0/1	0=Standard, 1=XL
Prorunner.Direction	Bool	0/1	Direction of rotation of lift, seen from front 0=CW, 1=CCW
Prorunner.ColomnHeight	Real	mm.	Total height of the Prorunner
Prorunner.SupportHeight	Real	mm.	Height between floor and bottom of Prorunner
Prorunner.GearRation	Real	i	[i] Gear ratio of the motor (see motor nameplate)
Prorunner.RPM	Real	rpm	[rpm] Rotations of the motor per minute on 50Hz (see motor nameplate)
Prorunner.InfeedLevels	Int	0..99	Number of infeed sub-modules / levels
Prorunner.OutfeedLevels	Int	0..99	Number of outfeed sub-modules / levels
Encoder.PulsesPerRevolution	Int	1..1024	Number of pulses per motor revolution (EI72 = 4)
Options.CarrierObjectDetection	Bool	0/1	Monitoring of empty carriers at checking position.
Options.CarrierCheckPosition	Real	mm.	Checking position object detection on carrier (checking by means of sensor iB3)
Carrier.Amount	Int	0..99	Number of carriers present on Prorunner mk5
Carrier.LoweringAdapter	Real	mm.	Minimum spacing between carriers
Carrier.MinimumSpacing	Real	mm.	Minimum spacing between carriers
Carrier.MaximumSpacing	Real	mm.	Maximum chain length between carriers
Carrier.TotalTravelLength	Real	mm.	Total travel length of one carriers (complete modulo)
ObjectDimension.MaxHeight	Real	mm.	Maximum height of objects
ObjectDimension.MaxLength	Real	mm.	Maximum length of objects
ObjectDimension.MinLength	Real	mm.	Minimum length of objects
ObjectDimension.MaxWidth	Real	mm.	Maximum width of objects
Speed.Frequency	Int	Hz	Number of Hertz of the motor (Nominal = 50 Hz)
Speed.Acceleration	Int	ms.	Number of milliseconds to accelerate from standstill to desired speed
Speed.Deceleration	Int	ms.	Number of milliseconds to decelerate from current speed to standstill

6.5 Inputs main module Prorunner mk5

Inputs are required for the system to function properly. Here the required sensors are declared, and the status of the installation.

Tabel 05:   Inputs main module Prorunner mk5

Naming	Data type	Unit	Description
iConfiguration	UDT		**UDT_Prorunnner_mk5_Encoder_Configuration** UDT as discussed in section below. This contains all requirements/settings for the installation to function properly
iEnabled	Bool	0/1	System is switched on. Safety functions are operational, hardware has no problems, and power supplies to any controllers are switched on. 1 = Installation switched on
iReset	Bool	0/1	Reset command to reset faults.
iInitialisationMode	Bool	0/1	Start of initialisation procedure. Must remain present until the initialisation procedure is completed. Automatic / Manual mode is being ignored. 1=Initialisation is active
iAutomaticMode	Bool	0/1	Installation is in automatic mode. The direction of rotation of the PRORUNNER is only in the primary direction.
iManualMode	Bool	0/1	Installation is in manual mode. Manual commands influence the direction of rotation.
iManualUp	Bool	0/1	Command for upward movement (seen from input modules) in manual mode
iManualDown	Bool	0/1	Command for downward movement (seen from input modules) in manual mode
iB1	Bool	0/1	Carrier reference position
iB3	Bool	0/1	Empty carriers message by means of photocell detection (optional)
iReset_Maintenance	Bool	0/1	Reset the time until maintenance. (Use after providing servicing the Prorunner)

6.6   Outputs main module Prorunner mk5

Outputs must be declared by the customer.
Outputs provide feedback such as faults, status and communication.

Tabel 06:   Outputs main module Prorunner mk5

Naming	Data type	Unit	Description
oAlarm	Bool	0/1	Fault active
oAlarmCode	Int	0	Active fault code (See chapter 'Faults' for the correct overview)
oAlarmFeedback	Word	0	Active fault feedback for HMI. One bit is reserved for each fault. Fault 1 = bit 0, fault 2 = bit 1, etc.
oStatus	Int	0	See chapter 'Status Prorunner mk5' for further information.
oOperating_Hours	Dint	#	Displays the total movement time of the Prorunner
oHours_Until_Maintenance	Dint	#	Displays the remaining operating hours until it is advised to perform maintenance on the Prorunner
oMaintenance_Required	Bool	0/1	Signal that maintenance interval is due, and maintenance is advised.

6.7   Motor interface main module Prorunner mk5

One motor is used for the main module. All commands are prepared via this motor interface to handle different forms of motor actuation.
For more information, please refer to chapter '16 - Motor interface'

We recommend carrying out the motor in conjunction with a frequency controller because there are different requirements for actuation:
- Mechanism is less loaded if engine starts slower by means of acceleration
- Quickstop must be possible <= 100ms.
  Quickstop = quickest possible stop with pre-defined deceleration in controller
- Energize must be possible (This is not a requirement, but more an extra function/security)
  Energize = Motor must be capable of being energized without moving; this is used to keep the lift in place if the brake is not functioning properly.

The software block has been tested with a SEW frequency controller: → Movitrac B → MC07B0015-4-5A3-S0
This one used a 1.5kW motor. Communication can be done through S-Bus or I/O

Tabel 07:   Motor interface main module Prorunner mk5

Naming	Data type	Unit	Description
xProrunner	UDT		**UDT_MotorControl** Motor interface Prorunner

6.8   Status main module Prorunner mk5

The status of the Prorunner is output, giving the user a clear picture of the status/movements of the Prorunner mk5.

Tabel 08:   Status main module Prorunner mk5

Code	Description
0	NO ACTION / SWITCHED OFF: Prorunner switched off / no mode active
1	FAULT: Prorunner blocked by fault
2	WAITING: Prorunner ready for use / start
3	MANUAL OPERATION / MANUAL MODE: Prorunner in manual mode
4	TURNING / AUTOMATIC MODE: Prorunner moving and ready
5	EMPTY SIGNAL: PRORUNNER waits at infeed level until infeed conveyor indicates that an object is ready for infeeding.
6	STOPPED DUE TO INFEED TIME PERIOD OR BLOCKING OF INFEED MODULE: Prorunner waits for safe position under or above the relevant infeed module until the infeed module indicates it has an object ready for picking up or is no longer blocked.
7	STOPPED DUE TO OUTFEED MODULE REMAINING BUSY OR BLOCKAGE OUTFEED MODULE: Prorunner waits for safe position above or under the relevant outfeed module until outfeed module indicates it no longer has an object or is no longer blocked.
10	INITIALISATION PROCEDURE ACTIVE Prorunner busy with initialisation procedure.
11	INITIALISATION PROCEDURE READY Prorunner ready with initialisation procedure.

6.9   Faults main module Prorunner mk5

The software function block issues an outfeed signal and a fault code in the event of a fault.
With the outfeed signal 'oAlarm' it is possible to indicate a fault by, for example, switching on a red lamp. With the fault code 'oAlarmCode' you can indicate this better.
With the fault word 'oAlarmFeedback' you can generate a clearly defined fault message by means of an HMI. The faults are divided over 16 bits. Code 1 = bit 0 ... Code 16 = bit 15.
Below is the list of faults that may be active with explanation/result and solution.
Some faults are only possible when selecting the relevant options.

Tabel 09:   Faults list main module Prorunner mk5

Code	Description / Cause	Effect	Solution
5	Movement of Prorunner blocked. Encoder detects no pulses within maximum time limits.	Prorunner is blocked. Quickstop functionality is activated (if possible) Initialisation must be carried out again.	Check Prorunner for blockages, if no blockages can be determined: Check the operation/adjustment encoder. Check whether encoder function block is called fast enough on the PLC; this must be <= 2ms. Give the reset command to reset the fault (iReset).
6	Prorunner moving in wrong direction; the encoder detects incorrect direction of rotation.	Prorunner is blocked. Quickstop functionality is activated (if possible) Initialisation must be carried out again.	Check direction of rotation encoder Prorunner. Give the reset command to reset the fault (iReset).
7	Movement of PRORUNNER seen while motor not being controlled.	Prorunner is blocked. Energize functionality is activated (if possible) Initialisation must be carried out again.	Check mechanical adjustment (Rem) PRORUNNER. Give the reset command to reset the fault (iReset).
8	Configuration is not entered correctly	Prorunner is blocked. Initialisation is not possible.	Check configuration settings. Make sure that everything is entered correctly and not below the minimum value.
10	Carrier not seen within maximum distance margin between carriers.	Prorunner is blocked. Quickstop functionality is activated (if possible) Initialisation must be carried out again.	Check settings chain lengths in the configuration; check this against the actual distance between the carriers. Check mechanical tolerances of the carrier re the reference sensor. Give the reset command to reset the fault.

Code	Description / Cause	Effect	Solution
11	Unknown carrier reported. Distance between carriers below the minimum distance margin between carriers	Prorunner is blocked. Quickstop functionality is activated (if possible) Initialisation must be carried out again.	Check settings chain lengths in the configuration; check this against the actual distance between the carriers. Check sensor i = MM-B1, since sensor was triggered earlier than usual. Give the reset command to reset the fault.
12	Carrier not empty, during inspection in combination with sensor iB3.	Automatic operation is stopped.	Remove object from carrier. Give the reset command to reset the fault.
13	Fault controller/inverter PRORUNNER.	Automatic operation is stopped.	Check operation/fault controller/drive. Make sure that it is ready for operation again. Give the reset command to reset drive fault. Wait until the controller is ready again.
14	Initialisation necessary	Prorunner is blocked.	Perform initialisation
15	Initialisation procedure TIMEOUT: Procedure takes longer than the total chain length with +50% margin!	Initialisation has not been completed. Automatic / Manual mode is not possible!	Check status sub infeed/outfeed modules, and restart procedure
16	Initialisation procedure ERROR: • Not all carriers seen by sensor iB1 • Chain length between carriers is too short • Chain length between carriers is too long • Total chain length is incorrect	Initialisation has not been completed. Automatic / Manual mode is not possible!	Check adjustment sensor iB1 PRORUNNER. Check configuration PRORUNNER. Restart procedure by giving initialisation command again.

6.10 Maintenance Prorunner mk5

During normal operation, the software will count the operating hours of the Prorunner. If this time exceeds the maintenance interval, the Prorunner should be serviced. The Software block is equipped with in- and outputs to generate an maintenance required warning and reset the maintenance data.

Please use the maintenance required bit to generate a warning on the HMI screen. Refer to paragraph 6.5 and 6.6 for more information regarding this.

7 Function block encoder Prorunner mk5

```
                        %DB1051
                     "DB_Prorunner_
                       mk5_Encoder"
            ┌──────────────────────────────────┐
            │            %FB1051               │
            │      "FB_Prorunner_mk5_Encoder"  │
  ──────────┤ EN                          ENO  ├──────────
   %I0.1:P   │                                  │
 "iE2-A":P ──┤ iE2_A                            │
   %I0.2:P   │                                  │
 "iE2-B":P ──┤ iE2_B                            │
   %I0.0:P   │                                  │
  "iB1":P ───┤ iB1                              │
            │                                  │
 "DB_Prorunner_                                 │
  mk5_Main".HS_                                 │
Encoder_Command ─┤ xHS_Commands                 │
            │                                  │
 "DB_Prorunner_                                 │
  mk5_Main".HS_                                 │
Encoder_Status ──┤ xHS_Status                   │
            │                                  │
 "DB_Prorunner_                                 │
  mk5_Main".Carrier ─┤ xCarrier                 │
            │                                  │
 "DB_MotorControl".  │ xMotorControl_           │
    Prorunner ───────┤ Prorunner                │
            └──────────────────────────────────┘
```
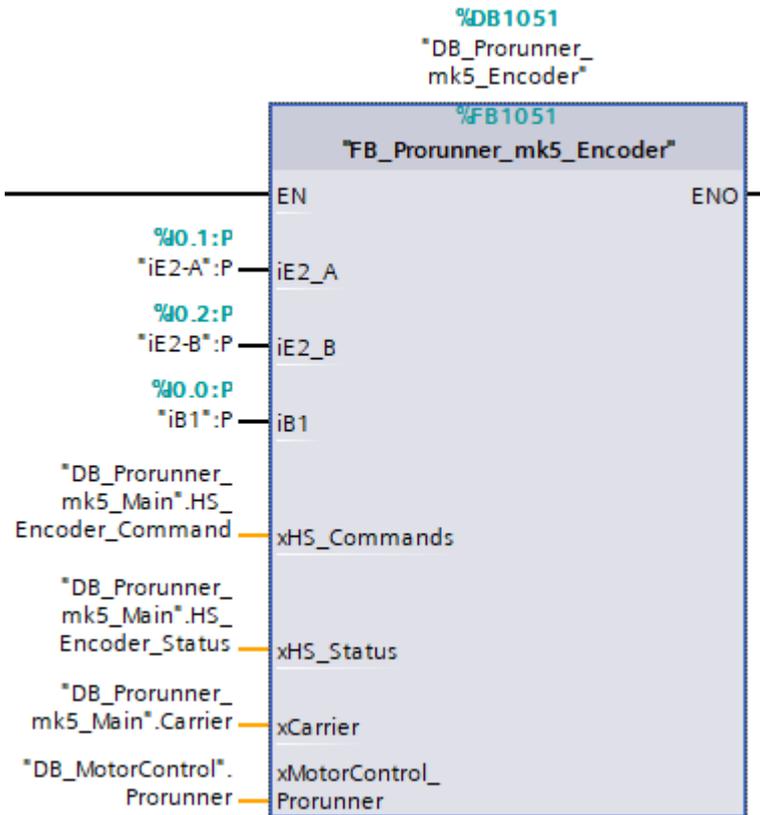
With this software block, the encoder processing is called up. This block must be specially called, because of the high/higher frequency of the encoder. This must be approximately 4ms.

7.1 Function block specifications

Block name:	FB_ Prorunner_mk5_Encoder
Block number:	FB1051
Version:	V4.1
Required PLC blocks:	TON_TIMER
Required PLC data types:	UDT_Prorunner_mk5_Carrier
	UDT_Prorunner_mk5_Customer_Information
	UDT_Prorunner_mk5_Encoder_Handshake_IN
	UDT_Prorunner_mk5_Encoder_Handshake_OUT
Function block call	Time interrupt 4ms (OB1050 – Time interrupt)
Optimised block access	Yes/~~No~~
Programming language	LAD, SCL
STEP7 version	TIA Portal V14 + SP1

7.2   Flowchart diagram encoder
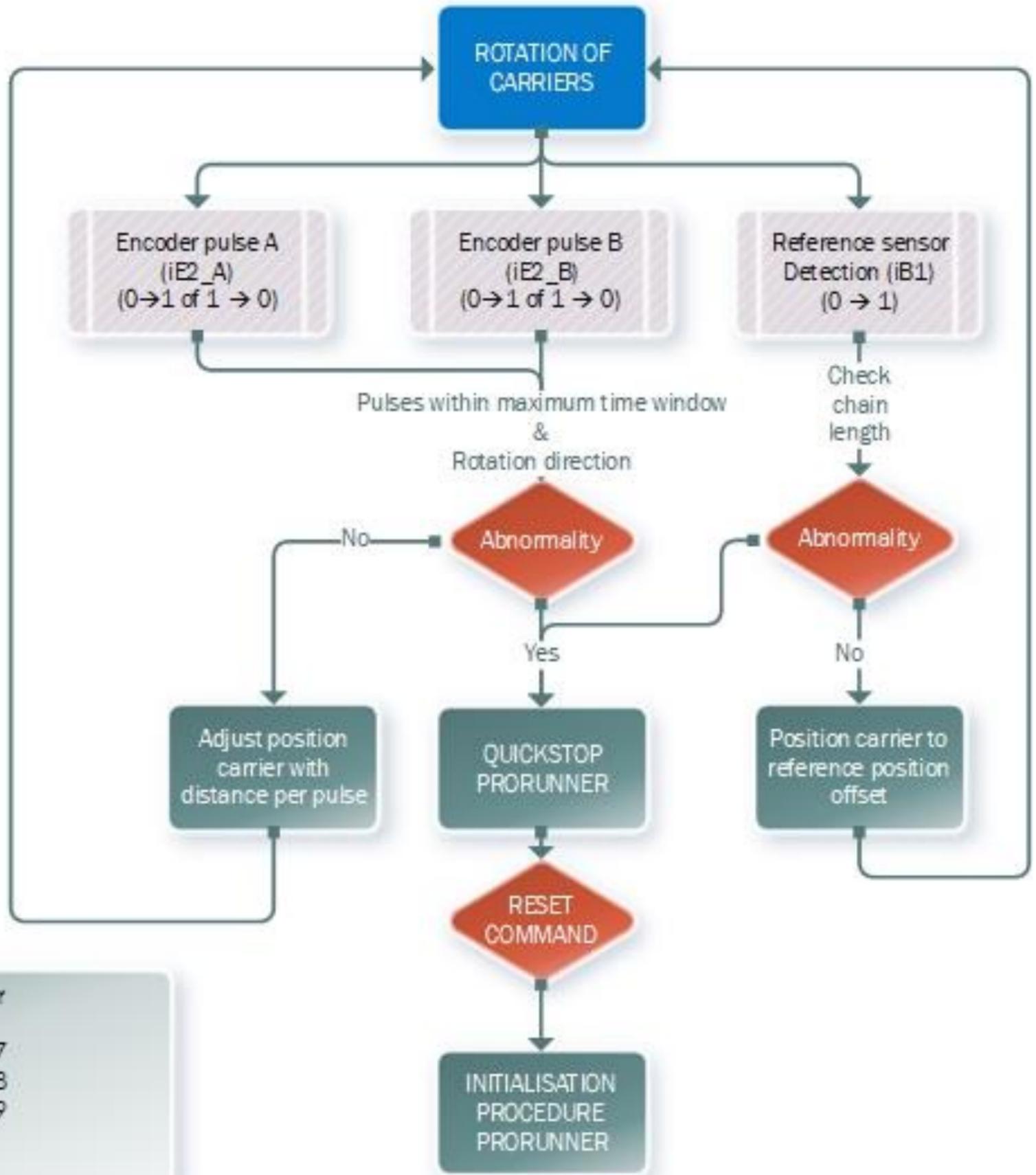
7.3 Inputs encoder

Inputs are required for the system to function properly. The required sensors and the communication interface with the Prorunner are declared here.

Some inputs must be called via peripheral addressing. Explanation can be found here: → Siemens - Where and when do you need peripheral addressing?

Tabel 10:   Inputs encoder Prorunner mk5

Naming	Data type	Unit	Description
iE2_A	Bool	0/1	Pulse A encoder - for this, always use the input from the input periphery. Example: 'i=MM-E2-A':P This queries the actual status of the input instead of the saved status of the input in the normal cycle of the PLC. Adding the ':P' takes care of this.
iE2_B	Bool	0/1	Pulse B encoder - for this, always use the input from the input periphery. Example: 'i=MM-E2-B':P This queries the actual status of the input instead of the saved status of the input in the normal cycle of the PLC. Adding the ':P' takes care of this.
iB1	Bool	0/1	Carrier reference position - for this, always use the input from the input periphery. Example: 'i=MM-B1':P This queries the actual status of the input instead of the saved status of the input in the normal cycle of the PLC. Adding the ':P' takes care of this.

7.4 Interfaces encoder

With the interface, information is exchanged between encoder and main module.
These interfaces are used for:
- Communication encoder ←→ Prorunner
- Updating carriers PRORUNNER

Tabel 11: Interface encoder Prorunner mk5

Naming	Data type	Unit	Description
xHS_Commands	UDT		**UDT_Prorunner_mk5_Encoder_Handshake_Command** This is the communication interface (HandShakes) of PRORUNNER → Encoder. This is a direct reference to the DB of the main module.
xHS_Status	UDT		**UDT_Prorunner_mk5_Encoder_Handshake_Status** This is the communication interface (HandShakes) of Encoder → PRORUNNER. This is a direct reference to the DB of the main module.
xCarrier			**UDT_Prorunner_mk5_Carrier** This is a direct reference to the DB of the main module. This allows the encoder to directly update the position of the carriers.
xMotorControl_Prorunner	UDT		**UDT_MotorControl** Motor interface Prorunner

8 Function block infeed module RDC2/MBC2

Figuur 08: Function block infeed module RDC2/MBC2
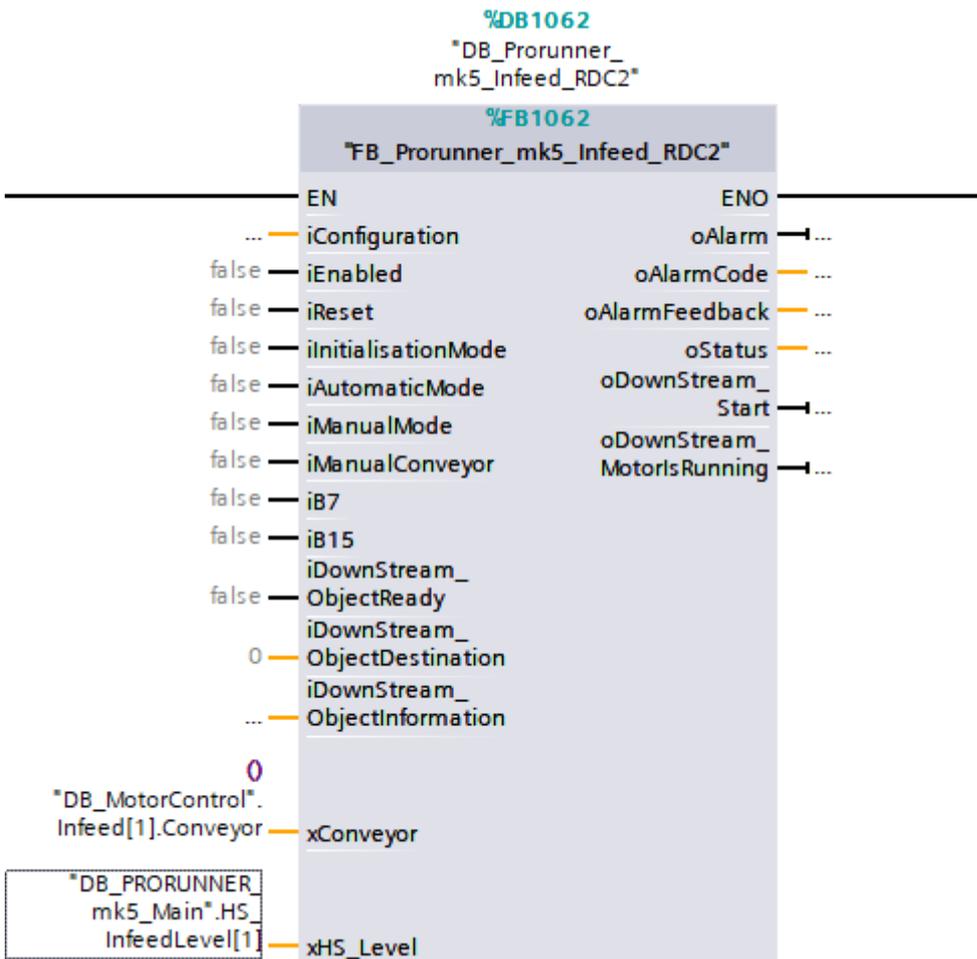
With this software block, the infeed module RDC2/MBC2 is called.
'RDC2' stands for: Roller Drive Conveyor type 2 → Fixed position
'MBC2' stands for: Multi Belt Conveyor type 2 → Fixed position

