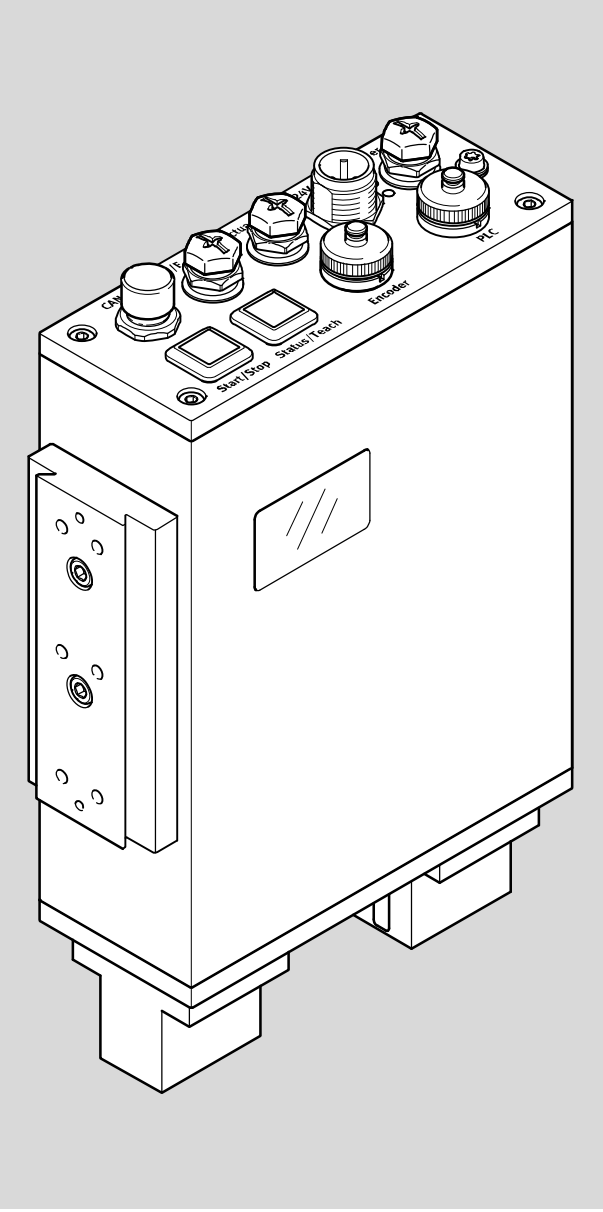
Checkbox Compact



FESTO

Description

Function

Type CHB-C-N

Description
8046182
en 1508e
[8043163]

Original ..... de

Version ..... en 1508e

Designation ..... GDCA-CHB-C-N

Order no. 8046182

Intended use

The Festo Checkbox Compact® has been designed for use under normal operating conditions in closed rooms in industrial installations.

The Checkbox documented in this description is intended exclusively for use as follows: Contactless checking of the position and quality of small parts e.g. screws, springs, bolts, which pass through on a conveyor belt.

Use the Checkbox only as follows:

- As intended in an industrial environment
- In perfect technical condition
- In its original state without unauthorised modifications. Only the conversions or modifications described in the documentation supplied with the product are permitted. The guarantee will become invalid if the Checkbox is opened.

The maximum values specified for pressures, temperatures, electrical connections etc. must not be exceeded.

Please observe the standards specified in the relevant chapters and comply with the regulations of the trade association and the German Technical Control Board (TÜV), the VDE conditions as well as the relevant national regulations.

Light beam
With regard to the blue light hazard, the Checkbox Compact exceeds the limit values of the free group in accordance with DIN EN 62471:2009-03. Therefore, an assignment to risk group 1 applies for the blue light hazard.

Looking at the light source for a long or prolonged period can dazzle your eyes and cause irritation.

Take measures to prevent eye exposure:

- Do not remove any housing parts.
- Only mount/remove the prism support when the power supply is switched off.
- Also take measures to ensure that if the light beam is reflected off mirrored or reflective objects, it does not pose a hazard (for example, by providing screening).
- Do not look directly into the light beam and do not direct the beam into the eyes of other people.

Ordinary light sources are divergent, i.e. the illuminated area becomes larger as the distance from the light source increases. As a result, the risk of eye injury decreases as the distance from the light source increases. However, as the Checkbox Compact uses parallel light, the risk of eye injury is not reduced as the distance increases; this applies to both looking directly at the beam and looking into the beam via a reflective surface.

Operating requirements

– The features of the conveyed part which determine the orientation and quality must be recognizable and distinguishable for the Checkbox.

– It must be possible to integrate the Checkbox in the material flow.

Target group

This description is intended exclusively for technicians trained in control and automation technology who have experience in installing and commissioning electronic systems.

Service

Please consult your local Festo Service if you have any technical problems.

Scope of delivery

Checkbox Compact	Module with control panel, I/O interface, light source and camera
Operator package	Data storage medium, brief description

Important user information

Danger categories

This description includes instructions on the possible dangers that can occur if the product is used incorrectly. These instructions are marked with a signal word (Warning, Caution, etc), printed on a shaded background and marked additionally with a pictogram. A distinction is made between the following danger warnings:

Warning
... means that failure to observe this instruction may result in serious personal injury and/or damage to property.

Caution
... means that failure to observe this instruction may result in personal injury and/or damage to property.

Note
... means that failure to observe this instruction may result in damage to property.

The following pictograms also mark passages in the text which warn about the incorrect handling of certain components.

Electrostatically sensitive devices. Incorrect handling can result in damage to components.

Marking of special information

The following pictograms mark passages in the text which contain special information.

Pictograms

Information
Highlights recommendations, tips and references to other information sources.

Accessories
Highlights information regarding suitable accessories.

Environment
Highlights sections dealing with environmental aspects.

Text designations

- Bullet points denote activities that can be carried out in any order.

1. Figures indicate activities which must be carried out in the sequence shown from top to bottom.

– Arrowheads indicate general lists.

– Menu commands of the software are framed in square brackets, e. g. the command [System parameter] in the [View] menu opens the window for setting the parameters.

– For selections within tree structures, e.g. for setting the system parameters in CheckKon, the paths are marked with a square. You will therefore find e. g. in the path ◇ System ◇ Operating modes the parameter ◆ Lock the Teach button = Off

– Inputs and outputs of the plug connectors are specified with the pin number as follows:
Input pin 1 I/1
Output pin 2 O/2

– Plug connectors are represented as when viewed on the device. This representation corresponds to the view of the (cable) connections which are to be wired.

Information regarding this description

This description refers to the standard designs of the Checkbox Compact type CHB-C-N with operating system version 3.5.

The version number is shown on the display in the stop status (see chapter 2.5).

The options and parameters available depend on the operating system, the type of connected Checkbox and on the factory pre-settings. Customer-specific designs may differ in technical data, parameter settings and method of functioning.

The pre-setting of the Checkbox can be modified if required with the software packages CheckKon (function “Modify system”) or CheckOpti (see chapter 1.2).

Documentation on the Checkbox

Information on using the Checkbox can be found in the following descriptions:

Documentation		Table of contents
Description for checkbox CHB-C-N – GDCA-CHB-C-N		Description of the function, commissioning, operation and maintenance of the Checkbox.
Descriptions for the software packages – Software CheckKon – Software CheckOpti	 P.SW-KON P.SW-OPTI	 – Operation of the CheckKon software – Operation of the CheckOpti software