8.1 Function block specifications infeed module RDC2/MBC2

Block name:	FB_Prorunner_mk5_Infeed_RDC2/MBC2
Block number:	FB1062
Version:	V4.1
Required PLC blocks:	TON_TIMER
Required PLC data types:	UDT_MotorControl
	UDT_Prorunner_mk5_Carrier
	UDT_Prorunner_mk5_Customer_Information
	UDT_Prorunner_mk5_Infeed_Configuration
	UDT_Prorunner_mk5_Infeed_Handshake
Function block call	Cyclical (OB1)
Optimised block access	Yes/~~No~~
Programming language	LAD, SCL
STEP7 version	TIA Portal V14 + SP1

8.2 Components infeed module RDC2/MBC2

Figuur 09: Components infeed module RDC2
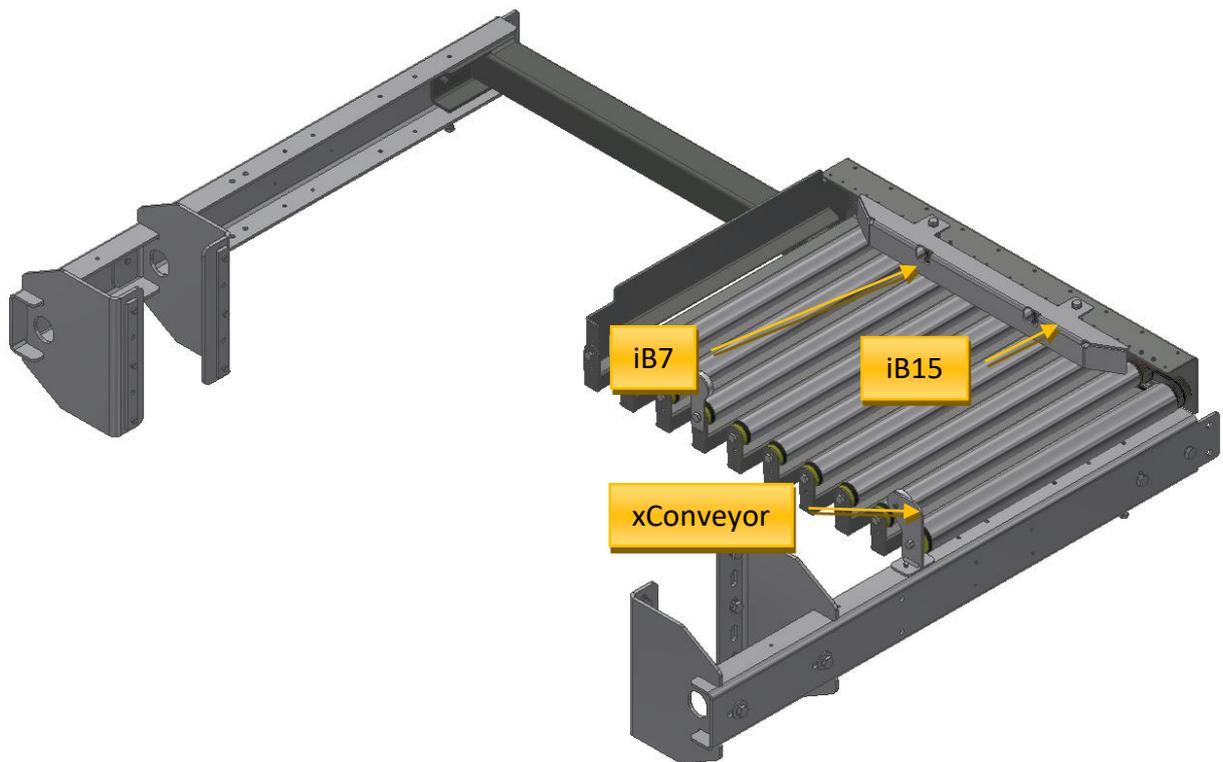
Figuur 10: Components infeed module MBC2
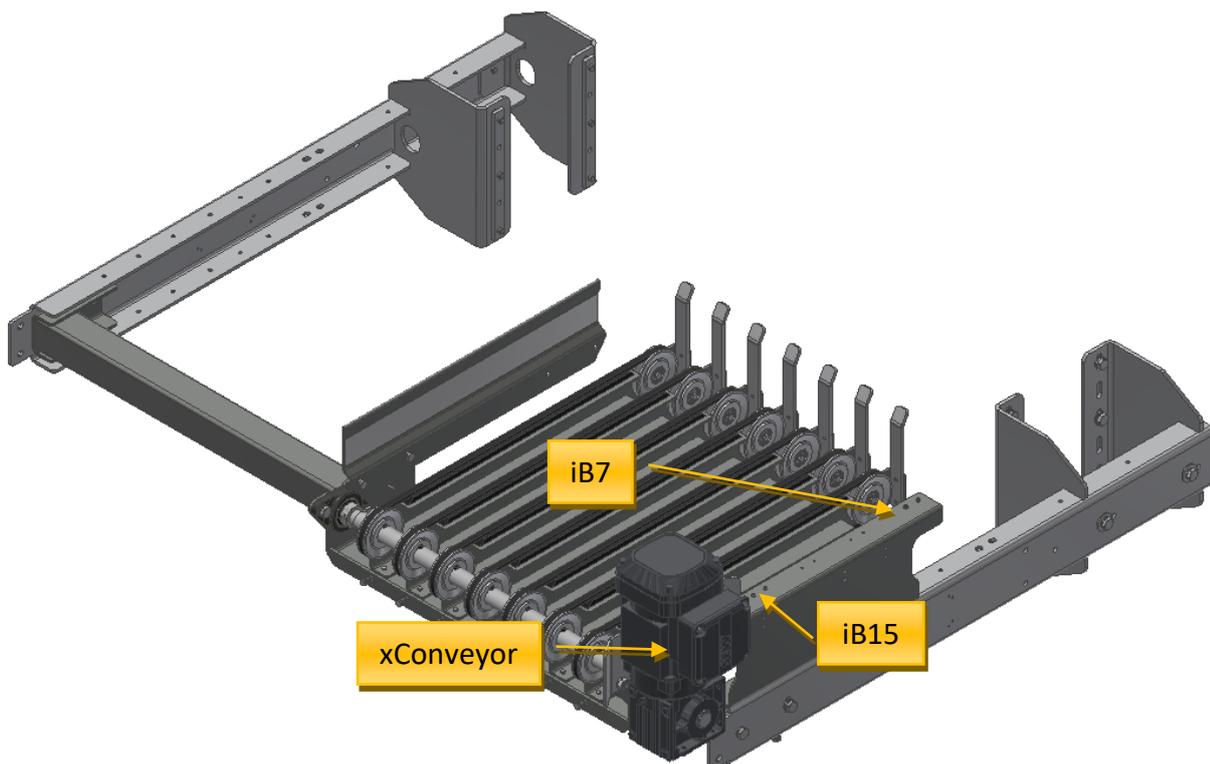
Tabel 12:   Components infeed module RDC2

Code		Type
iB15	Sensor/ photocell: Product position monitoring. This photocell monitors whether the product has completely entered the infeed roller conveyor.	GL6-P4211 C42-2
iB7	Sensor/ photocell: Product on infeed. This photocell detects whether the product has entered the infeed roller conveyor	GL6-P4211 C42-2
xConveyor	Actuation roller conveyor	Drivecontrol 20/54 + Rollerdrive

Tabel 13:   Components infeed module MBC2

Code		Type
iB15	Sensor/ photocell: Product position monitoring. This photocell monitors whether the product has completely entered the infeed conveyor.	GT6
iB7	Sensor/ photocell: Product on infeed. This photocell detects whether the product has entered the infeed conveyor	GT6
xConveyor	Actuation multi belt conveyor	SEW

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8.3 Flow chart functionality infeed module RDC2/MBC2

INFEED MK5 IDLE / OFF

No (iEnable = FALSE)

Stepper = 0

RDC2 – Roller drive conveyor fixed

V1.0 – BJA – 9/3/2018
V1.1 – BJA – 27/7/2018

iReset = TRUE

INFEED enabled

Yes (iEnable = TRUE)

EQUIPMENT BLOCKED

Stepper = 7

INFEED ENABLED

Infeed mode selection

iManualMode = TRUE

iAutomatic = TRUE

iInitialisationMode = TRUE

INFEED MANUAL MODE

Stepper = 1

INFEED AUTOMATIC MODE

Stepper = 3

INFEED INITIALISATION CHECK

iManualConveyor = TRUE

INFEED CONFIGURATION CHECK

Stepper = 5

INITIALISATION READY

iB7 = FALSE

STARTUP REQUIRED

NO

No

xConveyor.Forward = TRUE

YES

RUN INFEED conveyor for xx seconds

INFEED STARTUP CHECK

Stepper = 6

iB7 = FALSE
iB15 = FALSE

RUN INFEED conveyor for xx seconds

iB7 = TRUE
iB15 = FALSE

iB7 = FALSE
iB15 = FALSE

COMPLETED SUCCESFULLY

Initialisation ready
Stepper = 4

Check sensor iB15 for abnormalities

Check sensor iB7 for abnormalities

INFEED IDLE

Stepper = 10
Conveyor= IDLE

iDownStream_ObjectReady = TRUE
PRODUCT READY FOR INFEED

Empty carrier in area infeed module
Time remaing > Time needed

Empty carrier outside area infeed module
Time remaing < Time needed

INFEED OBJECT RECEIVE

Stepper = 15
Conveyor= RUNNING

iB15 = TRUE

iB7 = FALSE

iB15 triggered to long

INFEED OBJECT ACCEPT

Stepper = 16
Conveyor= RUNNING

xHS_Level.Prorunn er.Carrier.Passed = TRUE

iB15 triggered to short

iB15 = FALSE

Transport not completed within time limits

OBJECT ON INFEED

Stepper = 17
Conveyor= RUNNING

Transport completed to fast

iB7 = TRUE

WAIT FOR CARRIER PICKUP

Stepper = 18
Conveyor= IDLE

8.4 Configuration infeed module RDC2/MBC2

Configuration according to UDT_Prorunner_mk5_Infeed_Configuration

Tabel 14:   Configuration infeed module RDC2/MBC2

Naming	Data type	Unit	Description
Module.Level	Int	1..20	Level number.
Module.Height	Real	mm.	Exact height of the conveyor, measured from the ground floor
Options.LowspeedPickup	Bool	0/1	Picking up by using lower speed (1=active)
Conveyor.Speed	Real	m/s.	Speed of conveyor track at rated actuation (metre per second)
Conveyor.Length	Real	mm.	Exact length of infeed conveyor
Transport.CycleTime	Real	s.	Time necessary to perform infeed transport.
Transport.Speed	Int	Hz	Number of Hertz (Nominal = 50 Hz)
Transport.Acceleration	Int	ms.	Number of milliseconds to accelerate from standstill to desired speed
Transport.Deceleration	Int	ms.	Number of milliseconds to decelerate from current speed to standstill

8.5 Inputs infeed module RDC2/MBC2

Inputs must be declared by the customer. Inputs provide information such as configuration, status of installation, status sensors, manual pushbutton and communication signals with downstream transport

Tabel 15:   Inputs infeed module RDC2/MBC2

Naming	Data type	Unit	Description
iConfiguration	UDT		UDT as discussed in section above
iEnabled	Bool	0/1	System is switched on. Safety functions are operational and power supplies to the controllers are switched on.
iReset	Bool	0/1	Reset command to reset faults.
iInitialisationMode	Bool	0/1	Start of initialisation procedure.
iAutomaticMode	Bool	0/1	Installation is in automatic mode. Operation is influenced by the sensors and communication with the infeed/outfeed conveyor.
iManualMode	Bool	0/1	Installation is in manual mode. The operation is influenced by the manual commands.
iManualConveyor	Bool	0/1	Command for manual actuation of roller conveyor
iB7	Bool	0/1	Sensor that detects that product is on infeed.
iB15	Bool	0/1	Sensor for product position monitoring.
iDownStream_ObjectReady	Bool	0/1	Communication signal of downstream transport: Object ready for infeeding.
iDownStream_ObjectDestination	Int	1..20	Communication signal of downstream transport: Object destination level.
iDownStream_ObjectInformation	UDT		Communication signal of downstream transport: 'UDT_Prorunner_mk5_Customer_Information' Any information that can be sent along with each object.

8.6 Outputs infeed module RDC2/MBC2

Outputs must be declared by the customer. Outputs provide feedback such as faults, status and communication signals with downstream transport.

Tabel 16:   Outputs infeed module RDC2

Naming	Data type	Unit	Description
oAlarm	Bool	0/1	Fault active
oAlarmCode	Int	0	Active fault code (See chapter 'Faults' for the correct overview)
oAlarmFeedback	Word	0	Active fault feedback for HMI. One bit is reserved for each fault. Fault 1 = bit 0, fault 2 = bit 1, etc.
oStatus	Int	0	See chapter 'Status Prorunner mk5' for further information.
oDownStream_Start	Bool	0/1	Communication signal to downstream transport: Infeed module ready/busy for transport to the end of the roller conveyor
oDownStream_MotorIsRunning	Bool	0/1	Communication signal to downstream transport: Infeed module roller conveyor running. If this signal stops, the roller conveyor downstream must also stop.

8.7 Motor interface infeed module RDC2/MBC2

One motor is used for the infeed module. All commands are prepared via this motor interface to handle different forms of motor actuation.
For more information, please refer to chapter '16 - Motor interface'

Tabel 17:   Motor interface infeed module RDC2

Naming	Data type	Unit	Description
xConveyor	UDT		**UDT_MotorControl** Motor interface infeed module RDC2/MBC2

8.8 Status infeed module RDC2/MBC2

The status of the infeed module is output, giving the user a clear picture of the status/movements of the infeed module

Tabel 18:   Status infeed module RDC2/MBC2

Code	Description / Cause
0	NO ACTION: Infeed module switched off / no mode active
1	MANUAL OPERATION: Infeed module in manual mode
3	INITIALISATION PROCEDURE ACTIVE: Infeed module busy with initialisation procedure.
4	INITIALISATION PROCEDURE READY: Infeed module finished with initialisation procedure.
5	CONFIGURATION CHECK: Infeed module finished with initialisation procedure.
6	RESTART / START-UP PROCEDURE: Procedure after fault; this involves checking whether an object is present and whether it is correctly positioned.
7	FAULT: Infeed module blocked by fault
10	WAITING: Infeed module ready for use, object infeeding can be started
15	OBJECT INFEEDING BUSY: Infeed module busy with object infeeding.
16	OBJECT ACCEPTED ON INFEED CONVEYOR: Infeed module has received object on belt (sensor iB15)
17	OBJECT PRESENT ON INFEED CONVEYOR: Infeed module in the process of moving object to the end of the roller conveyor (sensor iB7 covered and iB15 uncovered).
18	WAIT UNTIL OBJECT HAS BEEN PICKED UP: Infeed module waits until Prorunner mk5 has picked up object. Information is also made available in this status/step.

8.9 Faults infeed module RDC2/MBC2

With the outfeed signal 'oAlarm' it is possible to indicate a fault by, for example, switching on a red lamp. With the fault code 'oAlarmCode' you can indicate this better.
With the fault word 'oAlarmFeedback' you can generate a clearly defined fault message by means of an HMI. The faults are divided over 16 bits. Code 1 = bit 0 ... Code 16 = bit 15.
Below is the list of faults that may be active with explanation/result and solution.

Tabel 19:   Faults list infeed module RDC2/MBC2

Code	Description / Cause	Effect	Solution
1	Feeding object in is taking too long. Sensor object detection does not see the object within time limits	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked. Start-up procedure of infeed conveyor must be carried out.	Put the object down manually in the sensors; iB15 uncovered, iB7 covered. Give the reset command to reset the fault. Resetting is not possible if sensor iB15 is covered.
2	Object fed in too fast. It is possible that the product is too long and/or that an unknown object has been seen.	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked. Start-up procedure of infeed conveyor must be carried out.	Check for unknown objects. Put the object down manually in the sensors; iB15 uncovered, iB7 covered. Give the reset command to reset the fault. Resetting is not possible if sensor iB15 is covered.
3	Unknown object detected. Sensors triggered while the infeed module is not busy with this step.	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked. Start-up procedure of infeed conveyor must be carried out.	Check for unknown objects. Give the reset command to reset the fault. Resetting is not possible if sensor iB15 is covered.
4	Object too small. iB15 triggered for too short. Time is calculated with the shortest product length.	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked. Start-up procedure of infeed conveyor must be carried out.	Check object length. Give the reset command to reset the fault. Resetting is not possible if sensor iB15 is covered.
5	Object too big. iB15 triggered for too long. Time is calculated with the longest product length	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked. Start-up procedure of infeed conveyor must be carried out.	Check object length. Give the reset command to reset the fault. Resetting is not possible if sensor iB15 is covered.
6	Unknown destination of object on infeed conveyor. This must higher than '0' and less than or equal to the number of levels present.	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked. Start-up procedure of infeed conveyor must be carried out.	Remove object from infeed conveyor and check communication with downstream transport. Give the reset command to reset the fault. Resetting is not possible if sensor iB15 is covered.
8	Configuration is not entered correctly	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked.	Check configuration settings. Make sure that everything is entered correctly and not below the minimum value.

Code	Description / Cause	Effect	Solution
9	Start-up procedure time-out. Sensor iB15 does not become untriggered.	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked.	Put the object down manually in the sensors; iB15 uncovered, iB7 covered. Give the reset command to reset the fault.
13	Fault controller/drive conveyor track.	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked. (Depending on position)	Check operation/fault controller/drive. Make sure that it is ready for operation again. Give the reset command to reset the fault.
15	Initialisation procedure: object still detected on conveyor track.	Initialisation has not been completed.	Empty the conveyor track. Restart procedure by giving initialisation command again.

9 Function block infeed module RDC3

Figuur 11: Function block infeed module RDC3
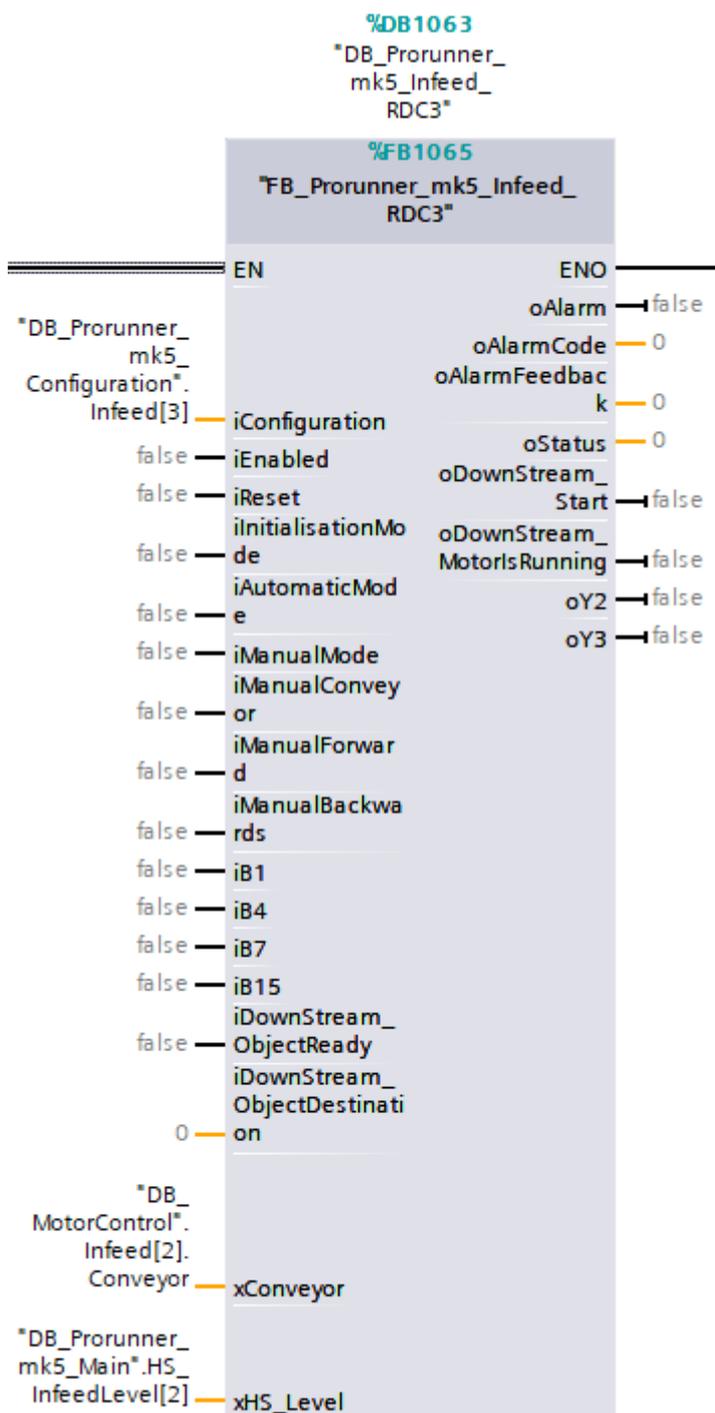
With this software block, the infeed module RDC4 is called.
RDC3 stands for: Tilting Rollerdrive Conveyor type 3 → Moveable

9.1 Function block specifications infeed module RDC3

Block name:	FB_Prorunner_mk5_Infeed_RDC3
Block number:	FB1065
Version:	V0.9
Required PLC blocks:	TON_TIMER
Required PLC data types:	UDT_MotorControl
	UDT_Prorunner_mk5_Carrier
	UDT_Prorunner_mk5_Customer_Information
	UDT_Prorunner_mk5_Infeed_Configuration
	UDT_Prorunner_mk5_Infeed_Handshake
Function block call	Cyclical (OB1)
Optimised block access	Yes/~~No~~
Programming language	LAD, SCL
STEP7 version	TIA Portal V14 + SP1