Tab. 0/1: Documentation on the Checkbox

Product specific terms and abbreviations

Term/abbreviation	Significance
CHB-C-N	A device of the type Checkbox Compact (without transporting device) for identifying conveyed parts of a parts type.
Defective part	An inspection part on which at least one feature lies outside the tolerance.
Deviation	The Checkbox assesses the feature of an inspection part which differs most from the Teach data. The smaller the value of the inspection part deviation, the more accurately the inspection part corresponds to the sample parts.
Feature	Characteristic features are ascertained from the contour data of the sample and inspection parts by tools (configuration in CheckOpti). These are e.g. length, height, etc.
Good part	An inspection part on which all features lie within the tolerance.
Inspection parts	All parts shown during the test procedure.
Orientation	The parts to be tested by the Checkbox can be placed on the transporting device facing in different directions. During the Teach procedure you can define the orientations by showing the different directions. Orientation 1 is the preferred orientation (nominal orientation).
RUN mode	Operating mode of the Checkbox for automatic parts testing (preset when starting the CHB-C-N). AUTO mode in earlier versions.
Sample parts	Good parts which have been selected for the Teach procedure and which possess all the features necessary for identifying the check program.
SCTR value	During the Teach procedure the SCTR value (scatter of characteristics) shows the extent of the scatter of characteristics of the sample parts in a check program. The SCTR value specifies the maximum value of the scatter of characteristics for the current feature which differs to the greatest extent.
(System) parameters	Settings of the Checkbox (in some cases can only be set with the CheckKon configuration software).
Teach data	All of the characteristic values ascertained during the Teach procedure, each with min./max. limits and the average value.

Term/abbreviation	Significance
Teach procedure	During the Teach procedure, sample parts on the transporting device are shown to the Checkbox and the features are scanned. This is also referred to as “Teaching parts”.
Test data	The test data is the data used for the test. These correspond to the Teach data plus admitted tolerances.
Test procedure	During the test procedure, inspection parts on the transporting device are shown to the Checkbox and graded according to their features with regard to orientation and observance of the tolerances. This is also referred to as “Testing parts”.
TEACH mode	Operating mode of the Checkbox in which the Teach procedure is carried out.
Test program	Program with tools defined by the teach data of the sample parts (configuration in CheckOpti).
Tolerance	Factor in per cent related to the average values and which affects the min./max. limits of all features.

Tab. 0/2: Terms and abbreviations

System overview

Chapter 1

Contents

1.1 The Festo Checkbox

The Festo Checkbox ® enables the optical (contactless) positioning and quality inspection of conveyed parts and it precisely controls the actuators for sorting the inspected parts and parts assigned to the result groups (tracking, ejection of parts, etc.).

1.2 Software package

Various software packages are available for user-friendly commissioning, optimizing and monitoring.

Software package	Functions
CheckKon Checkbox configurator	– Displaying and evaluating the most recently registered test part – Displaying and logging of the parts contour as well as the characteristics derived from the contour – Displaying the light intensity recognized by the camera – Displaying and printing out of the system configuration – Displaying and modifying the system parameters – Support in project planning, management and documentation
CheckOpti Checkbox optimizer	– Convenient teaching of the sample parts – Monitored checking of parts, displaying the registered features – Evaluation of the inspection of workpieces with regard to reliability (evaluation) – Graphic display of the test sequence – Optimization of the inspection of workpieces through manual adaptation of the min./max. values of the Teach data or through additional tools – Support in project planning, management and documentation
Festo Field Device Tool (FFT)	– Loading a new operating system – Changing network settings (IP address)

Tab. 1/1: Software package

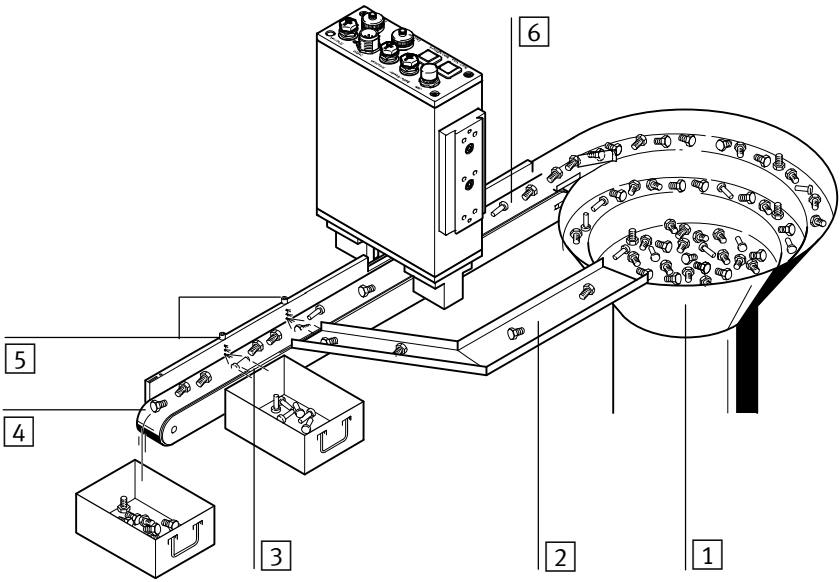
The software package, operating system updates and current product information on the Checkbox Compact can be found on the Festo website at www.festo.com/sp.

1.3 Function range

Function
Teach function – Teaching new parts without programming – Saving the features of the taught check program
Quality inspection [1)] – Testing the quality, e.g. with pivoted parts and milling parts – Machine-sorting of incorrect and foreign parts
Position detection (nominal orientation) – Position-controlled transfer of the good parts to the following machine – Return of incorrectly oriented good parts to the small parts conveyor A check of the position and of the buffer zone can be made at the same time.
Buffer zone check Monitoring the buffer zone with **one** sensor. If the buffer zone is full: Return of the good parts to the small parts conveyor. If the conveyed parts form a jam on the buffer zone for a long period, the small parts conveyor will be switched off.
Buffer zone check with switching hysteresis [2)] – Monitoring of the buffer zone with **two** sensors for delayed switching of the small parts conveyor (hysteresis).
Good part counting with preselected number of items [2)] A continuously running counter ascertains the sum of all good parts – Supplying of defined amounts of components through specification of a target number for good parts.
[1)] Extended quality inspection with CheckOpti [2)] The system parameters must be activated or set in CheckKon

Tab. 1/2: Function range

1.4 Operational principle



1 Small parts conveyor e.g. vibration feeder, centrifuge, step feeder

2 Return of incorrectly oriented parts to the small parts conveyor

3 Sorting out defective parts (faulty parts, foreign parts)

4 Further transfer of good parts to a buffer zone or the next machine

5 Actuators e.g. exhaust valves

6 Transporting device e.g. conveyor belt, linear axis

Fig. 1/1: Integration of the Checkbox in a transporting device:
Example with conveyor belt and two actuators

The function principle of the Checkbox is based on

– The contactless recognition of small parts

– The teaching of new parts without programming

– An integrated quality inspection.

Identification

A small parts conveyor separates the conveyed parts and passes them on to the transporting device. The transporting device (e.g. conveyor belt, linear axis) can be fitted with a maximum of 4 actuators for returning or separating the conveyed parts.

The Checkbox registers each part in contour pictures. From the contours the system ascertains part-specific features such as length, height and surface. On the basis of the features the Checkbox recognizes:

– The orientation

– The dimensional accuracy

– The quality.

Teaching

The nominal contour of a conveyed part is ascertained by a simple procedure:

1. You “show” the Checkbox samples of the conveyed part type several times one after the other (= scan) in the nominal orientation.

2. You scan the sample parts in further orientations if required.

3. You save the features of the check program as Teach data.

4. You test the Teach data in the test mode.

Testing

Each registered conveyed part is compared with the saved Teach data and then sorted into different types. The test parts are separated basically via 3 conveying paths:

- Good parts are passed on e.g. to an assembly system.
- Incorrectly oriented parts are returned to the small parts conveyor.
- Faulty or foreign parts (defective parts) are rejected.

1.5 Buffer zone

The buffer zone serves as a parts buffer for the next machine e.g. an assembly system.

The Checkbox can monitor the highest and lowest filling states of the buffer zone and if the jam of parts is long, it can switch the small parts conveyor on or off as required. (Buffer zone check, see Fig. 1/2).

Additionally by means of a second sensor, the small parts conveyor can be switched to delay. (Buffer zone check with hysteresis, see Fig. 1/3).

Signal delay

The buffer zone inputs are processed by the Checkbox with a debounce time. This time delay is configurable. The sensor signal is only then evaluated if it is present for the duration of the configured time delay. This delay prevents each conveyed part from triggering the signal “Buffer zone full” when it passes the sensor.

The delay time between the detection of a conveyed part by the sensor and the interpretation of the signal by the Checkbox must be taken into account when the buffer zone sections are planned.