9.2   Components infeed module RDC3

Figuur 12: Components infeed module RDC3
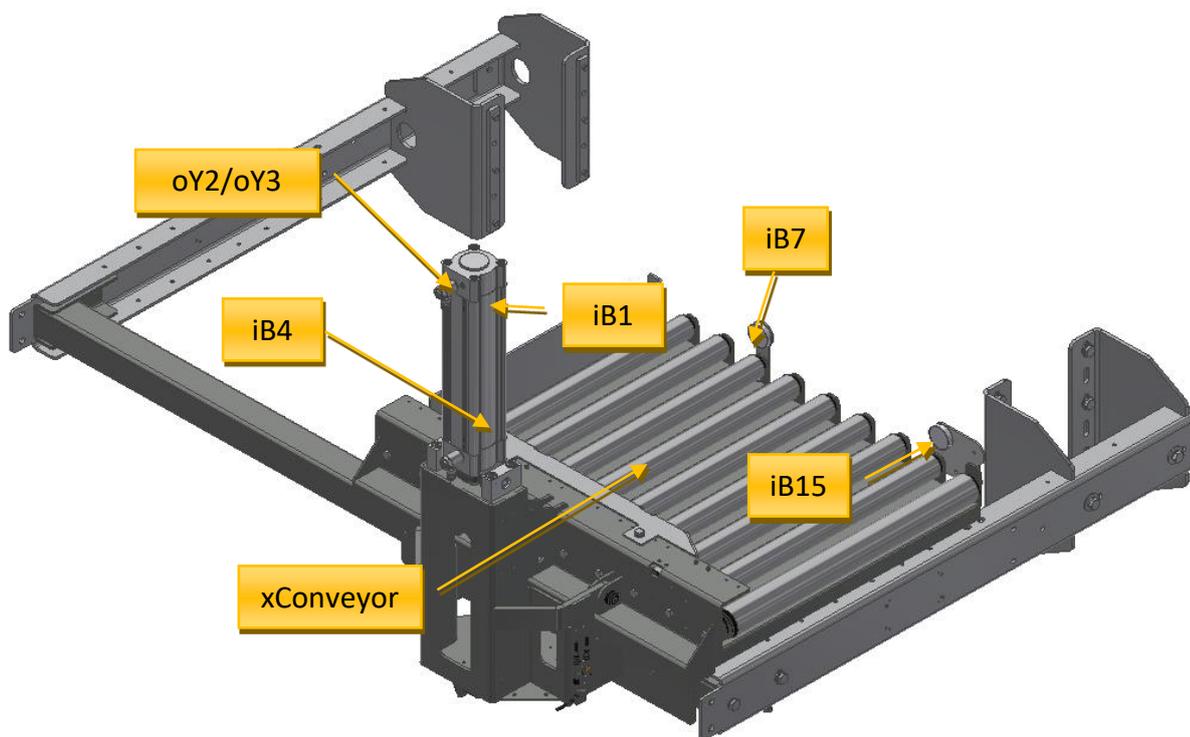
Tabel 20:   Components infeed module RDC4

Code		Type
iB15	Sensor/ photocell: Product position monitoring. This photocell monitors whether the product has completely entered the infeed roller conveyor.	GL6-P4211 C42-2
iB7	Sensor/ photocell: Product on infeed. This photocell detects whether the product has entered the infeed roller conveyor	GL6-P4211 C42-2
iB1	Inductive approach: Wait for position (from Prorunner) Sensor detection that horizontal movement is in waiting position. This is the position in which no object can be entered, and the conveyor is in a safe position for the Prorunner carriers.	SMT-8M-A-PS-24V-E-1-N-M12
iB3	Inductive approach: Low-speed infeed position Sensor detection that horizontal movement should switch to waiting position to low speed.	SMT-8M-A-PS-24V-E-1-N-M12
xConveyor	Actuation roller conveyor	Drivecontrol 20/54 Rollerdrive
oY2/oY3	Actuation tilting movement	Pneumatic Valve

9.4   Flow chart functionality infeed module RDC3

RDC3 – Tilting rollerdrive conveyor

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9.5   Configuration infeed module RDC3

Configuration according to UDT_Prorunner_mk5_Infeed_Configuration

Tabel 21:   Configuration infeed module RDC3

Naming	Data type	Unit	Description
Module.Level	Int	1..20	Level number.
Module.Height	Real	mm.	Exact height of the conveyor measured from the floor
Options.LowspeedPickup	Bool	0/1	Picking up by using lower speed (1=active)
Conveyor.Speed	Real	m/s.	Speed of conveyor track at rated actuation (metre per second)
Conveyor.Length	Real	mm.	Exact length of infeed conveyor
Transport.CycleTime	Real	s.	Time necessary to perform infeed transport.
Transport.Speed	Int	Hz	Number of Hertz (Nominal = 50 Hz)
Transport.Acceleration	Int	ms.	Number of milliseconds to accelerate from standstill to desired speed
Transport.Deceleration	Int	ms.	Number of milliseconds to decelerate from current speed to standstill
Movement.CycleTime	Real	s.	Time needed to tilt conveyor between infeed position and waiting position.

9.6   Inputs infeed module RDC3

Inputs must be declared by the customer. Inputs provide information such as configuration, status of installation, status sensors, manual pushbutton and communication signals with downstream transport

Tabel 22:   Inputs infeed module RDC3

Naming	Data type	Unit	Description
iConfiguration	UDT		UDT as discussed in section above
iEnabled	Bool	0/1	System is switched on. Safety functions are operational and power supplies to the controllers are switched on.
iReset	Bool	0/1	Reset command to reset faults.
iInitialisationMode	Bool	0/1	Start of initialisation procedure.
iAutomaticMode	Bool	0/1	Installation is in automatic mode. Operation is influenced by the sensors and communication with the infeed/outfeed conveyor.
iManualMode	Bool	0/1	Installation is in manual mode. The operation is influenced by the manual commands.
iManualConveyor	Bool	0/1	Command for manual actuation of roller conveyor
iManualForwards	Bool	0/1	Command manual actuation of horizontal movement to the infeed position
iManualBackwards	Bool	0/1	Command manual actuation of horizontal movement to the waiting position
iB1	Bool	0/1	Sensor for detection of waiting position
iB4	Bool	0/1	Sensor for detection of infeed position
iB7	Bool	0/1	Sensor for position of entered product
iB15	Bool	0/1	Sensor for product position control
iDownStream_ObjectReady	Bool	0/1	Communication signal of downstream transport: Object ready for infeeding.
iDownStream_ObjectDestination	Int	1..20	Communication signal of downstream transport: Object destination level.
iDownStream_ObjectInformation	UDT		Communication signal of downstream transport: 'UDT_Prorunner_mk5_Customer_Information' Any information that can be sent along with each object. This UDT can be configured by yourself.

9.7 Outputs infeed module RDC3

Exits must be declared by the customer. Outputs provide feedback such as faults, status and communication signals with downstream transport.

Tabel 23: Outputs infeed module RDC3

Naming	Data type	Unit	Description
oAlarm	Bool	0/1	Fault active
oAlarmCode	Int	0	Active fault code (See chapter 'Faults' for the correct overview)
oAlarmFeedback	Word	0	Active fault feedback for HMI. One bit is reserved for each fault. Fault 1 = bit 0, fault 2 = bit 1, etc.
oStatus	Int	0	See chapter 'Status Prorunner mk5' for further information.
oDownStream_Start	Bool	0/1	Communication signal to downstream transport: Infeed module ready/busy for transport to the end of the roller conveyor
oDownStream_MotorIsRunning	Bool	0/1	Communication signal to downstream transport: Infeed module roller conveyor running. If this signal stops, the roller conveyor downstream must also stop.
oY2	Bool	0/1	Tilt the conveyor to the wait (upwards) position
oY3	Bool	0/1	Tilt the conveyor to the infeed (downwards) position

9.8 Motor interface infeed module RDC3

Two motors are used for the infeed module. All commands are prepared via this motor interface to handle different forms of motor actuation.
For more information, please refer to chapter '16 - Motor interface'

Tabel 24: Motor interface infeed module RDC3

Naming	Data type	Unit	Description
xConveyor	UDT		**UDT_MotorControl** Motor interface roller conveyor infeed module RDC4

9.9 Status infeed module RDC3

The status of the infeed module is output, giving the user a clear picture of the status/movements of the infeed module RDC3

Tabel 25: Status infeed module RDC3

Code	Description / Cause
0	NO ACTION: Infeed module switched off / no mode active
1	MANUAL OPERATION: Infeed module in manual mode
3	INITIALISATION PROCEDURE ACTIVE: Infeed module busy with initialisation procedure.
4	INITIALISATION PROCEDURE READY: Infeed module finished with initialisation procedure.
5	CONFIGURATION CHECK: Infeed module finished with initialisation procedure.
6	RESTART / START-UP PROCEDURE: Procedure after fault; this involves checking whether an object is present and whether it is correctly positioned.
7	FAULT: Infeed module blocked by fault
10	WAITING: Infeed module ready for use, object infeeding can be started
11	MOVEMENT TO INFEED POSITION: Infeed module busy with horizontal movement to infeed position
12	AT INFEED POSITION: Infeed module ready for transport of object
13	MOVEMENT TO WAITING POSITION: Infeed module busy with horizontal movement to waiting position
14	AT WAIT POSITION: Infeed module in waiting position.
15	OBJECT INFEEDING BUSY: Infeed module busy with object infeeding.
16	OBJECT ACCEPTED ON INFEED CONVEYOR: Infeed module has received object on belt (sensor iB15)
17	OBJECT PRESENT ON INFEED CONVEYOR: Infeed module in the process of moving object to the end of the roller conveyor (sensor iB7 covered and iB15 uncovered).
18	WAIT UNTIL OBJECT HAS BEEN PICKED UP: Infeed module waits until Prorunner mk5 has picked up object. Information is also made available in this status/step.

9.10 Faults infeed module RDC3

With the outfeed signal 'oAlarm' it is possible to indicate a fault by, for example, switching on a red lamp. With the fault code 'oAlarmCode' you can indicate this better.
With the fault word 'oAlarmFeedback' you can generate a clearly defined fault message by means of an HMI. The faults are divided over 16 bits. Code 1 = bit 0 ... Code 16 = bit 15.
Below is the list of faults that may be active with explanation/effect and solution.

Tabel 26:   Faults list infeed module RDC3

Code	Description / Cause	Effect	Solution
1	Feeding object in is taking too long. Sensor object detection does not see the object within time limits	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked. Start-up procedure of infeed conveyor must be carried out.	Put the object down manually in the sensors; iB15 uncovered, iB7 covered. Give the reset command to reset the fault. Resetting is not possible if sensor iB15 is covered.
2	Object fed in too fast. It is possible that the product is too long and/or that an unknown object has been seen.	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked. Start-up procedure of infeed conveyor must be carried out.	Check for unknown objects. Put the object down manually in the sensors; iB15 uncovered, iB7 covered. Give the reset command to reset the fault. Resetting is not possible if sensor iB15 is covered.
3	Unknown object detected. Sensors triggered while the infeed module is not busy with this step.	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked. Start-up procedure of infeed conveyor must be carried out.	Check for unknown objects. Give the reset command to reset the fault. Resetting is not possible if sensor iB15 is covered.
4	Object too small. iB15 triggered for too short. Time is calculated with the shortest product length	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked. Start-up procedure of infeed conveyor must be carried out.	Check object length. Give the reset command to reset the fault. Resetting is not possible if sensor iB15 is covered.
5	Object too big. iB15 triggered for too long. Time is calculated with the longest product length	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked. Start-up procedure of infeed conveyor must be carried out.	Check object length. Give the reset command to reset the fault. Resetting is not possible if sensor iB15 is covered.
6	Unknown destination of object on infeed conveyor. This must higher than '0' and less than or equal to the number of levels present.	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked. Start-up procedure of infeed conveyor must be carried out.	Remove object from infeed conveyor and check communication with downstream transport. Give the reset command to reset the fault. Resetting is not possible if sensor iB15 is covered.
8	Configuration is not entered correctly	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked.	Check configuration settings. Make sure that everything is entered correctly and not below the minimum value.

Code	Description / Cause	Effect	Solution
9	Start-up procedure time-out. Sensor iB15 does not become untriggered.	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked.	Put the object down manually in the sensors; iB15 uncovered, iB7 covered. Give the reset command to reset the fault.
10	Movement to waiting position is taking too long	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked.	Check why this is taking too long. Check adjustment/operation of the iB1 sensor Give the reset command to reset the fault.
11	Movement to infeed position is taking too long	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked.	Check why this is taking too long. Check adjustment/operation of the iB4 sensor Give the reset command to reset the fault.
12	Position horizontal movement no longer correct.	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked.	Check adjustment/operation of the iB1 & iB4 sensor. Give the reset command to reset the fault.
13	Fault controller/drive conveyor track.	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked. (Depending on position)	Check operation/fault controller/drive. Make sure that it is ready for operation again. Give the reset command to reset the fault.
14	Fault controller/drive horizontal movement.	See fault 13	See fault 13
15	Initialisation procedure: object still detected on conveyor track.	Initialisation has not been completed.	Empty the conveyor track. Restart procedure by giving initialisation command again.
16	Initialisation procedure: Safe position not reached	Initialisation has not been completed.	Check the movement of the infeed module. Check operation and adjustment of position indicator sensors. Restart procedure by giving initialisation command again.

10 Function block infeed module RDC4

Figuur 13: Function block infeed module RDC4
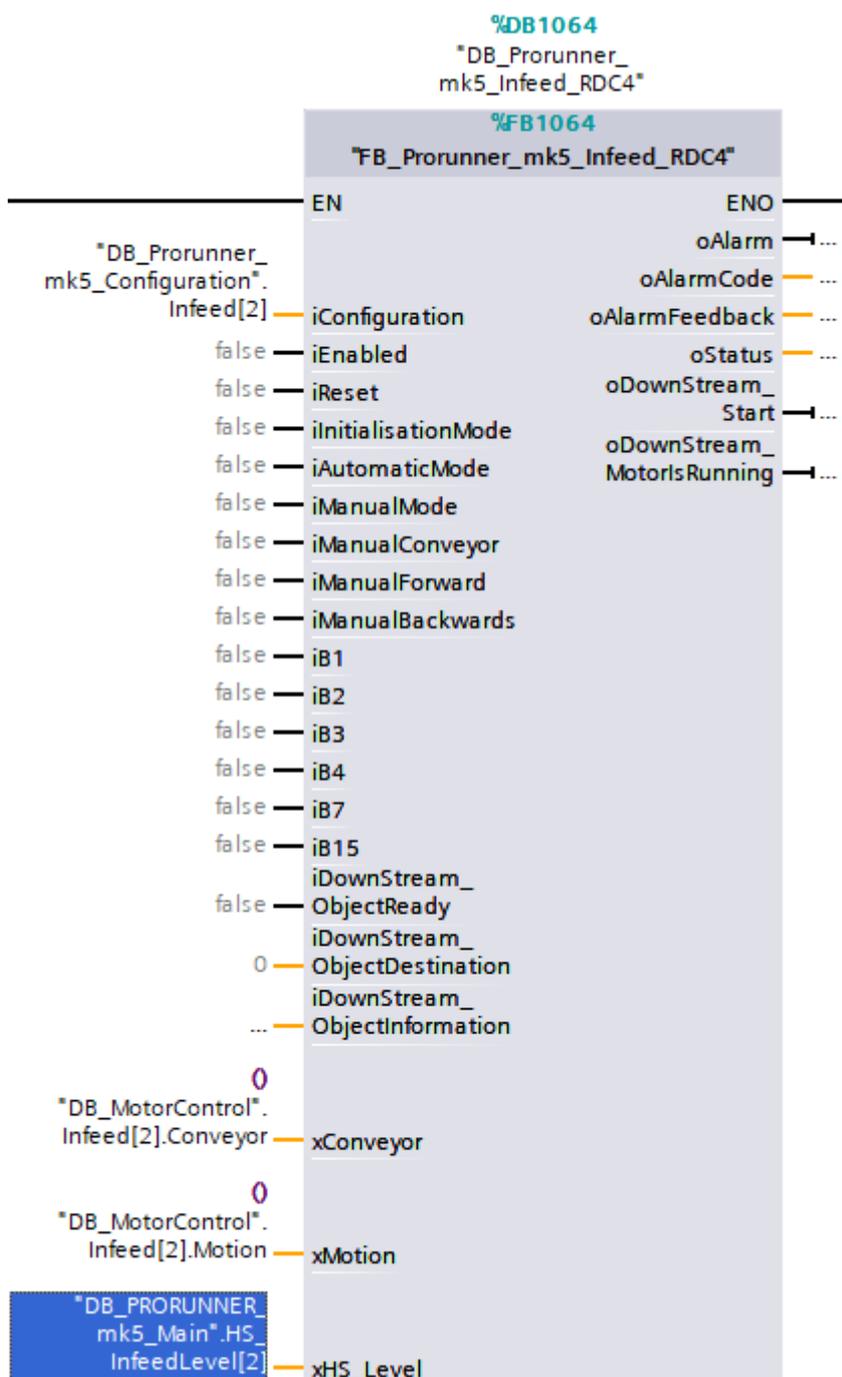
With this software block, the infeed module RDC4 is called.
RDC4 stands for: Roller Drive Conveyor type 4 → Moveable

10.1 Function block specifications infeed module RDC4

Block name:	FB_Prorunner_mk5_Infeed_RDC4
Block number:	FB1064
Version:	V1.2
Required PLC blocks:	TON_TIMER
Required PLC data types:	UDT_MotorControl
	UDT_Prorunner_mk5_Carrier
	UDT_Prorunner_mk5_Customer_Information
	UDT_Prorunner_mk5_Infeed_Configuration
	UDT_Prorunner_mk5_Infeed_Handshake
Function block call	Cyclical (OB1)
Optimised block access	Yes/~~No~~
Programming language	LAD, SCL
STEP7 version	TIA Portal V14 + SP1

10.2 Components infeed module RDC4

Figuur 14: Components infeed module RDC4
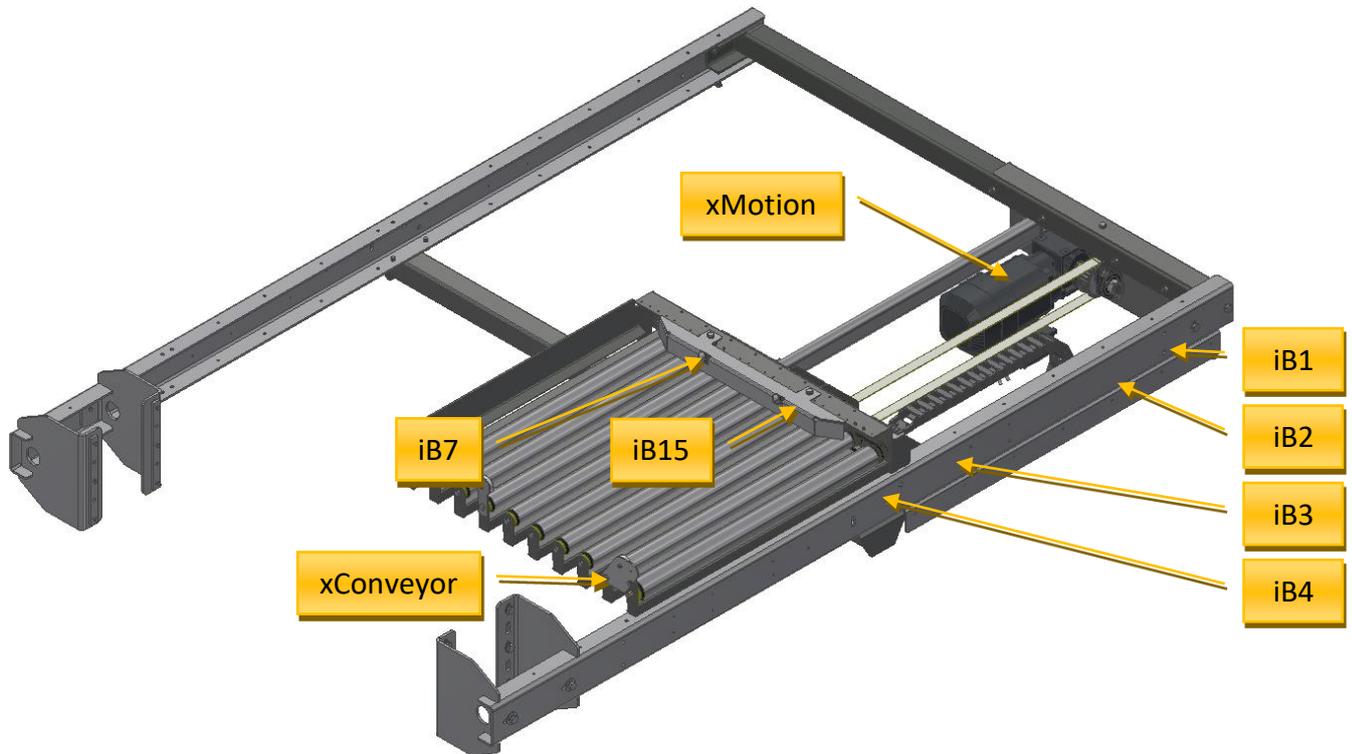
Tabel 27:   Components infeed module RDC4

Code		Type
iB15	Sensor/ photocell: Product position monitoring. This photocell monitors whether the product has completely entered the infeed roller conveyor.	GL6-P4211 C42-2
iB7	Sensor/ photocell: Product on infeed. This photocell detects whether the product has entered the infeed roller conveyor	GL6-P4211 C42-2
iB1	Inductive approach: Wait for position (from Prorunner) Sensor detection that horizontal movement is in waiting position. This is the position in which no object can be entered, and the conveyor is in a safe position for the Prorunner carriers.	IME18-08BPSZC0K
iB2	Inductive approach: Low speed waiting position Sensor detection that horizontal movement should switch to waiting position to low speed.	IME18-08BPSZC0K
iB4	Inductive approach: Infeed position (In Prorunner) Sensor detection that horizontal movement is at Infeed position. This is the position in which an object can be fed in.	IME18-08BPSZC0K
iB3	Inductive approach: Low-speed infeed position Sensor detection that horizontal movement should switch to waiting position to low speed.	IME18-08BPSZC0K
xConveyor	Actuation roller conveyor	Drivecontrol 20/54 Rollerdrive
xMotion	Actuation horizontal movement	SEW drive See Qimarox info

Qimarox

10.4 Flow chart functionality infeed module RDC4

RDC4 – Roller drive conveyor shuttle

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V1.1 – BJA – 27/7/2018

10.5 Configuration infeed module RDC4

Configuration according to UDT_Prorunner_mk5_Infeed_Configuration

Tabel 28:   Configuration infeed module RDC4

Naming	Data type	Unit	Description
Module.Level	Int	1..20	Level number.
Module.Height	Real	mm.	Exact height of the conveyor measured from the floor
Options.LowspeedPickup	Bool	0/1	Picking up by using lower speed (1=active)
Conveyor.Speed	Real	m/s.	Speed of conveyor track at rated actuation (metre per second)
Conveyor.Length	Real	mm.	Exact length of infeed conveyor
Transport.CycleTime	Real	s.	Time necessary to perform infeed transport.
Transport.Speed	Int	Hz	Number of Hertz (Nominal = 50 Hz)
Transport.Acceleration	Int	ms.	Number of milliseconds to accelerate from standstill to desired speed
Transport.Deceleration	Int	ms.	Number of milliseconds to decelerate from current speed to standstill
Movement.CycleTime	Real	s.	Time needed to move conveyor track between infeed position and waiting position.
Movement.InfeedPosition	Real	mm.	Position: infeed position
Movement.BasicPosition	Real	mm.	Position: waiting position
Movement.Speed	Real	m/s.	Speed of movement
Movement.HighSpeed	Int	Hz	Number of Hertz (Nominal = 50 Hz)
Movement.LowSpeed	Int	Hz	Number of Hertz (Nominal = 50 Hz)
Movement.Acceleration	Int	ms.	Number of milliseconds to accelerate from standstill to desired speed
Movement.Deceleration	Int	ms.	Number of milliseconds to decelerate from current speed to standstill

10.6 Inputs infeed module RDC4

Inputs must be declared by the customer. Inputs provide information such as configuration, status of installation, status sensors, manual pushbutton and communication signals with downstream transport

Tabel 29:   Inputs infeed module RDC4

Naming	Data type	Unit	Description
iConfiguration	UDT		UDT as discussed in section above
iEnabled	Bool	0/1	System is switched on. Safety functions are operational and power supplies to the controllers are switched on.
iReset	Bool	0/1	Reset command to reset faults.
iInitialisationMode	Bool	0/1	Start of initialisation procedure.
iAutomaticMode	Bool	0/1	Installation is in automatic mode. Operation is influenced by the sensors and communication with the infeed/outfeed conveyor.
iManualMode	Bool	0/1	Installation is in manual mode. The operation is influenced by the manual commands.
iManualConveyor	Bool	0/1	Command for manual actuation of roller conveyor
iManualForwards	Bool	0/1	Command manual actuation of horizontal movement to the infeed position
iManualBackwards	Bool	0/1	Command manual actuation of horizontal movement to the waiting position
iB1	Bool	0/1	Sensor for detection of waiting position
iB2	Bool	0/1	Sensor for detection of low speed waiting position
iB3	Bool	0/1	Sensor for detection of low-speed infeed position
iB4	Bool	0/1	Sensor for detection of infeed position
iB7	Bool	0/1	Sensor for position of entered product
iB15	Bool	0/1	Sensor for product position control
iDownStream_ObjectReady	Bool	0/1	Communication signal of downstream transport: Object ready for infeeding.
iDownStream_ObjectDestination	Int	1..20	Communication signal of downstream transport: Object destination level.
iDownStream_ObjectInformation	UDT		Communication signal of downstream transport: 'UDT_Prorunner_mk5_Customer_Information' Any information that can be sent along with each object. This UDT can be configured by yourself.