Dimensioning the buffer zone

The buffer zone sections (see Fig. 1/2) must be dimensioned so that uninterrupted operation of the machine is possible. Instructions on dimensioning the buffer zone can be found in the following table.

Dimensioning the buffer zone sections	
A	Section between the transporting device and the sensor. Section A must accept all conveyed parts which lie between the Checkbox and the sensor when a conveyed part has been registered by the sensor. The length depends on: – The geometry of the conveyed parts – The maximum feeder rate of the small parts conveyor – The length of the transporting device
B	Section between the sensor and the next machine. When the small parts conveyor is switched on again, uninterrupted operation of the assembly system must be guaranteed until the first new conveyed parts arrive. Section B must be designed so that a sufficient number of conveyed parts can be made available. The length depends on: – The geometry of the conveyed parts – The maximum time delay between switching on the small parts conveyor again and making the new conveyed parts available – The length and speed of the transporting device – The average feed amount of good parts in the nominal orientation – - The cycle rate of the machine
AB*)	Section between sensors 1 and 2 (Fig. 1/3). Section AB determines the switching delay (hysteresis) of the small parts conveyor for regulating the supply of parts. The longer the section is, the less the switching frequency.
*) Set the “Number of buffer zone sensors = 2” with CheckKon	

Tab. 1/3: Buffer zone sections

Also observe Chapter 3.3 and Chapter 3.6.5 when connecting the buffer zone sensors.

1 Transporting device

2 Sensor 1

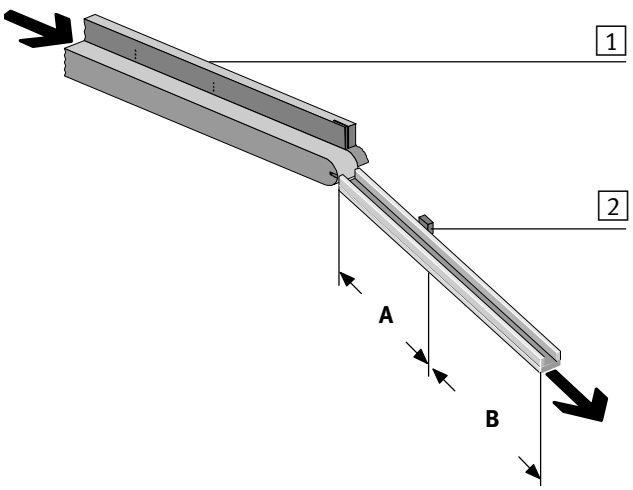


Fig. 1/2: Buffer zone check

1 Transporting device

2 Sensor 2

3 Sensor 1

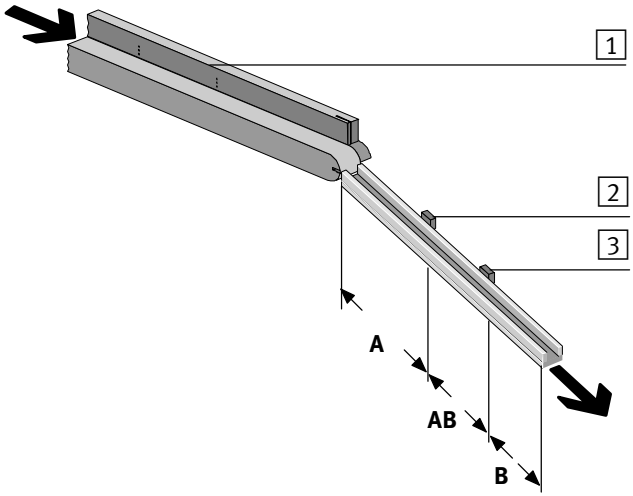


Fig. 1/3: Buffer zone check with hysteresis

Mounting and commissioning

Chapter 2

Contents

2.1 General instructions

Warning
Risk of injury
- During operation, make sure that no danger is caused by the controlled peripheral equipment

Caution
Risk of injury, damage to components
- When removing from the packaging, make sure nothing can fall
- When mounting and removing, make sure nothing can fall
- Only carry out commissioning procedures when fully mounted

Caution
Damage to components.
- Before carrying out mounting, installation and/or maintenance work, always switch off the power supply.

Caution
Glare and eye irritation.

- Do not remove any housing parts.
- Only mount/remove the prism support when the power supply is switched off
- Mount the Checkbox only in its original state with closed, intact housing.
- Mount or remove the Checkbox only when the power supply is switched off.
- Mount the Checkbox in such a way that it is not possible to look directly into the light beam.
- Also take measures to ensure that if the light beam is reflected off mirrored or reflective objects, it does not pose a hazard (for example, by providing screening).
- Do not stare directly into the light beam and do not direct the beam into the eyes of other people.

1 Prism support

2 Opening for the light beam

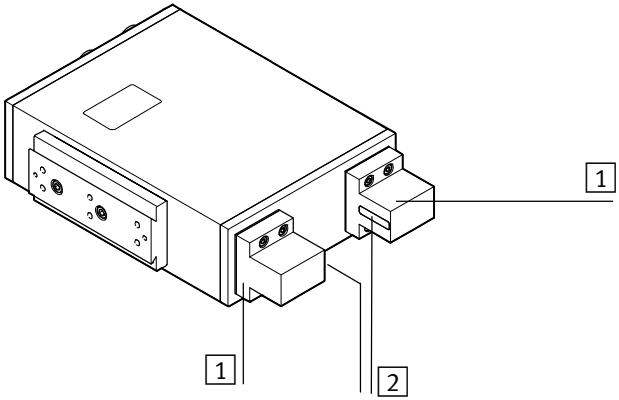


Fig. 2/1: Lighting

2.2 Mounting

Transport

Always transport the Checkbox in its original packing; further transport safety measures are not necessary.

Mounting location

Please observe the following ambient conditions in particular:

- The mounting location must be free of vibration
- There must be stable mechanical fastening
- Clean ambient atmosphere: Free of oil, no paint spray, no grinding dust
- Screening of external light influences, external heat and extreme magnetic fields (e.g. due to induction furnaces).
- The mounting position should be as cool and vertical as possible

In this way you will achieve optimum test results and ensure a long service life of the device.

Temperature

A built-in temperature sensor protects the device. The permissible ambient temperature relates to a 1 A load at the outputs; with a 3 A load approx. 5 °C lower is permissible. The maximum ambient temperature depends on a variety of parameters, e.g. parts rate, mounting method, thermal radiation, input and output circuitry, supply voltage, etc.

Transporting device

In order to ensure a reliable and reproducible test result, the transporting device used should fulfill the following requirements:

- Use a high-grade transporting system which conveys the parts at a constant speed.
- Ensure the stable position of the parts, e.g. by means of mechanical devices.
- Ensure a good transfer of parts from the small parts conveyor to the transporting device and that the transporting device is mechanically decoupled from the small parts conveyor.

- Also use mechanical devices to secure the transfer of parts from the transporting device to the buffer zone (e.g. drop pipe, slide, chute) of the subsequent machine so that the orientation of parts cannot be subsequently changed.

Space requirement

Observe the space required for installation of the Checkbox. The dimensions of the Checkbox and specifications on weight can be found in the appendix A.5.

Mounting

A mounting profile with dovetail guide is attached to the side of the Checkbox. If you want to mount the Checkbox from the other side, remove the profile and attach it to the opposite side of the Checkbox.

Caution
Damage to components.

- Only modify the Checkbox in a clean environment
- Only use suitable screws. The screw-in depth in the device is limited to a maximum of 6 mm.

A connecting kit (type HMSV-12) is available as an accessory from Festo.

1 Mounting profile of the Checkbox

2 Clamping elements with 4 M5x45 socket head screws

3 2 M5x16 socket head screws with centring sleeves

4 Adapter plate

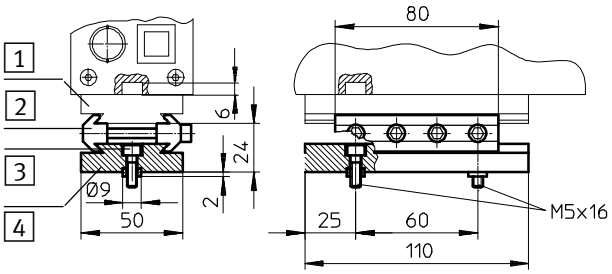


Fig. 2/2: Mounting the Checkbox with connecting kit HMSV-12

Mount the Checkbox over the transporting device so that:

– The Checkbox and transporting device are mounted securely to each other (Fig. 2/3)

– The field of view of the camera is not impeded

– The optical channel is not covered by the transporting device

The Checkbox Compact has excellent imaging properties over the entire working space. The contrast of the image is optimised for very fine details on the sensor side.