10.7 Outputs infeed module RDC4

Exits must be declared by the customer. Outputs provide feedback such as faults, status and communication signals with downstream transport.

Tabel 30:   Outputs infeed module RDC4

Naming	Data type	Unit	Description
oAlarm	Bool	0/1	Fault active
oAlarmCode	Int	0	Active fault code (See chapter 'Faults' for the correct overview)
oAlarmFeedback	Word	0	Active fault feedback for HMI. One bit is reserved for each fault. Fault 1 = bit 0, fault 2 = bit 1, etc.
oStatus	Int	0	See chapter 'Status Prorunner mk5' for further information.
oDownStream_Start	Bool	0/1	Communication signal to downstream transport: Infeed module ready/busy for transport to the end of the roller conveyor
oDownStream_MotorIsRunning	Bool	0/1	Communication signal to downstream transport: Infeed module roller conveyor running. If this signal stops, the roller conveyor downstream must also stop.

10.8 Motor interface infeed module RDC4

Two motors are used for the infeed module. All commands are prepared via this motor interface to handle different forms of motor actuation.
For more information, please refer to chapter '16 - Motor interface'

Tabel 31:   Motor interface infeed module RDC4

Naming	Data type	Unit	Description
xConveyor	UDT		**UDT_MotorControl** Motor interface roller conveyor infeed module RDC4
xMotion	UDT		**UDT_MotorControl** Motor interface horizontal movement infeed module RDC4

10.9 Status infeed module RDC4

The status of the infeed module is output, giving the user a clear picture of the status/movements of the infeed module RDC4

Tabel 32:   Status infeed module RDC4

Code	Description / Cause
0	NO ACTION: Infeed module switched off / no mode active
1	MANUAL OPERATION: Infeed module in manual mode
3	INITIALISATION PROCEDURE ACTIVE: Infeed module busy with initialisation procedure.
4	INITIALISATION PROCEDURE READY: Infeed module finished with initialisation procedure.
5	CONFIGURATION CHECK: Infeed module finished with initialisation procedure.
6	RESTART / START-UP PROCEDURE: Procedure after fault; this involves checking whether an object is present and whether it is correctly positioned.
7	FAULT: Infeed module blocked by fault
10	WAITING: Infeed module ready for use, object infeeding can be started
11	MOVEMENT TO INFEED POSITION: Infeed module busy with horizontal movement to infeed position
12	AT INFEED POSITION: Infeed module ready for transport of object
13	MOVEMENT TO WAITING POSITION: Infeed module busy with horizontal movement to waiting position
14	AT WAIT POSITION: Infeed module in waiting position.
15	OBJECT INFEEDING BUSY: Infeed module busy with object infeeding.
16	OBJECT ACCEPTED ON INFEED CONVEYOR: Infeed module has received object on belt (sensor iB15)
17	OBJECT PRESENT ON INFEED CONVEYOR: Infeed module in the process of moving object to the end of the roller conveyor (sensor iB7 covered and iB15 uncovered).
18	WAIT UNTIL OBJECT HAS BEEN PICKED UP: Infeed module waits until Prorunner mk5 has picked up object. Information is also made available in this status/step.

10.10 Faults outfeed module RDC4

With the outfeed signal 'oAlarm' it is possible to indicate a fault by, for example, switching on a red lamp. With the fault code 'oAlarmCode' you can indicate this better.
With the fault word 'oAlarmFeedback' you can generate a clearly defined fault message by means of an HMI. The faults are divided over 16 bits. Code 1 = bit 0 ... Code 16 = bit 15.
Below is the list of faults that may be active with explanation/effect and solution.

Tabel 33:   Faults list infeed module RDC4

Code	Description / Cause	Effect	Solution
1	Feeding object in is taking too long. Sensor object detection does not see the object within time limits	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked. Start-up procedure of infeed conveyor must be carried out.	Put the object down manually in the sensors; iB15 uncovered, iB7 covered. Give the reset command to reset the fault. Resetting is not possible if sensor iB15 is covered.
2	Object fed in too fast. It is possible that the product is too long and/or that an unknown object has been seen.	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked. Start-up procedure of infeed conveyor must be carried out.	Check for unknown objects. Put the object down manually in the sensors; iB15 uncovered, iB7 covered. Give the reset command to reset the fault. Resetting is not possible if sensor iB15 is covered.
3	Unknown object detected. Sensors triggered while the infeed module is not busy with this step.	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked. Start-up procedure of infeed conveyor must be carried out.	Check for unknown objects. Give the reset command to reset the fault. Resetting is not possible if sensor iB15 is covered.
4	Object too small. iB15 triggered for too short. Time is calculated with the shortest product length	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked. Start-up procedure of infeed conveyor must be carried out.	Check object length. Give the reset command to reset the fault. Resetting is not possible if sensor iB15 is covered.
5	Object too big. iB15 triggered for too long. Time is calculated with the longest product length	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked. Start-up procedure of infeed conveyor must be carried out.	Check object length. Give the reset command to reset the fault. Resetting is not possible if sensor iB15 is covered.
6	Unknown destination of object on infeed conveyor. This must higher than '0' and less than or equal to the number of levels present.	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked. Start-up procedure of infeed conveyor must be carried out.	Remove object from infeed conveyor and check communication with downstream transport. Give the reset command to reset the fault. Resetting is not possible if sensor iB15 is covered.
8	Configuration is not entered correctly	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked.	Check configuration settings. Make sure that everything is entered correctly and not below the minimum value.

Code	Description / Cause	Effect	Solution
9	Start-up procedure time-out. Sensor iB15 does not become untriggered.	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked.	Put the object down manually in the sensors; iB15 uncovered, iB7 covered. Give the reset command to reset the fault.
10	Movement to waiting position is taking too long	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked.	Check why this is taking too long. Check adjustment/operation of the iB1 sensor Give the reset command to reset the fault.
11	Movement to infeed position is taking too long	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked.	Check why this is taking too long. Check adjustment/operation of the iB4 sensor Give the reset command to reset the fault.
12	Position horizontal movement no longer correct.	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked.	Check adjustment/operation of the iB1 & iB4 sensor. Give the reset command to reset the fault.
13	Fault controller/drive conveyor track.	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked. (Depending on position)	Check operation/fault controller/drive. Make sure that it is ready for operation again. Give the reset command to reset the fault.
14	Fault controller/drive horizontal movement.	See fault 13	See fault 13
15	Initialisation procedure: object still detected on conveyor track.	Initialisation has not been completed.	Empty the conveyor track. Restart procedure by giving initialisation command again.
16	Initialisation procedure: Safe position not reached	Initialisation has not been completed.	Check the movement of the infeed module. Check operation and adjustment of position indicator sensors. Restart procedure by giving initialisation command again.

11 Function block infeed module MBC4

With this software block, the infeed module MBC4 is called.
MBC4 stands for: Multibelt conveyor 4 → Moveable

11.1 Function block specifications infeed module MBC4

Block name: FB_Prorunner_mk5_Infeed_MBC4
Block number: FB1066
Version: V0.1
Required PLC blocks: TON_TIMER
Required PLC data types: UDT_MotorControl
                               UDT_Prorunner_mk5_Carrier
                               UDT_Prorunner_mk5_Customer_Information
                               UDT_Prorunner_mk5_Infeed_Configuration
                               UDT_Prorunner_mk5_Infeed_Handshake
Function block call   Cyclical (OB1)
Optimised block access   Yes/~~No~~
Programming language   LAD, SCL
STEP7 version   TIA Portal V14 + SP1

11.2 Components infeed module MBC4

Figuur 15: Components infeed module RDC4
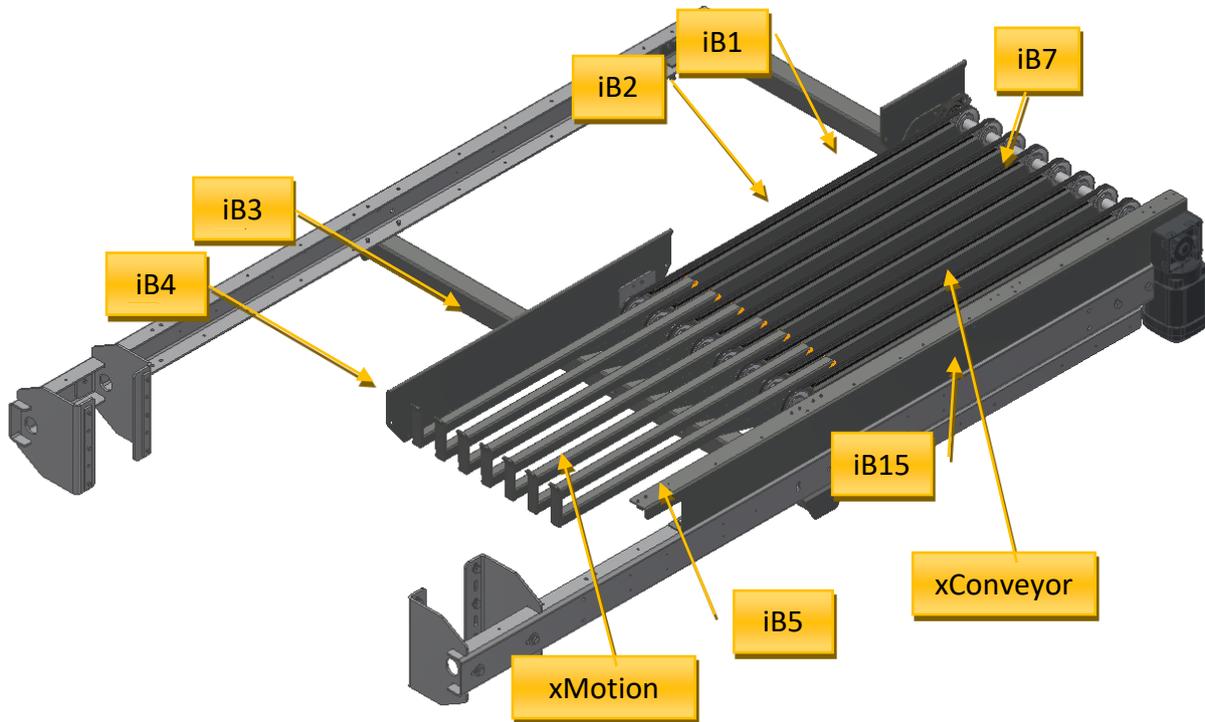
Tabel 34:   Components infeed module RDC4

Code		Type
iB15	Sensor/ photocell: Product position monitoring. This photocell monitors whether the product has completely entered the infeed roller conveyor.	GL6-P4211 C42-2
iB7	Sensor/ photocell: Product on infeed. This photocell detects whether the product has entered the infeed roller conveyor	GL6-P4211 C42-2
iB1	Inductive approach: Wait for position (from Prorunner) Sensor detection that horizontal movement is in waiting position. This is the position in which an object can be entered, and the conveyor is in a safe position for the Prorunner carriers.	IM-18
iB2	Inductive approach: Wait for position (from Proruner) low speed Sensor detection that switches the shuttle to low speed when moving to the wait position	IM-18
iB3	Inductive approach: Infeed position (from Proruner) low speed Sensor detection that switches the shuttle to low speed when moving to the infeed position	IM-18
iB4	Inductive approach: Infeed position (from Prorunner) Sensor detection that horizontal movement is at infeed position so a carrier of the Prorunner can pick up the object	IM-18
iB5	Sensor/ photocell: Product picked up from conveyor	GL6
xConveyor	Actuation roller conveyor	SEW
xMotion	Actuation Shuttle movement	SEW

11.3 Configuration infeed module MBC4

Configuration according to UDT_Prorunner_mk5_Infeed_Configuration

Tabel 35: Configuration infeed module MBC4

Naming	Data type	Unit	Description
Module.Level	Int	1..20	Level number.
Module.Height	Real	mm.	Exact height of the conveyor measured from the floor
Options.LowspeedPickup	Bool	0/1	Picking up by using lower speed (1=active)
Conveyor.Speed	Real	m/s.	Speed of conveyor track at rated actuation (metre per second)
Conveyor.Length	Real	mm.	Exact length of infeed conveyor
Transport.CycleTime	Real	s.	Time necessary to perform infeed transport.
Transport.Speed	Int	Hz	Number of Hertz (Nominal = 50 Hz)
Transport.Acceleration	Int	ms.	Number of milliseconds to accelerate from standstill to desired speed
Transport.Deceleration	Int	ms.	Number of milliseconds to decelerate from current speed to standstill
Movement.CycleTime	Real	s.	Time needed to move shuttle between infeed position and waiting position.
Movement.Speed	Real	m/s.	Speed of movement
Movement.HighSpeed	Int	Hz	Number of Hertz (Nominal = 50 Hz)
Movement.LowSpeed	Int	Hz	Number of Hertz (Nominal = 50 Hz)
Movement.Acceleration	Int	ms.	Number of milliseconds to accelerate from standstill to desired speed
Movement.Deceleration	Int	ms.	Number of milliseconds to decelerate from current speed to standstill

11.4 Inputs infeed module MBC4

Inputs must be declared by the customer. Inputs provide information such as configuration, status of installation, status sensors, manual pushbutton and communication signals with downstream transport

Tabel 36:   Inputs infeed module MBC4

Naming	Data type	Unit	Description
iConfiguration	UDT		UDT as discussed in section above
iEnabled	Bool	0/1	System is switched on. Safety functions are operational and power supplies to the controllers are switched on.
iReset	Bool	0/1	Reset command to reset faults.
iInitialisationMode	Bool	0/1	Start of initialisation procedure.
iAutomaticMode	Bool	0/1	Installation is in automatic mode. Operation is influenced by the sensors and communication with the infeed/outfeed conveyor.
iManualMode	Bool	0/1	Installation is in manual mode. The operation is influenced by the manual commands.
iManualConveyor	Bool	0/1	Command for manual actuation of roller conveyor
iManualForwards	Bool	0/1	Command manual actuation of horizontal movement to the infeed position
iManualBackwards	Bool	0/1	Command manual actuation of horizontal movement to the waiting position
iB1	Bool	0/1	Sensor for detection of waiting position (stop)
iB2	Bool	0/1	Sensor for detection of waiting position (low speed)
iB3	Bool	0/1	Sensor for detection of infeed position (low speed)
iB4	Bool	0/1	Sensor for detection of infeed position (stop)
iB5	Bool	0/1	Sensor for detection of product picked up
iB7	Bool	0/1	Sensor for position of entered product
iB15	Bool	0/1	Sensor for product position control
iDownStream_ObjectReady	Bool	0/1	Communication signal of downstream transport: Object ready for infeeding.
iDownStream_ObjectDestination	Int	1..20	Communication signal of downstream transport: Object destination level.
iDownStream_ObjectInformation	UDT		Communication signal of downstream transport: 'UDT_Prorunner_mk5_Customer_Information' Any information that can be sent along with each object. This UDT can be configured by yourself.

11.5 Outputs infeed module MBC4

Exits must be declared by the customer. Outputs provide feedback such as faults, status and communication signals with downstream transport.

Tabel 37:   Outputs infeed module MBC4

Naming	Data type	Unit	Description
oAlarm	Bool	0/1	Fault active
oAlarmCode	Int	0	Active fault code (See chapter 'Faults' for the correct overview)
oAlarmFeedback	Word	0	Active fault feedback for HMI. One bit is reserved for each fault. Fault 1 = bit 0, fault 2 = bit 1, etc.
oStatus	Int	0	See chapter 'Status Prorunner mk5' for further information.
oDownStream_Start	Bool	0/1	Communication signal to downstream transport: Infeed module ready/busy for transport to the end of the roller conveyor
oDownStream_MotorIsRunning	Bool	0/1	Communication signal to downstream transport: Infeed module roller conveyor running. If this signal stops, the roller conveyor downstream must also stop.

11.6 Motor interface infeed module MBC4

Two motors are used for the infeed module. All commands are prepared via this motor interface to handle different forms of motor actuation.
For more information, please refer to chapter '16 - Motor interface'

Tabel 38:   Motor interface infeed module MBC4

Naming	Data type	Unit	Description
xConveyor	UDT		**UDT_MotorControl** Motor interface multi belt conveyor infeed module MBC4
xMotion	UDT		**UDT_MotorControl** Motor interface shuttle movement

11.7 Status infeed module MBC4

The status of the infeed module is output, giving the user a clear picture of the status/movements of the infeed module MBC4

Tabel 39:   Status infeed module MBC4

Code	Description / Cause
0	NO ACTION: Infeed module switched off / no mode active
1	MANUAL OPERATION: Infeed module in manual mode
3	INITIALISATION PROCEDURE ACTIVE: Infeed module busy with initialisation procedure.
4	INITIALISATION PROCEDURE READY: Infeed module finished with initialisation procedure.
5	CONFIGURATION CHECK: Infeed module finished with initialisation procedure.
6	RESTART / START-UP PROCEDURE: Procedure after fault; this involves checking whether an object is present and whether it is correctly positioned.
7	FAULT: Infeed module blocked by fault
10	WAITING: Infeed module ready for use, object infeeding can be started
11	MOVEMENT TO INFEED POSITION: Infeed module busy with horizontal movement to infeed position
12	AT INFEED POSITION: Infeed module ready for transport of object
13	MOVEMENT TO WAITING POSITION: Infeed module busy with horizontal movement to waiting position
14	AT WAIT POSITION: Infeed module in waiting position.
15	OBJECT INFEEDING BUSY: Infeed module busy with object infeeding.
16	OBJECT ACCEPTED ON INFEED CONVEYOR: Infeed module has received object on belt (sensor iB15)
17	OBJECT PRESENT ON INFEED CONVEYOR: Infeed module in the process of moving object to the end of the roller conveyor (sensor iB7 covered and iB15 uncovered).
18	WAIT UNTIL OBJECT HAS BEEN PICKED UP: Infeed module waits until Prorunner mk5 has picked up object. Information is also made available in this status/step.

11.8 Faults infeed module MBC4

With the outfeed signal 'oAlarm' it is possible to indicate a fault by, for example, switching on a red lamp. With the fault code 'oAlarmCode' you can indicate this better.
With the fault word 'oAlarmFeedback' you can generate a clearly defined fault message by means of an HMI. The faults are divided over 16 bits. Code 1 = bit 0 ... Code 16 = bit 15.
Below is the list of faults that may be active with explanation/effect and solution.

Tabel 40:   Faults list infeed module MBC4

Code	Description / Cause	Effect	Solution
1	Feeding object in is taking too long. Sensor object detection does not see the object within time limits	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked. Start-up procedure of infeed conveyor must be carried out.	Put the object down manually in the sensors; iB15 uncovered, iB7 covered. Give the reset command to reset the fault. Resetting is not possible if sensor iB15 is covered.
2	Object fed in too fast. It is possible that the product is too long and/or that an unknown object has been seen.	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked. Start-up procedure of infeed conveyor must be carried out.	Check for unknown objects. Put the object down manually in the sensors; iB15 uncovered, iB7 covered. Give the reset command to reset the fault. Resetting is not possible if sensor iB15 is covered.
3	Unknown object detected. Sensors triggered while the infeed module is not busy with this step.	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked. Start-up procedure of infeed conveyor must be carried out.	Check for unknown objects. Give the reset command to reset the fault. Resetting is not possible if sensor iB15 is covered.
4	Object too small. iB15 triggered for too short. Time is calculated with the shortest product length	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked. Start-up procedure of infeed conveyor must be carried out.	Check object length. Give the reset command to reset the fault. Resetting is not possible if sensor iB15 is covered.
5	Object too big. iB15 triggered for too long. Time is calculated with the longest product length	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked. Start-up procedure of infeed conveyor must be carried out.	Check object length. Give the reset command to reset the fault. Resetting is not possible if sensor iB15 is covered.
6	Unknown destination of object on infeed conveyor. This must higher than '0' and less than or equal to the number of levels present.	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked. Start-up procedure of infeed conveyor must be carried out.	Remove object from infeed conveyor and check communication with downstream transport. Give the reset command to reset the fault. Resetting is not possible if sensor iB15 is covered.
8	Configuration is not entered correctly	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked.	Check configuration settings. Make sure that everything is entered correctly and not below the minimum value.

Code	Description / Cause	Effect	Solution
9	Start-up procedure time-out. Sensor iB15 does not become untriggered.	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked.	Put the object down manually in the sensors; iB15 uncovered, iB7 covered. Give the reset command to reset the fault.
10	Movement to waiting position is taking too long	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked.	Check why this is taking too long. Check adjustment/operation of the iB1 sensor Give the reset command to reset the fault.
11	Movement to infeed position is taking too long	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked.	Check why this is taking too long. Check adjustment/operation of the iB4 sensor Give the reset command to reset the fault.
12	Position horizontal movement no longer correct.	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked.	Check adjustment/operation of the iB1 & iB4 sensor. Give the reset command to reset the fault.
13	Fault controller/drive conveyor track.	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked. (Depending on position)	Check operation/fault controller/drive. Make sure that it is ready for operation again. Give the reset command to reset the fault.
14	Fault controller/drive horizontal movement.	See fault 13	See fault 13
15	Initialisation procedure: object still detected on conveyor track.	Initialisation has not been completed.	Empty the conveyor track. Restart procedure by giving initialisation command again.
16	Initialisation procedure: Safe position not reached	Initialisation has not been completed.	Check the movement of the infeed module. Check operation and adjustment of position indicator sensors. Restart procedure by giving initialisation command again.

12 Function block outfeed module RDC2/MBC2

Figuur 16: Function block outfeed module RDC2/MBC2
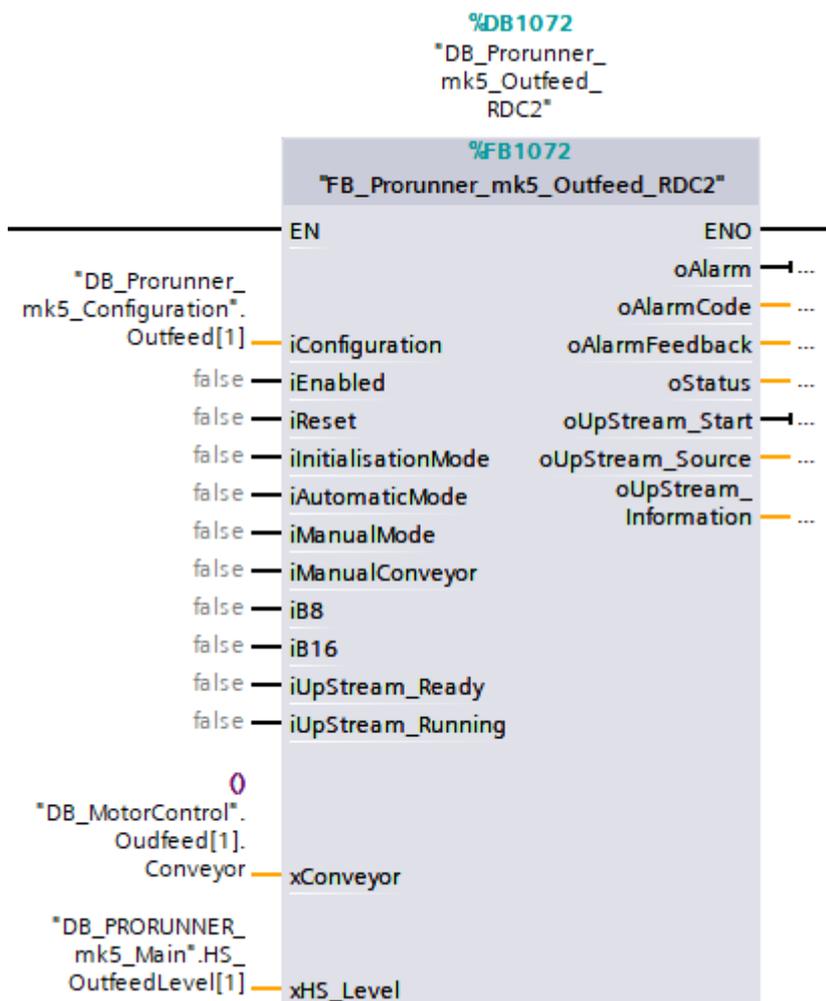
With this software block, the outfeed module RDC2/MBC2 is called.
'RDC2' stands for: Roller Drive Conveyor type 2 → Fixed position
'MBC2' stands for: Multi Belt Conveyor type 2 → Fixed position

12.1 Function block specifications outfeed module RDC2/MBC2

Block name:	FB_Prorunner_mk5_Outfeed_RDC2/MBC2
Block number:	FB1072
Version:	V4.1
Required PLC blocks:	TON_TIMER
Required PLC data types:	UDT_MotorControl
	UDT_Prorunner_mk5_Carrier
	UDT_Prorunner_mk5_Customer_Information
	UDT_Prorunner_mk5_Outfeed_Configuration
	UDT_Prorunner_mk5_Outfeed_Handshake
Function block call	Cyclical (OB1)
Optimised block access	Yes/~~No~~
Programming language	LAD, SCL
STEP7 version	TIA Portal V14 + SP1

12.2 Components outfeed module RDC2/MBC2

Figuur 17: Components outfeed module RDC2
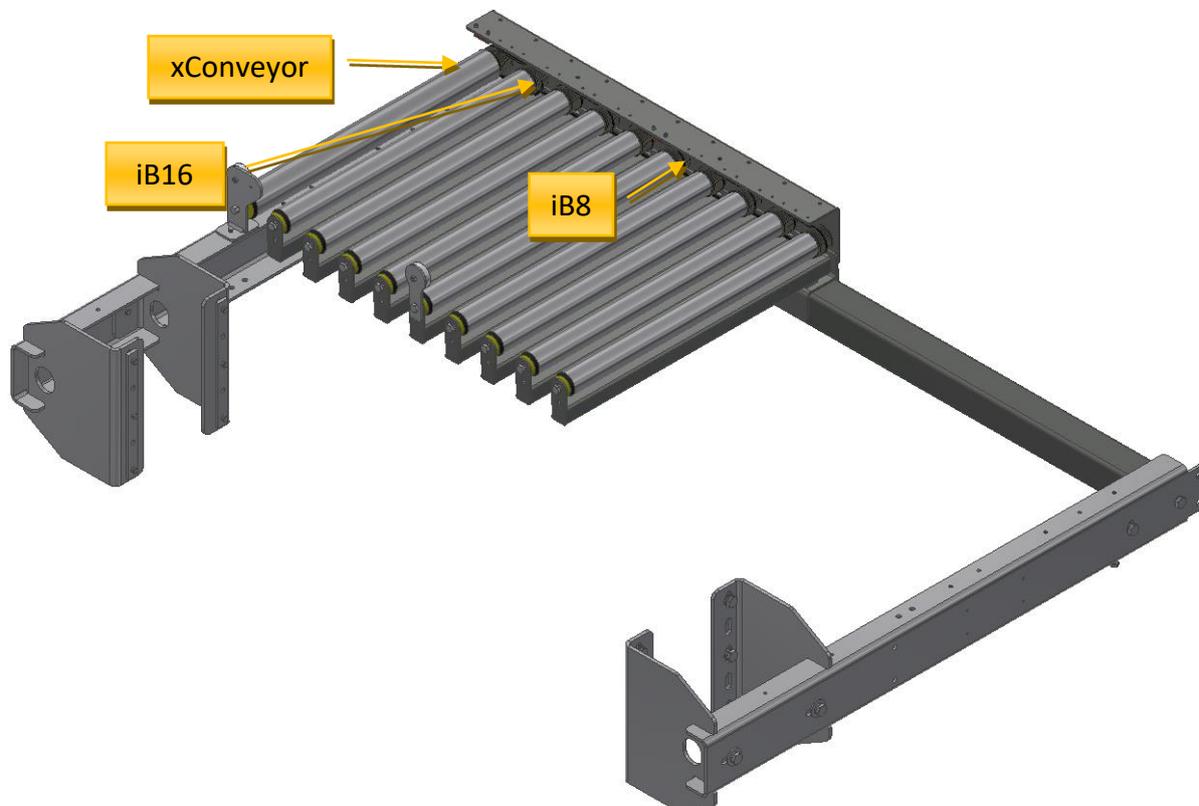
Tabel 41:   Components outfeed module RDC2

Code		Type
iB8	Sensor/Photocell: Product on outfeed This photocell monitors whether a product is present on the outfeed conveyor.	GL6-P4211 C42-2
iB16	Sensor/photocell; Product has left module This photocell detects whether the product has run out on the outfeed conveyor	GL6-P4211 C42-2
xConveyor	Actuation roller conveyor	Drivecontrol 20/54 Rollerdrive

Tabel 42:
Components outfeed module MBC2

Code		Type
iB8	Sensor/Photocell: Product on outfeed This photocell monitors whether a product is present on the outfeed conveyor.	GT6
iB16	Sensor/photocell; Product has left module This photocell detects whether the product has run out on the outfeed conveyor	GT6
xConveyor	Actuation conveyor	SEW

12.3 Flow chart functionality outfeed module RDC2/MBC2

RDC2 – Roller drive conveyor fixed

V1.0 – BJA – 12/3/2018
V1.1 – BJA – 27/7/2018
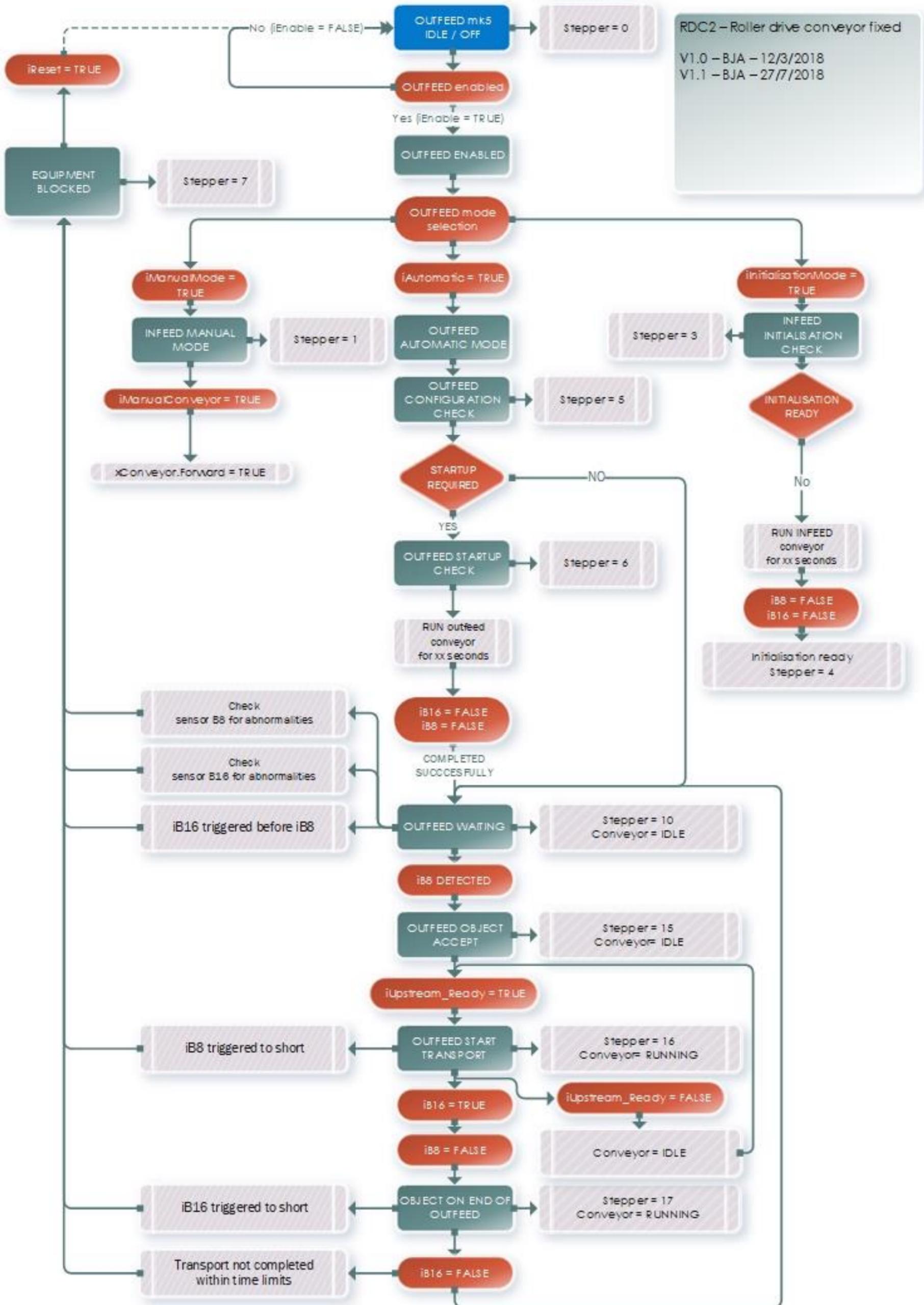
12.4 Configuration outfeed module RDC2/MBC2

Configuration according to UDT_Prorunner_mk5_Outfeed_Configuration

Tabel 43:   Configuration outfeed module RDC2/MBC2

Naming	Data type	Unit	Description
Module.Level	Int	1..20	Level number.
Module.Height	Real	mm.	Exact height of the belt, measured from the floor
Options.LowspeedDropoff	Bool	0/1	Drop off by means of use of lower speed (1=active)
Conveyor.Speed	Real	m/s.	Speed of conveyor track at rated actuation (metre per second)
Conveyor.Length	Real	mm.	Exact length of outfeed conveyor
Transport.CycleTime	Real	s.	Time needed to perform outfeed transport.
Transport.Speed	Int	Hz	Number of Hertz (Nominal = 50 Hz)
Transport.Acceleration	Int	ms.	Number of milliseconds to accelerate from standstill to desired speed
Transport.Deceleration	Int	ms.	Number of milliseconds to decelerate from current speed to standstill

12.5 Inputs outfeed module RDC2/MBC2

Inputs must be declared by the customer.

Inputs provide information such as configuration, status of installation, status sensors, manual pushbutton and communication signals with upstream transport

Tabel 44:   Inputs outfeed module RDC2/MBC2

Naming	Data type	Unit	Description
iConfiguration	UDT		UDT as discussed in section above
iEnabled	Bool	0/1	System is switched on. Safety functions are operational and power supplies to the controllers are switched on.
iReset	Bool	0/1	Reset command to reset faults.
iInitialisationMode	Bool	0/1	Start of initialisation procedure.
iAutomaticMode	Bool	0/1	Installation is in automatic mode. Operation is influenced by the sensors and communication with the infeed/outfeed conveyor.
iManualMode	Bool	0/1	Installation is in manual mode. The operation is influenced by the manual commands.
iManualConveyor	Bool	0/1	Command for manual actuation of roller conveyor
iB8	Bool	0/1	Sensor for registering product presence
iB16	Bool	0/1	Sensor for detection of product running out onto outfeed conveyor
iUpStream_Ready	Bool	0/1	Communication signal of upstream transport: Transport system ready to receive object
iUpStream_Running	Bool	0/1	Communication signal of upstream transport: Transport system systems ready & transport running.

12.6 Outputs outfeed module RDC2/MBC2

Exits must be declared by the customer.

Outputs provide feedback such as faults, status and communication signals with upstream transport.

Tabel 45:   Outputs outfeed module RDC2/MBC2

Naming	Data type	Unit	Description
oAlarm	Bool	0/1	Fault active
oAlarmCode	Int	0	Active fault code (See chapter 'Faults' for the correct overview)
oAlarmFeedback	Word	0	Active fault feedback for HMI. One bit is reserved for each fault. Fault 1 = bit 0, fault 2 = bit 1, etc.
oStatus	Int	0	See chapter 'Status Prorunner mk5' for further information.
oUpStream_ObjectReady	Bool	0/1	Communication signal to the upstream transport: Object ready for outfeed.
oUpStream_ObjectSource	Int	1..20	Communication signal to the upstream transport: Object source level.
oUpStream_ObjectInformation	UDT		Communication signal to the upstream transport: 'UDT_Prorunner_mk5_Customer_Information' Additional information that was sent with the object.

12.7 Motor interface outfeed module RDC2/MBC2

One motor is used for the outfeed module. All commands are prepared via this motor interface to handle different forms of motor actuation.
For more information, please refer to chapter '16 - Motor interface'

Tabel 46:   Motor interface outfeed module RDC2/MBC2

Naming	Data type	Unit	Description
xConveyor	UDT		**UDT_MotorControl** Motor interface outfeed module RDC2/MBC2

12.8 Status outfeed module RDC2/MBC2

The status of the outfeed module is output, giving the user a clear picture of the status/movements of the outfeed module RDC2/MBC2.

Tabel 47:   Status outfeed module RDC2/MBC2

Code	Description / Cause
0	NO ACTION: Outfeed module switched off / no mode active
1	MANUAL OPERATION: Outfeed module in manual mode
3	INITIALISATION PROCEDURE ACTIVE: Outfeed module busy with initialisation procedure.
4	INITIALISATION PROCEDURE READY: Outfeed module finished with initialisation procedure.
5	CONFIGURATION CHECK: Outfeed module finished with initialisation procedure.
6	RESTART / START-UP PROCEDURE: Procedure after fault; this involves checking whether an object is present and whether it is correctly positioned.
7	FAULT: Outfeed module blocked by fault
10	WAITING: Outfeed module ready for use; depositing objects allowed
15	OBJECT ACCEPTED ON OUTFEED TRACK: Outfeed module has received object on track (sensor iB8)
16	OBJECT TRANSPORT BUSY Outfeed module in the process of moving object to the end of the conveyor track (sensor iB16 covered)
17	OBJECT AT END OF TRACK: Object at end of the conveyor track, waiting for iB16 to be uncovered.

12.9 Faults outfeed module RDC2/MBC2

With the outfeed signal 'oAlarm' it is possible to indicate a fault by, for example, switching on a red lamp. With the fault code 'oAlarmCode' you can indicate this better.
With the fault word 'oAlarmFeedback' you can generate a clearly defined fault message by means of an HMI. The faults are divided over 16 bits. Code 1 = bit 0 ... Code 16 = bit 15.
Below is the list of faults that may be active with explanation/result and solution.

Tabel 48:   Faults list outfeed module RDC2/MBC2

Code	Description / Cause	Effect	Solution
1	Object outfeeding is taking too long.	Automatic operation is stopped. Command to PRORUNNER that outfeed module is blocked. Start-up procedure of outfeed conveyor must be carried out.	Remove object manually from the conveyor track Give the reset command to reset the fault. Resetting is not possible if sensor iB8 or iB16 is covered.
2	No drop off detected, while carrier declares that it has an object present	Automatic operation is stopped. Command to PRORUNNER that outfeed module is blocked. Start-up procedure of outfeed conveyor must be carried out.	Check if object is correctly aligned on the carrier so the photocells detect the object. If no object is present, reset the alarm
3	Unknown object detected. Sensors triggered while the outfeed module is not busy with the corresponding step.	Automatic operation is stopped. Command to PRORUNNER that outfeed module is blocked. Start-up procedure of outfeed conveyor must be carried out.	Check for unknown objects. Give the reset command to reset the fault. Resetting is not possible if sensor iB8 or iB16 is covered.
4	Object too small. iB16 triggered for too short. Time is calculated with the minimum product length	Automatic operation is stopped. Command to PRORUNNER that outfeed module is blocked. Start-up procedure of outfeed conveyor must be carried out.	Check object length. Give the reset command to reset the fault. Resetting is not possible if sensor iB8 or iB16 is covered.
5	Object too big. iB16 triggered for too long. Time is calculated with the maximum product length	Automatic operation is stopped. Command to PRORUNNER that outfeed module is blocked. Start-up procedure of outfeed conveyor must be carried out.	Check object length. Give the reset command to reset the fault. Resetting is not possible if sensor iB8 or iB16 is covered.
8	Configuration is not entered correctly	Automatic operation is stopped. Command to PRORUNNER that outfeed module is blocked.	Check configuration settings. Make sure that everything is entered correctly and not below the minimum value.
9	Start-up procedure time-out. Sensor iB8 & iB16 does not become untriggered.	Automatic operation is stopped. Command to PRORUNNER that outfeed module is blocked.	Remove object manually; iB8 uncovered & iB16 uncovered. Give the reset command to reset the fault.
13	Fault controller/drive conveyor track.	Automatic operation is stopped. Command to PRORUNNER that outfeed module is blocked. (Depending on position)	Check operation/fault controller/drive. Make sure that it is ready for operation again. Give the reset command to reset the fault.

Code	Description / Cause	Effect	Solution
15	Initialisation procedure: object still detected on conveyor track.	Initialisation has not been completed.	Empty the conveyor track. Restart procedure by giving initialisation command again.

13 Function block outfeed module RDC3

Figuur 18: Function block outfeed module RDC3
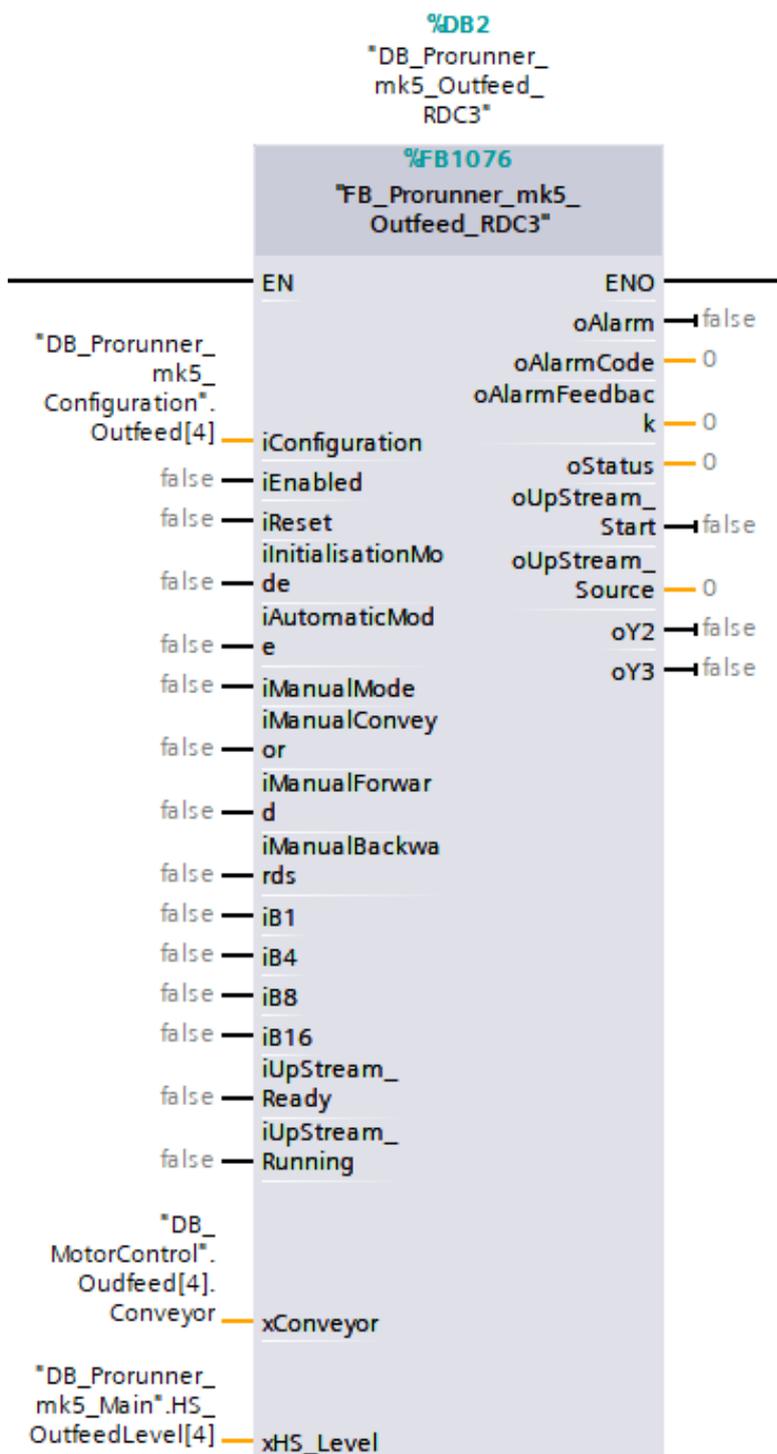
With this software block, the outfeed module RDC3 is called.
RDC3 stands for: Tilting Roller Drive Conveyor type 3 → Moveable

13.1 Function block specifications outfeed module RDC4

Block name:	FB_Prorunner_mk5_Outfeed_RDC3
Block number:	FB1076
Version:	V0.9
Required PLC blocks:	TON_TIMER
Required PLC data types:	UDT_MotorControl
	UDT_Prorunner_mk5_Carrier
	UDT_Prorunner_mk5_Outfeed_Configuration
	UDT_Prorunner_mk5_Outfeed_Handshake
Function block call	Cyclical (OB1)
Optimised block access	Yes/No
Programming language	LAD, SCL
STEP7 version	TIA Portal V14 + SP1

13.2 Components outfeed module RDC4

Figuur 19: Components outfeed module RDC4
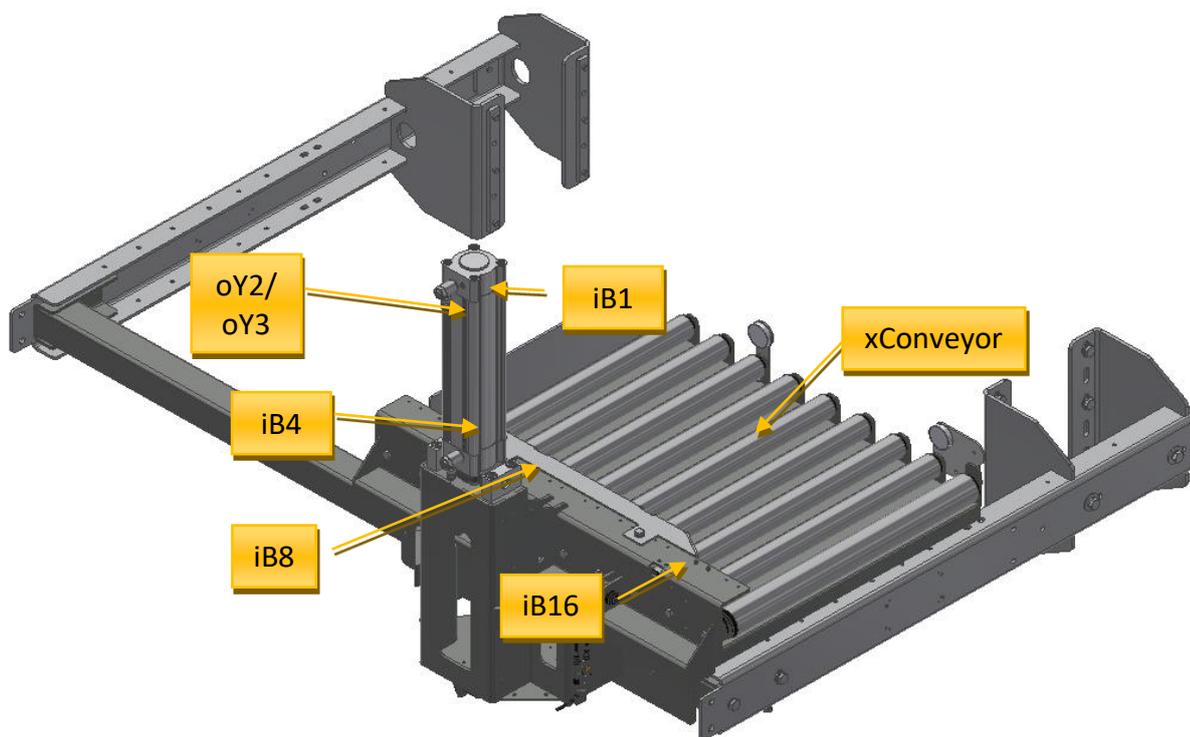
Tabel 49:   Components infeed module RDC3

Code		Type
iB16	Sensor/ photocell: Product position monitoring. This photocell monitors whether the product has completely left the outfeed roller conveyor.	GL6-P4211 C42-2
iB8	Sensor/ photocell: Product on infeed. This photocell detects whether the product is dropped on the outfeed conveyor	GL6-P4211 C42-2
iB1	Inductive approach: Wait for position (from Prorunner) Sensor detection that horizontal movement is in waiting position. This is the position in which no object can be entered, and the conveyor is in a safe position for the Prorunner carriers.	SMT-8M-A-PS-24V-E-1-N-M12
iB4	Inductive approach: Outfeed position (In Prorunner) Sensor detection that horizontal movement is at outfeed position. This is the position in which an object can be transported.	SMT-8M-A-PS-24V-E-1-N-M12
xConveyor	Actuation roller conveyor	Drivecontrol 20/54 Rollerdrive
oY2/oY3	Actuation tilting movement	Air valve

Qimarox

13.4 Flow chart functionality outfeed module RDC3

RDC3 – Tilting rollerdrive conveyor

V1.0 – GVl – 29/4/2021
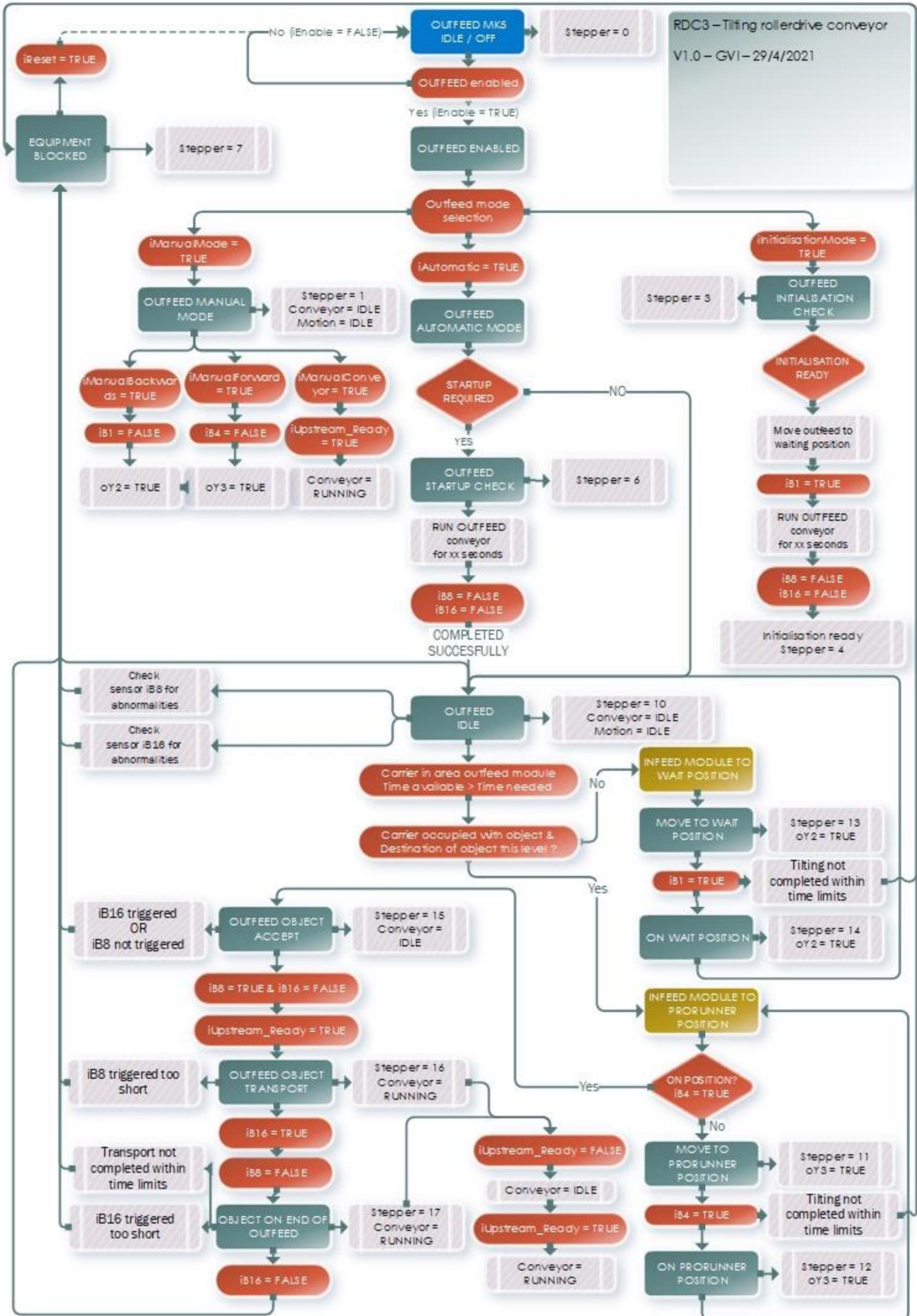
13.5 Configuration outfeed module RDC3

Configuration according to UDT_Prorunner_mk5_outfeed_Configuration

Tabel 50:   Configuration outfeed module RDC3

Naming	Data type	Unit	Description
Module.Level	Int	1..20	Level number.
Module.Height	Real	mm.	Exact height of the conveyor measured from the floor
Options.LowspeedDropoff	Bool	0/1	Drop off by means of use of lower speed (1=active)
Conveyor.Speed	Real	m/s.	Speed of conveyor track at rated actuation (metre per second)
Conveyor.Length	Real	mm.	Exact length of outfeed conveyor
Transport.CycleTime	Real	s.	Time needed to perform outfeed transport.
Transport.Speed	Int	Hz	Number of Hertz (Nominal = 50 Hz)
Transport.Acceleration	Int	ms.	Number of milliseconds to accelerate from standstill to desired speed
Transport.Deceleration	Int	ms.	Number of milliseconds to decelerate from current speed to standstill
Movement.CycleTime	Real	s.	Time needed to tilt conveyor between outfeed position and waiting position.

13.6 Inputs outfeed module RDC3

Inputs must be declared by the customer. Inputs provide information such as configuration, status of installation, status sensors, manual pushbutton and communication signals with downstream transport

Tabel 51:   Inputs outfeed module RDC3

Naming	Data type	Unit	Description
iConfiguration	UDT		UDT as discussed in section above
iEnabled	Bool	0/1	System is switched on. Safety functions are operational and power supplies to the controllers are switched on.
iReset	Bool	0/1	Reset command to reset faults.
iInitialisationMode	Bool	0/1	Start of initialisation procedure.
iAutomaticMode	Bool	0/1	Installation is in automatic mode. Operation is influenced by the sensors and communication with the infeed/outfeed conveyor.
iManualMode	Bool	0/1	Installation is in manual mode. The operation is influenced by the manual commands.
iManualConveyor	Bool	0/1	Command for manual actuation of roller conveyor
iManualForwards	Bool	0/1	Command manual actuation of horizontal movement to the infeed position
iManualBackwards	Bool	0/1	Command manual actuation of horizontal movement to the waiting position
iB1	Bool	0/1	Sensor for detection of waiting position
iB4	Bool	0/1	Sensor for detection of infeed position
iB8	Bool	0/1	Sensor for detection object present outfeed conveyor
iB16	Bool	0/1	Sensor for detection object left outfeed conveyor
iUpStream_Ready	Bool	0/1	Communication signal of upstream transport: Transport system ready to receive object
iUpStream_Running	Bool	0/1	Communication signal of upstream transport: Transport system systems ready & transport running.

13.7 Outputs outfeed module RDC3

Exits must be declared by the customer. Outputs provide feedback such as faults, status and communication signals with downstream transport.

Tabel 52:   Outputs outfeed module RDC3

Naming	Data type	Unit	Description
oAlarm	Bool	0/1	Fault active
oAlarmCode	Int	0	Active fault code (See chapter 'Faults' for the correct overview)
oAlarmFeedback	Word	0	Active fault feedback for HMI. One bit is reserved for each fault. Fault 1 = bit 0, fault 2 = bit 1, etc.
oStatus	Int	0	See chapter 'Status Prorunner mk5' for further information.
oUpStream_ObjectReady	Bool	0/1	Communication signal to the upstream transport: Object ready for outfeed.
oUpStream_ObjectSource	Int	1..20	Communication signal to the upstream transport: Object source level.
oY2	Bool	0/1	Tilt the conveyor to the wait (upwards) position
oY3	Bool	0/1	Tilt the conveyor to the outfeed (downwards) position

13.8 Motor interface infeed module RDC3

Two motors are used for the infeed module. All commands are prepared via this motor interface to handle different forms of motor actuation.
For more information, please refer to chapter '16 - Motor interface'

Tabel 53:   Motor interface infeed module RDC3

Naming	Data type	Unit	Description
xConveyor	UDT		**UDT_MotorControl** Motor interface roller conveyor infeed module RDC4

13.9 Status outfeed module RDC3

The status of the output module is output, giving the user a clear picture of the status/movements of the outfeed module RDC3

Tabel 54:   Status outfeed module RDC3

Code	Description / Cause
0	NO ACTION: Infeed module switched off / no mode active
1	MANUAL OPERATION: Infeed module in manual mode
3	INITIALISATION PROCEDURE ACTIVE: Infeed module busy with initialisation procedure.
4	INITIALISATION PROCEDURE READY: Infeed module finished with initialisation procedure.
5	CONFIGURATION CHECK: Infeed module finished with initialisation procedure.
6	RESTART / START-UP PROCEDURE: Procedure after fault; this involves checking whether an object is present and whether it is correctly positioned.
7	FAULT: Infeed module blocked by fault
10	WAITING: Infeed module ready for use, object infeeding can be started
11	MOVEMENT TO OUTFEED POSITION: Infeed module busy with horizontal movement to outfeed position
12	AT OUTFEED POSITION: Outfeed module ready for dropoff of product
13	MOVEMENT TO WAITING POSITION: Infeed module busy with horizontal movement to waiting position
14	AT WAIT POSITION: Infeed module in waiting position.
15	ACCEPT PRODUCT ON OUTFEED CONVEYOR: Product detected (iB8) on outfeed module, request outfeed clearance from upstream
16	OBJECT TRANSPORT: Upstream able to receive object, start transport with rollerconveyor
17	OBJECT ON END OUTFEED CONVEYOR: Object detected on end of conveyor (iB16) wait until object is gone

13.10 Faults outfeed module RDC3

With the outfeed signal 'oAlarm' it is possible to indicate a fault by, for example, switching on a red lamp. With the fault code 'oAlarmCode' you can indicate this better.

With the fault word 'oAlarmFeedback' you can generate a clearly defined fault message by means of an HMI. The faults are divided over 16 bits. Code 1 = bit 0 ... Code 16 = bit 15.

Below is the list of faults that may be active with explanation/effect and solution.

Tabel 55: Faults list outfeed module RDC3

Code	Description / Cause	Effect	Solution
1	Object outfeeding is taking too long.	Automatic operation is stopped. Command to PRORUNNER that outfeed module is blocked. Start-up procedure of outfeed conveyor must be carried out.	Remove object manually from the conveyor track. Give the reset command to reset the fault. Resetting is not possible if sensor iB8 or iB16 is covered.
2	No drop off detected, while carrier declares that it has an object present	Automatic operation is stopped. Command to PRORUNNER that outfeed module is blocked. Start-up procedure of outfeed conveyor must be carried out.	Check if object is correctly aligned on the carrier so the photocells detect the object. If no object is present, reset the alarm
3	Unknown object detected. Sensors triggered while the outfeed module is not busy with the corresponding step.	Automatic operation is stopped. Command to PRORUNNER that outfeed module is blocked. Start-up procedure of outfeed conveyor must be carried out.	Check for unknown objects. Give the reset command to reset the fault. Resetting is not possible if sensor iB8 or iB16 is covered.
4	Object too small. iB16 triggered for too short. Time is calculated with the minimum product length	Automatic operation is stopped. Command to PRORUNNER that outfeed module is blocked. Start-up procedure of outfeed conveyor must be carried out.	Check object length. Give the reset command to reset the fault. Resetting is not possible if sensor iB8 or iB16 is covered.
5	Object too big. iB16 triggered for too long. Time is calculated with the maximum product length	Automatic operation is stopped. Command to PRORUNNER that outfeed module is blocked. Start-up procedure of outfeed conveyor must be carried out.	Check object length. Give the reset command to reset the fault. Resetting is not possible if sensor iB8 or iB16 is covered.
8	Configuration is not entered correctly	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked.	Check configuration settings. Make sure that everything is entered correctly and not below the minimum value.
9	Start-up procedure time-out. Sensor iB16 does not become untriggered.	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked.	Put the object down manually in the sensors; iB16 uncovered, iB8 uncovered. Give the reset command to reset the fault.
10	Movement to waiting position is taking too long	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked.	Check why this is taking too long. Check adjustment/operation of the iB1 sensor Give the reset command to reset the fault.

Code	Description / Cause	Effect	Solution
11	Movement to outfeed position is taking too long	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked.	Check why this is taking too long. Check adjustment/operation of the iB4 sensor Give the reset command to reset the fault.
12	Position horizontal movement no longer correct.	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked.	Check adjustment/operation of the iB1 & iB4 sensor. Give the reset command to reset the fault.
13	Fault controller/drive conveyor track.	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked. (Depending on position)	Check operation/fault controller/drive. Make sure that it is ready for operation again. Give the reset command to reset the fault.
14	Fault controller/drive horizontal movement.	See fault 13	See fault 13
15	Initialisation procedure: object still detected on conveyor track.	Initialisation has not been completed.	Empty the conveyor track. Restart procedure by giving initialisation command again.
16	Initialisation procedure: Safe position not reached	Initialisation has not been completed.	Check the movement of the infeed module. Check operation and adjustment of position indicator sensors. Restart procedure by giving initialisation command again.

14 Function block outfeed module RDC4

Figuur 20: Function block outfeed module RDC4

```
                              %DB1
                         "DB_Prorunner_
                          mk5_Outfeed_
                             RDC4"

                             %FB1075
                    "FB_Prorunner_mk5_Outfeed_RDC4"

                    EN                              ENO
                                                 oAlarm
 "DB_Prorunner_                               oAlarmCode
 mk5_Configuration".                       oAlarmFeedback
     Outfeed[3] — iConfiguration              oStatus
         false — iEnabled                oUpStream_Start
         false — iReset                  oUpStream_Source
         false — iInitialisationMode
         false — iAutomaticMode
         false — iManualMode
         false — iManualConveyor
         false — iManualForward
         false — iManualBackwards
         false — iB1
         false — iB2
         false — iB3
         false — iB4
         false — iB8
         false — iB16
         false — iUpStream_Ready
         false — iUpStream_Running

             0
 "DB_MotorControl".
     Oudfeed[3].
        Conveyor — xConveyor

             0
 "DB_MotorControl".
 Oudfeed[3].Motion — xMotion

 "DB_Prorunner_
 mk5_Main".HS_
 OutfeedLevel[3] — xHS_Level
```

With this software block, the outfeed module RDC4 is called.
RDC4 stands for: Roller Drive Conveyor type 4 → Moveable

14.1 Function block specifications outfeed module RDC4

Block name:	FB_Prorunner_mk5_Outfeed_RDC4
Block number:	FB1075
Version:	V4.1
Required PLC blocks:	TON_TIMER
Required PLC data types:	UDT_MotorControl
	UDT_Prorunner_mk5_Carrier
	UDT_Prorunner_mk5_Outfeed_Configuration
	UDT_Prorunner_mk5_Outfeed_Handshake
Function block call	Cyclical (OB1)
Optimised block access	Yes/~~No~~
Programming language	LAD, SCL
STEP7 version	TIA Portal V14 + SP1

14.2 Components outfeed module RDC4

Figuur 21: Components outfeed module RDC4
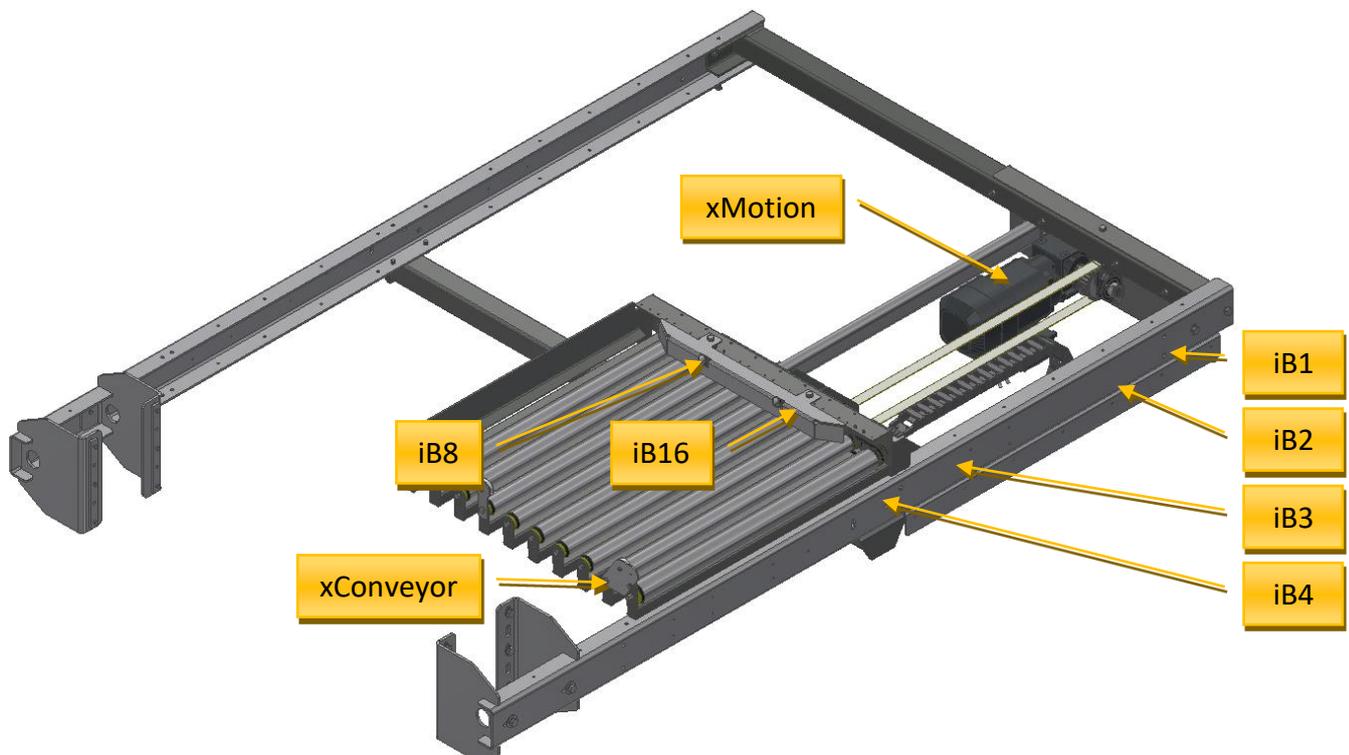
Tabel 56:   Components infeed module RDC4

Code		Type
iB16	Sensor/ photocell: Product position monitoring. This photocell monitors whether the product has completely left the outfeed roller conveyor.	GL6-P4211 C42-2
iB8	Sensor/ photocell: Product on infeed. This photocell detects whether the product is dropped on the outfeed conveyor	GL6-P4211 C42-2
iB1	Inductive approach: Wait for position (from Prorunner) Sensor detection that horizontal movement is in waiting position. This is the position in which no object can be entered, and the conveyor is in a safe position for the Prorunner carriers.	IME18-08BPSZC0K
iB2	Inductive approach: Low speed waiting position Sensor detection that horizontal movement should switch to waiting position to low speed.	IME18-08BPSZC0K
iB3	Inductive approach: Low-speed Outfeed position Sensor detection that horizontal movement should switch to waiting position to low speed.	IME18-08BPSZC0K
iB4	Inductive approach: Outfeed position (In Prorunner) Sensor detection that horizontal movement is at outfeed position. This is the position in which an object can be transported.	IME18-08BPSZC0K
xConveyor	Actuation roller conveyor	Drivecontrol 20/54 Rollerdrive
xMotion	Actuation horizontal movement	SEW drive See Qimarox info

14.4 Flow chart functionality outfeed module RDC4

RDC4 – Roller drive conveyor shuttle

V1.0 – BJA – 9/3/2018
V1.1 – BJA – 19/11/2018
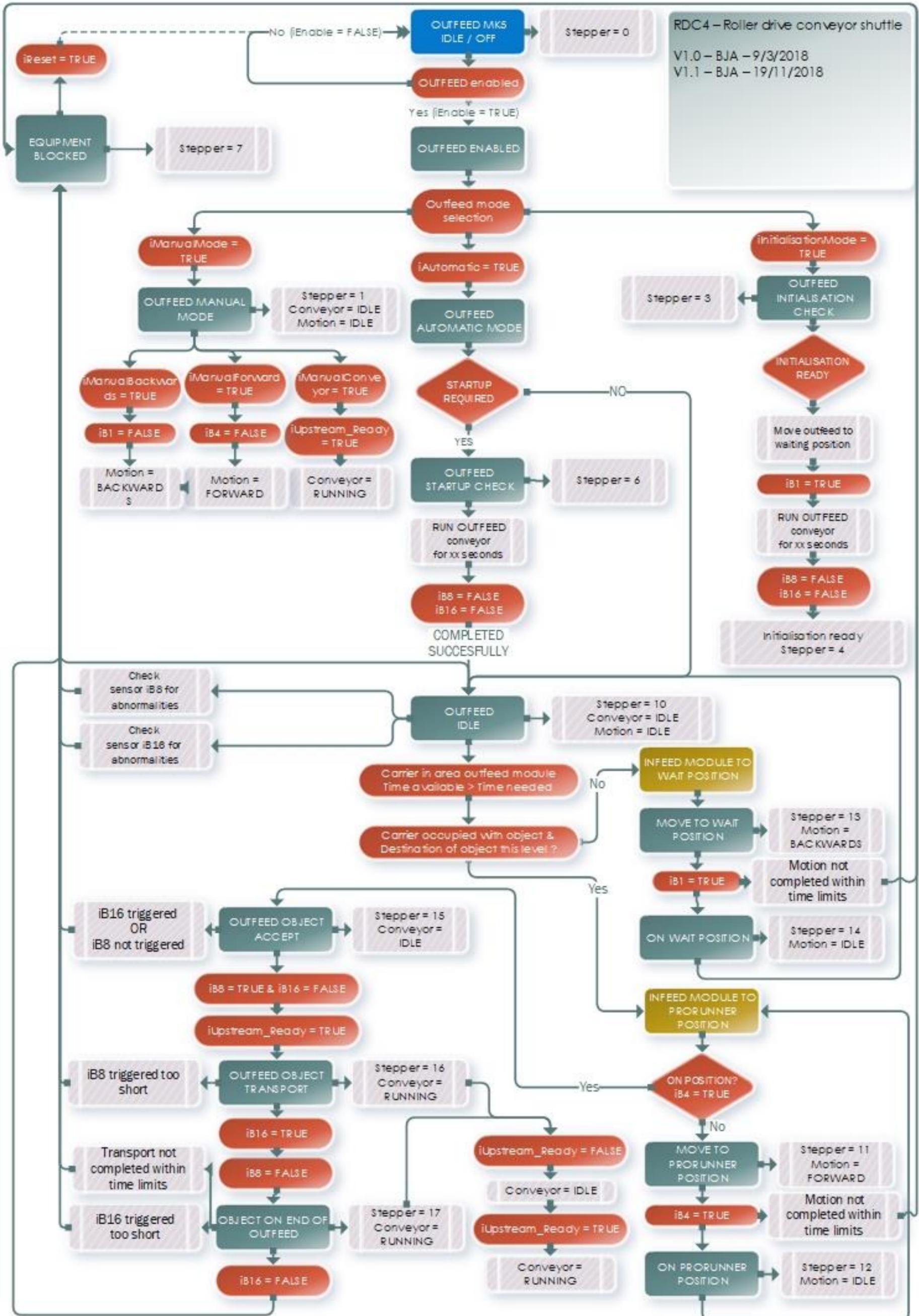
14.5 Configuration outfeed module RDC4

Configuration according to UDT_Prorunner_mk5_outfeed_Configuration

Tabel 57:   Configuration outfeed module RDC4

Naming	Data type	Unit	Description
Module.Level	Int	1..20	Level number.
Module.Height	Real	mm.	Exact height of the conveyor measured from the floor
Options.LowspeedDropoff	Bool	0/1	Drop off by means of use of lower speed (1=active)
Conveyor.Speed	Real	m/s.	Speed of conveyor track at rated actuation (metre per second)
Conveyor.Length	Real	mm.	Exact length of outfeed conveyor
Transport.CycleTime	Real	s.	Time needed to perform outfeed transport.
Transport.Speed	Int	Hz	Number of Hertz (Nominal = 50 Hz)
Transport.Acceleration	Int	ms.	Number of milliseconds to accelerate from standstill to desired speed
Transport.Deceleration	Int	ms.	Number of milliseconds to decelerate from current speed to standstill
Movement.CycleTime	Real	s.	Time needed to move conveyor track between outfeed position and waiting position.
Movement.InfeedPosition	Real	mm.	Position: outfeed position
Movement.BasicPosition	Real	mm.	Position: waiting position
Movement.Speed	Real	m/s.	Speed of movement
Movement.HighSpeed	Int	Hz	Number of Hertz (Nominal = 50 Hz)
Movement.LowSpeed	Int	Hz	Number of Hertz (Nominal = 50 Hz)
Movement.Acceleration	Int	ms.	Number of milliseconds to accelerate from standstill to desired speed
Movement.Deceleration	Int	ms.	Number of milliseconds to decelerate from current speed to standstill

14.6 Inputs outfeed module RDC4

Inputs must be declared by the customer. Inputs provide information such as configuration, status of installation, status sensors, manual pushbutton and communication signals with downstream transport

Tabel 58: Inputs outfeed module RDC4

Naming	Data type	Unit	Description
iConfiguration	UDT		UDT as discussed in section above
iEnabled	Bool	0/1	System is switched on. Safety functions are operational and power supplies to the controllers are switched on.
iReset	Bool	0/1	Reset command to reset faults.
iInitialisationMode	Bool	0/1	Start of initialisation procedure.
iAutomaticMode	Bool	0/1	Installation is in automatic mode. Operation is influenced by the sensors and communication with the infeed/outfeed conveyor.
iManualMode	Bool	0/1	Installation is in manual mode. The operation is influenced by the manual commands.
iManualConveyor	Bool	0/1	Command for manual actuation of roller conveyor
iManualForwards	Bool	0/1	Command manual actuation of horizontal movement to the infeed position
iManualBackwards	Bool	0/1	Command manual actuation of horizontal movement to the waiting position
iB1	Bool	0/1	Sensor for detection of waiting position
iB2	Bool	0/1	Sensor for detection of low speed waiting position
iB3	Bool	0/1	Sensor for detection of low-speed infeed position
iB4	Bool	0/1	Sensor for detection of infeed position
iB8	Bool	0/1	Sensor for detection object present outfeed conveyor
iB16	Bool	0/1	Sensor for detection object left outfeed conveyor
iUpStream_Ready	Bool	0/1	Communication signal of upstream transport: Transport system ready to receive object
iUpStream_Running	Bool	0/1	Communication signal of upstream transport: Transport system systems ready & transport running.

14.7 Outputs outfeed module RDC4

Exits must be declared by the customer. Outputs provide feedback such as faults, status and communication signals with downstream transport.

Tabel 59: Outputs outfeed module RDC4

Naming	Data type	Unit	Description
oAlarm	Bool	0/1	Fault active
oAlarmCode	Int	0	Active fault code (See chapter 'Faults' for the correct overview)
oAlarmFeedback	Word	0	Active fault feedback for HMI. One bit is reserved for each fault. Fault 1 = bit 0, fault 2 = bit 1, etc.
oStatus	Int	0	See chapter 'Status Prorunner mk5' for further information.
oUpStream_ObjectReady	Bool	0/1	Communication signal to the upstream transport: Object ready for outfeed.
oUpStream_ObjectSource	Int	1..20	Communication signal to the upstream transport: Object source level.

14.8 Motor interface infeed module RDC4

Two motors are used for the infeed module. All commands are prepared via this motor interface to handle different forms of motor actuation.
For more information, please refer to chapter '16 - Motor interface'

Tabel 60: Motor interface infeed module RDC4

Naming	Data type	Unit	Description
xConveyor	UDT		**UDT_MotorControl** Motor interface roller conveyor infeed module RDC4
xMotion	UDT		**UDT_MotorControl** Motor interface horizontal movement infeed module RDC4

14.9 Status outfeed module RDC4

The status of the output module is output, giving the user a clear picture of the status/movements of the outfeed module RDC4

Tabel 61:   Status outfeed module RDC4

Code	Description / Cause
0	NO ACTION: Infeed module switched off / no mode active
1	MANUAL OPERATION: Infeed module in manual mode
3	INITIALISATION PROCEDURE ACTIVE: Infeed module busy with initialisation procedure.
4	INITIALISATION PROCEDURE READY: Infeed module finished with initialisation procedure.
5	CONFIGURATION CHECK: Infeed module finished with initialisation procedure.
6	RESTART / START-UP PROCEDURE: Procedure after fault; this involves checking whether an object is present and whether it is correctly positioned.
7	FAULT: Infeed module blocked by fault
10	WAITING: Infeed module ready for use, object infeeding can be started
11	MOVEMENT TO OUTFEED POSITION: Infeed module busy with horizontal movement to outfeed position
12	AT OUTFEED POSITION: Outfeed module ready for dropoff of product
13	MOVEMENT TO WAITING POSITION: Infeed module busy with horizontal movement to waiting position
14	AT WAIT POSITION: Infeed module in waiting position.
15	ACCEPT PRODUCT ON OUTFEED CONVEYOR: Product detected (iB8) on outfeed module, request outfeed clearance from upstream
16	OBJECT TRANSPORT: Upstream able to receive object, start transport with rollerconveyor
17	OBJECT ON END OUTFEED CONVEYOR: Object detected on end of conveyor (iB16) wait until object is gone

14.10 Faults outfeed module RDC4

With the outfeed signal 'oAlarm' it is possible to indicate a fault by, for example, switching on a red lamp. With the fault code 'oAlarmCode' you can indicate this better.
With the fault word 'oAlarmFeedback' you can generate a clearly defined fault message by means of an HMI. The faults are divided over 16 bits. Code 1 = bit 0 ... Code 16 = bit 15.
Below is the list of faults that may be active with explanation/effect and solution.

Tabel 62:   Faults list outfeed module RDC4

Code	Description / Cause	Effect	Solution
1	Object outfeeding is taking too long.	Automatic operation is stopped. Command to PRORUNNER that outfeed module is blocked. Start-up procedure of outfeed conveyor must be carried out.	Remove object manually from the conveyor track Give the reset command to reset the fault. Resetting is not possible if sensor iB8 or iB16 is covered.
2	No drop off detected, while carrier declares that it has an object present	Automatic operation is stopped. Command to PRORUNNER that outfeed module is blocked. Start-up procedure of outfeed conveyor must be carried out.	Check if object is correctly aligned on the carrier so the photocells detect the object. If no object is present, reset the alarm
3	Unknown object detected. Sensors triggered while the outfeed module is not busy with the corresponding step.	Automatic operation is stopped. Command to PRORUNNER that outfeed module is blocked. Start-up procedure of outfeed conveyor must be carried out.	Check for unknown objects. Give the reset command to reset the fault. Resetting is not possible if sensor iB8 or iB16 is covered.
4	Object too small. iB16 triggered for too short. Time is calculated with the minimum product length	Automatic operation is stopped. Command to PRORUNNER that outfeed module is blocked. Start-up procedure of outfeed conveyor must be carried out.	Check object length. Give the reset command to reset the fault. Resetting is not possible if sensor iB8 or iB16 is covered.
5	Object too big. iB16 triggered for too long. Time is calculated with the maximum product length	Automatic operation is stopped. Command to PRORUNNER that outfeed module is blocked. Start-up procedure of outfeed conveyor must be carried out.	Check object length. Give the reset command to reset the fault. Resetting is not possible if sensor iB8 or iB16 is covered.
8	Configuration is not entered correctly	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked.	Check configuration settings. Make sure that everything is entered correctly and not below the minimum value.
9	Start-up procedure time-out. Sensor iB16 does not become untriggered.	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked.	Put the object down manually in the sensors; iB16 uncovered, iB8 uncovered. Give the reset command to reset the fault.
10	Movement to waiting position is taking too long	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked.	Check why this is taking too long. Check adjustment/operation of the iB1 sensor Give the reset command to reset the fault.

Code	Description / Cause	Effect	Solution
11	Movement to outfeed position is taking too long	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked.	Check why this is taking too long. Check adjustment/operation of the iB4 sensor Give the reset command to reset the fault.
12	Position horizontal movement no longer correct.	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked.	Check adjustment/operation of the iB1 & iB4 sensor. Give the reset command to reset the fault.
13	Fault controller/drive conveyor track.	Automatic operation is stopped. Command to PRORUNNER that infeed module is blocked. (Depending on position)	Check operation/fault controller/drive. Make sure that it is ready for operation again. Give the reset command to reset the fault.
14	Fault controller/drive horizontal movement.	See fault 13	See fault 13
15	Initialisation procedure: object still detected on conveyor track.	Initialisation has not been completed.	Empty the conveyor track. Restart procedure by giving initialisation command again.
16	Initialisation procedure: Safe position not reached	Initialisation has not been completed.	Check the movement of the infeed module. Check operation and adjustment of position indicator sensors. Restart procedure by giving initialisation command again.

15 Function block outfeed module MBC4

Figuur 22: Function block outfeed module MBC4
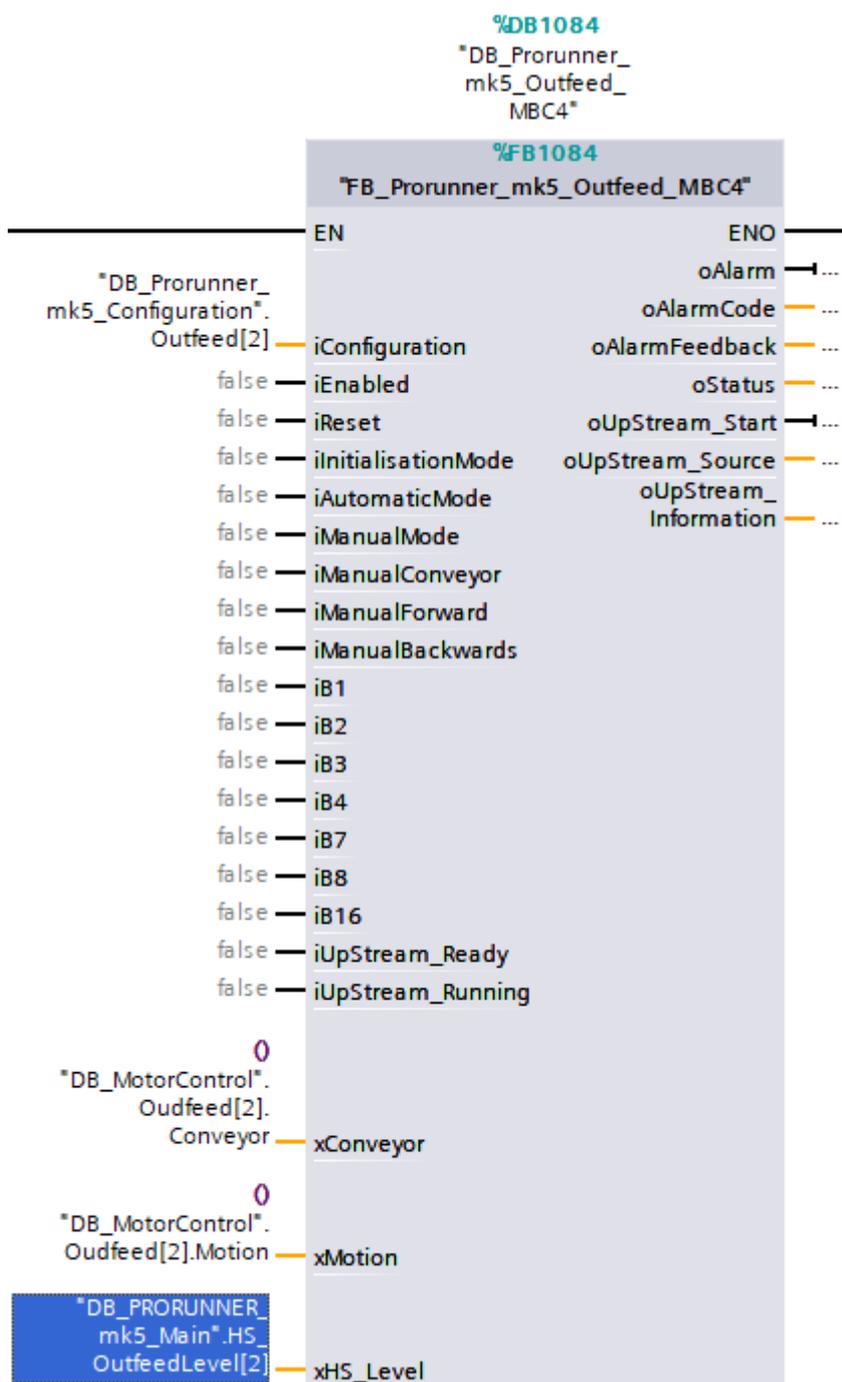
With this software block, the outfeed module MBC4 is called.
MBC4 stands for: Multi Belt Drive type 4 → Moveable

15.1 Function block specifications outfeed module MBC4

Block name:	FB_Prorunner_mk5_Outfeed_MBC4
Block number:	FB1084
Version:	V1.2
Required PLC blocks:	TON_TIMER
Required PLC data types:	UDT_MotorControl
	UDT_Prorunner_mk5_Carrier
	UDT_Prorunner_mk5_Customer_Information
	UDT_Prorunner_mk5_Infeed_Configuration
	UDT_Prorunner_mk5_Infeed_Handshake
Function block call	Cyclical (OB1)
Optimised block access	Yes/~~No~~
Programming language	LAD, SCL
STEP7 version	TIA Portal V14 + SP1

15.2 Components outfeed module MBC4

Figuur 23: Components outfeed module MBC4
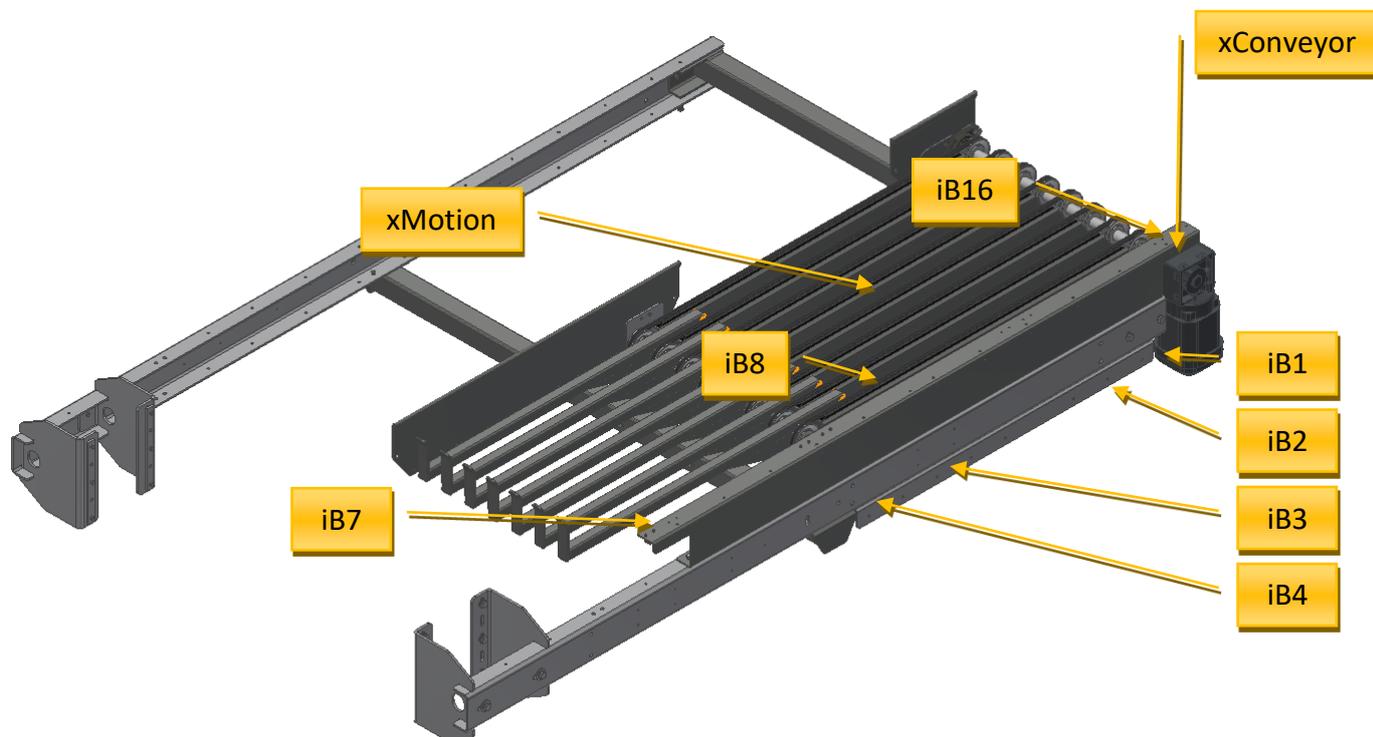
Tabel 63:   Components outfeed module MBC4

Code		Type
iB8	Sensor/photocell: Product present on track	GL6-P4211 C42-2
iB16	Sensor/photocell: Product run out onto conveyor	GL6-P4211 C42-2
iB1	Inductive approach: Wait for position (from Prorunner) Sensor detection that horizontal movement is in waiting position. This is the position in which no object can be entered, and the conveyor is in a safe position for the Prorunner carriers.	IME18-08BPSZC0K
iB2	Inductive approach: Low speed waiting position Sensor detection that horizontal movement should switch to waiting position to low speed.	IME18-08BPSZC0K
iB3	Inductive approach: Low-speed outfeed position Sensor detection that horizontal movement should switch to waiting position to low speed.	IME18-08BPSZC0K
iB4	Inductive approach: Outfeed position (In Prorunner) Sensor detection that horizontal movement is at Infeed position. This is the position in which an object can be fed in.	IME18-08BPSZC0K
iB7	Sensor/probe: Product deposited on rake	GTB6-P4211
xConveyor	Actuation roller conveyor	SEW drive See Qimarox info
xMotion	Actuation horizontal movement	SEW drive See Qimarox info

15.4 Flow chart functionality outfeed module MBC4

MBC4 – Multi belt conveyor shuttle

V1.0 – BJA – 13/3/2018
V1.1 – BJA – 27/7/2018
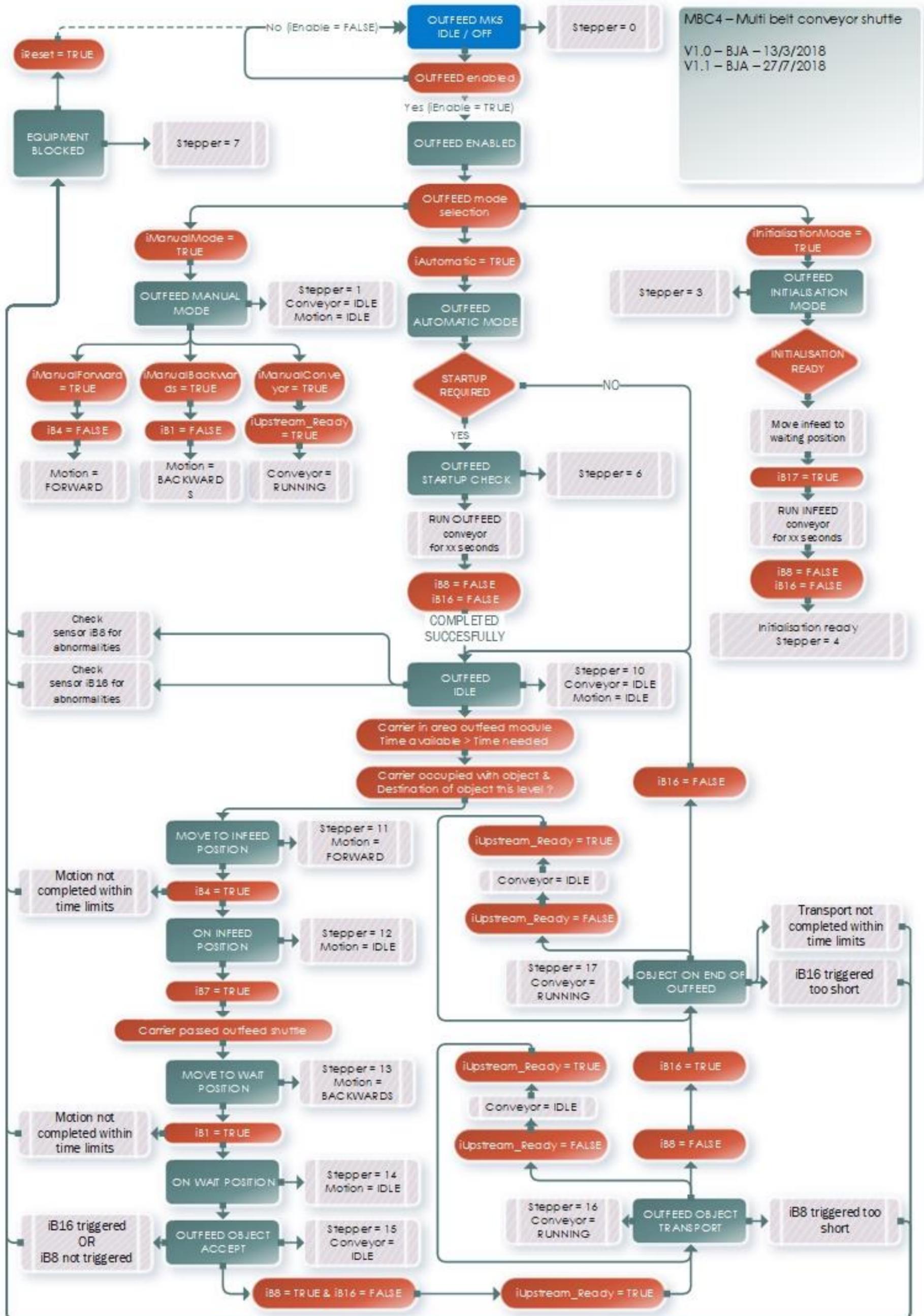
15.5 Configuration outfeed module MBC4

Configuration according to UDT_Prorunner_mk5_Outfeed_Configuration

Tabel 64: Configuration outfeed module MBC4

Naming	Data type	Unit	Description
Module.Level	Int	1..20	Level number.
Module.Height	Real	mm.	Exact height of the conveyor measured from the floor
Options.LowspeedDropoff	Bool	0/1	Drop off by means of use of lower speed (1=active)
Conveyor.Speed	Real	m/s.	Speed of conveyor track at rated actuation (metre per second)
Conveyor.Length	Real	mm.	Exact length of outfeed conveyor
Transport.CycleTime	Real	s.	Time needed to perform outfeed transport.
Transport.Speed	Int	Hz	Number of Hertz (Nominal = 50 Hz)
Transport.Acceleration	Int	ms.	Number of milliseconds to accelerate from standstill to desired speed
Transport.Deceleration	Int	ms.	Number of milliseconds to decelerate from current speed to standstill
Movement.CycleTime	Real	s.	Time needed to move conveyor track between outfeed position and waiting position.
Movement.InfeedPosition	Real	mm.	Position: outfeed position
Movement.BasicPosition	Real	mm.	Position: waiting position
Movement.Speed	Real	m/s.	Speed of movement
Movement.HighSpeed	Int	Hz	Number of Hertz (Nominal = 50 Hz)
Movement.LowSpeed	Int	Hz	Number of Hertz (Nominal = 50 Hz)
Movement.Acceleration	Int	ms.	Number of milliseconds to accelerate from standstill to desired speed
Movement.Deceleration	Int	ms.	Number of milliseconds to decelerate from current speed to standstill

15.6 Inputs outfeed module MBC4

Inputs must be declared by the customer.
Inputs provide information such as configuration, status of installation, status sensors, manual pushbutton and communication signals with upstream transport

Tabel 65:   Inputs outfeed module MBC4

Naming	Data type	Unit	Description
iConfiguration	UDT		UDT as discussed in section above
iEnabled	Bool	0/1	System is switched on. Safety functions are operational and power supplies to the controllers are switched on.
iReset	Bool	0/1	Reset command to reset faults.
iInitialisationMode	Bool	0/1	Start of initialisation procedure.
iAutomaticMode	Bool	0/1	Installation is in automatic mode. Operation is influenced by the sensors and communication with the infeed/outfeed conveyor.
iManualMode	Bool	0/1	Installation is in manual mode. The operation is influenced by the manual commands.
iManualConveyor	Bool	0/1	Command for manual actuation of roller conveyor
iManualForwards	Bool	0/1	Command manually actuation of horizontal movement to outfeed position
iManualBackwards	Bool	0/1	Command manual actuation of horizontal movement to the waiting position
iB1	Bool	0/1	Sensor for detection of waiting position
iB2	Bool	0/1	Sensor for detection of low speed waiting position
iB3	Bool	0/1	Sensor for detection of low-speed prorunner position
iB4	Bool	0/1	Sensor for detection of prorunner position
iB7	Bool	0/1	Sensor for detection object dropped off
iB8	Bool	0/1	Sensor for detection object present outfeed conveyor
iB16	Bool	0/1	Sensor for detection object left outfeed conveyor
iUpStream_Ready	Bool	0/1	Communication signal of upstream transport: Transport system ready to receive object
iUpStream_Running	Bool	0/1	Communication signal of upstream transport: Transport system systems ready & transport running.

15.7 Outputs outfeed module MBC4

Exits must be declared by the customer.
Outputs provide feedback such as faults, status and communication signals with upstream transport.

Tabel 66:   Outputs outfeed module MBC4

Naming	Data type	Unit	Description
oAlarm	Bool	0/1	Fault active
oAlarmCode	Int	0	Active fault code (See chapter 'Faults' for the correct overview)
oAlarmFeedback	Word	0	Active fault feedback for HMI. One bit is reserved for each fault. Fault 1 = bit 0, fault 2 = bit 1, etc.
oStatus	Int	0	See chapter 'Status Prorunner mk5' for further information.
oUpStream_ObjectReady	Bool	0/1	Communication signal to the upstream transport: Object ready for outfeed.
oUpStream_ObjectSource	Int	1..20	Communication signal to the upstream transport: Object source level.
oUpStream_ObjectInformation	UDT		Communication signal to the upstream transport: 'UDT_Prorunner_mk5_Customer_Information' Additional information that was sent with the object.

15.8 Motor interface outfeed module MBC4

Two motors are used for the outfeed module. All commands are prepared via this motor interface to handle different forms of motor actuation.
For more information, please refer to chapter '16 - Motor interface'

Tabel 67:   Motor interface outfeed module MBC4

Naming	Data type	Unit	Description
xConveyor	UDT		**UDT_MotorControl** Motor interface roller conveyor outfeed module RDC4
xMotion	UDT		**UDT_MotorControl** Motor interface horizontal movement outfeed module RDC4

15.9 Status outfeed module MBC4

The status of the outfeed module is output, giving the user a clear picture of the status/movements of the outfeed module MBC4

Tabel 68:   Status outfeed module MBC4

Code	Description / Cause
0	NO ACTION: Outfeed module switched off / no mode active
1	MANUAL OPERATION: Outfeed module in manual mode
3	INITIALISATION PROCEDURE ACTIVE: Outfeed module busy with initialisation procedure.
4	INITIALISATION PROCEDURE READY: Outfeed module finished with initialisation procedure.
5	CONFIGURATION CHECK: Outfeed module finished with initialisation procedure.
6	RESTART / START-UP PROCEDURE: Procedure after fault; this involves checking whether an object is present and whether it is correctly positioned.
7	FAULT: Outfeed module blocked by fault
10	WAITING: Outfeed module ready for use; feeding object in can be started
11	MOVEMENT TO INFEED POSITION: Outfeed module busy with horizontal movement to infeed position
12	AT INFEED POSITION: Outfeed module ready for transport of object
13	MOVEMENT TO WAITING POSITION: Outfeed module busy with horizontal movement to waiting position
14	AT WAIT POSITION: Outfeed module waiting at waiting position.
15	OBJECT ACCEPTED ON OUTFEED TRACK: Outfeed module has received object on track (sensor iB8)
16	OBJECT TRANSPORT BUSY Outfeed module in the process of moving object to the end of the conveyor track (sensor iB16 covered)
17	OBJECT AT END OF TRACK: Object at end of the conveyor track, waiting for iB16 to be uncovered.

15.10 Faults outfeed module MBC4

With the outfeed signal 'oAlarm' it is possible to indicate a fault by, for example, switching on a red lamp. With the fault code 'oAlarmCode' you can indicate this better.
With the fault word 'oAlarmFeedback' you can generate a clearly defined fault message by means of an HMI. The faults are divided over 16 bits. Code 1 = bit 0 ... Code 16 = bit 15.
Below is the list of faults that may be active with explanation/result and solution.

Tabel 69:   Faults list outfeed module MBC4

Code	Description / Cause	Effect	Solution
1	Object outfeeding is taking too long.	Automatic operation is stopped. Command to PRORUNNER that outfeed module is blocked. Start-up procedure of outfeed conveyor must be carried out.	Remove object manually from the conveyor track Give the reset command to reset the fault. Resetting is not possible if sensor iB8 or iB16 is covered.
3	Unknown object detected. Sensors triggered while the outfeed module is not busy with the corresponding step.	Automatic operation is stopped. Command to PRORUNNER that outfeed module is blocked. Start-up procedure of outfeed conveyor must be carried out.	Check for unknown objects. Give the reset command to reset the fault. Resetting is not possible if sensor iB8 or iB16 is covered.
4	Object too small. iB16 triggered for too short. Time is calculated with the minimum product length	Automatic operation is stopped. Command to PRORUNNER that outfeed module is blocked. Start-up procedure of outfeed conveyor must be carried out.	Check object length. Give the reset command to reset the fault. Resetting is not possible if sensor iB8 or iB16 is covered.
5	Object too big. iB16 triggered for too long. Time is calculated with the maximum product length	Automatic operation is stopped. Command to PRORUNNER that outfeed module is blocked. Start-up procedure of outfeed conveyor must be carried out.	Check object length. Give the reset command to reset the fault. Resetting is not possible if sensor iB8 or iB16 is covered.
8	Configuration is not entered correctly	Automatic operation is stopped. Command to PRORUNNER that outfeed module is blocked.	Check configuration settings. Make sure that everything is entered correctly and not below the minimum value.
9	Start-up procedure time-out. Sensor iB15 does not become untriggered.	Automatic operation is stopped. Command to PRORUNNER that outfeed module is blocked.	Put the object down manually in the sensors; iB15 uncovered, iB7 covered. Give the reset command to reset the fault.
10	Movement to waiting position is taking too long	Automatic operation is stopped. Command to PRORUNNER that outfeed module is blocked.	Check why this is taking too long. Check adjustment/operation of the iB1 sensor Give the reset command to reset the fault.
11	Movement to outfeed position is taking too long	Automatic operation is stopped. Command to PRORUNNER that outfeed module is blocked.	Check why this is taking too long. Check adjustment/operation of the iB4 sensor Give the reset command to reset the fault.

Code	Description / Cause	Effect	Solution
12	Position horizontal movement no longer correct.	Automatic operation is stopped. Command to PRORUNNER that outfeed module is blocked.	Check adjustment/operation of the iB1 & iB4 sensor. Give the reset command to reset the fault.
13	Fault controller/drive conveyor track.	Automatic operation is stopped. Command to PRORUNNER that outfeed module is blocked. (Depending on position)	Check operation/fault controller/drive. Make sure that it is ready for operation again. Give the reset command to reset the fault.
14	Fault controller/drive horizontal movement.	See fault 13	See fault 13
15	Initialisation procedure: object still detected on conveyor track.	Initialisation has not been completed.	Empty the conveyor track. Restart procedure by giving initialisation command again.
16	Initialisation procedure: Safe position not reached	Initialisation has not been completed.	Check the movement of the outfeed module. Check operation and adjustment of position indicator sensors. Restart procedure by giving initialisation command again.

16 Motor interface

All commands are prepared through the motor interface to handle different motor controls.
The motor interface handles the communication with the motor used to control the respective function.
The motor is controlled by means of commands and settings. The motor provides necessary feedback to maintain interaction through status information.

Tabel 70:   Motor control interface incoming commands → **UDT_Motorcontrol_Status**

Naming	Data type	Unit	Description
Status.AtTargetSpeed	Bool	0/1	Motor is running at desired speed
Status.MotorIsRunning	Bool	0/1	Motor is running. In the case of a controller, this is used to check whether the output stage is actually running.
Status.Blocked	Bool	0/1	Motor/Drive blocked
Status.Pulse	Bool	0/1	Motor/Drive has moved itself 1cm (10mm)
Status.ActualSpeed	Real	m/s.	Speed in meter per second on which the Prorunner is rotating
Status.ActualFrequency	Real	Hz	Number of Hertz (frequency) what the motor is currently running at.

Tabel 71:   Motor control interface outgoing commands → **UDT_Motorcontrol_Command**

Naming	Data type	Unit	Description
Command.Enable	Bool	0/1	Switch on motor control
Command.Reset	Bool	0/1	Reset motor control faults
Command.QuickStop	Bool	0/1	Stop motor quickly due to faults. (0.1 sec deceleration)
Command.Energize	Bool	0/1	Pre-magnetise motor
Command.Forward	Bool	0/1	Run motor forward, or send up
Command.Reverse	Bool	0/1	Run motor backwards, or send down
Command.HighSpeed	Bool	0/1	Use high speed (if this is fixed in the motor itself)
Command.Settings.Speed	Int	Hz	Number of Hertz of rated speed (Rated = 50 Hz)
Command.Settings.Acceleration	Int	ms	Number of milliseconds to accelerate from standstill to desired speed
Command.Settings.Deceleration	Int	ms	Number of milliseconds to decelerate from current speed to standstill

We recommend to carrying out all asynchronous motors with a frequency controller because there are different requirements for control:

- **Mechanism is less loaded if engine starts slower by means of acceleration**
- **Quickstop must be possible**
  Quickstop = quickest possible stop with pre-defined deceleration in controller
  This should be set to less than or equal to 0.1 second.

17 Checklist prorunner configuration

Tabel 72:   Checklist heights

Nr	Description	Unit	Configuration
1.	Height between ground floor and column Prorunner	mm	"DB_Prorunner_mk5_Configuration".Main.Prorunner.ColomnHeight
2.	Total height of column prorunner	mm	"DB_Prorunner_mk5_Configuration".Main.Prorunner.SupportHeight
3.	Reference sensor position	mm	Standard model = 595mm XL model = 750 mm
4.	Infeed level From ground floor to top of rollers (Example)	mm	"DB_Prorunner_mk5_Configuration".Infeed[1].Module.Height
5.	Outfeed level From ground floor to top of rollers (Example)	mm	"DB_Prorunner_mk5_Configuration".Outfeed[1].Module.Height
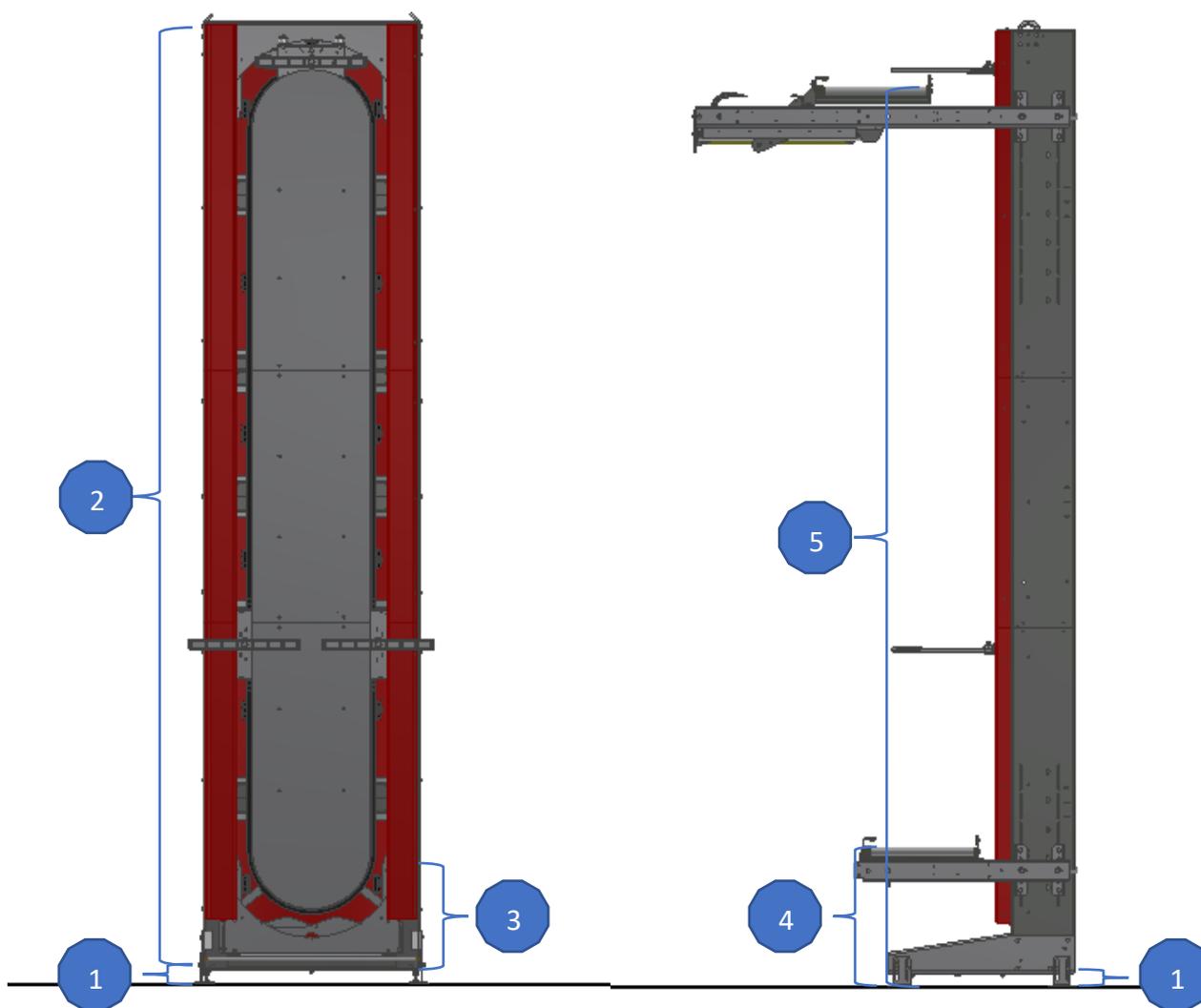
18 Checklist motor configuration

Tabel 73:   Checklist motor nameplate

Nr	Description	Unit	Configuration
1.	Rotation per minute on 50Hz	rpm	"DB_Prorunner_mk5_Configuration".Main.Prorunner.RPM
2.	Gearratio	i	"DB_Prorunner_mk5_Configuration".Main.Prorunner.GearRatio