– To achieve maximum contrast for small details, mount the device in such a way that the objects are passed as close as possible to the prism support on the sensor side. This is the side with the Start/Stop button.

1 Mounting profile

2 Optical channel of the camera

3 Glass surface on the prism support (opening for light beam)

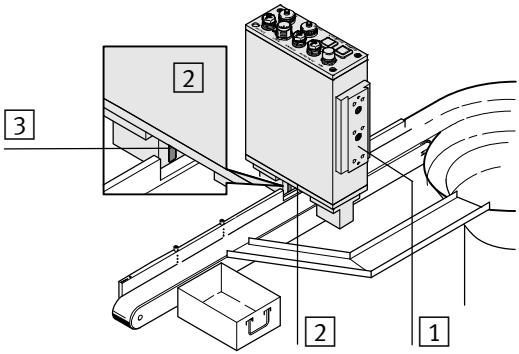


Fig. 2/3: Arrangement of the Checkbox over the transporting device (example)

Note
In order that a reliable test result can be achieved, the glass surfaces on the prism supports must not be scratched or dirty:

- Mount the Checkbox so that passing parts do not touch the glass surfaces.
- Ensure the stable position of the parts, e.g. by means of mechanical devices.
- If necessary, clean the glass surfaces, as described in chapter 6

2.3 Electrical connection

1 Reserved for Festo service

2 Buffer/Feeder

3 Actuators

4 Encoder

5 24 V DC

6 PLC

7 Ethernet

8 FE

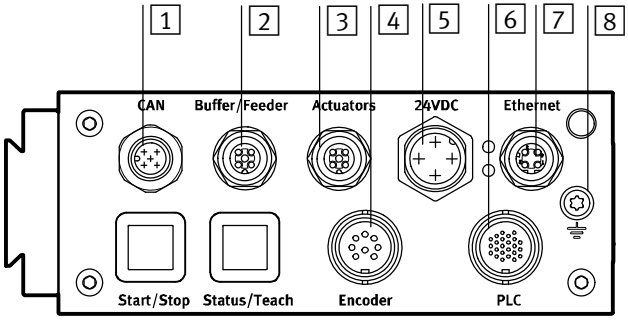


Fig. 2/4: Connections of the Checkbox

Function		Chapter
1	– Connection for Festo Service	
2	– Connection of 1 buffer zone sensor for controlling the flow of parts to the next machine – 24 V power outputs for controlling the supply system (small parts conveyor) and the transport system (transporting device)	3.3
3	– 24 V power outputs for controlling a maximum of 3 actuators for sorting out the tested conveyed parts	3.2
4	– Connection of a rotary pulse generator for determining the speed of the conveyor system with increased demands for length accuracy	3.5
5	– Connection for the 24 V DC operating voltage	2.3.2
6	– Connection of 2 buffer zone sensors for controlling the flow of parts to the next machine – 24 V power output for controlling the supply system (small parts conveyor) and the transporting device – I/O signals for process monitoring and higher-order control or for controlling a downstream-switched machine	3.6

Function		Chapter
7	– Connection of a diagnostic PC for system diagnosis, visualizing and optimizing the test procedure with the software packages CheckKon and CheckOpti	3.4
8	– Functional earth connection	2.3

Caution
- Check within the framework of your EMERGENCY STOP concept to ascertain the measures necessary for putting your machine/system into a safe state in the event of an EMERGENCY STOP (e.g. switching off the operating voltage, switching off pressure).

Preparing plugs and cables

Use plugs and sockets from the Festo supply programme which match the outer diameter of the cables used (www.festo.com/catalogue).

Note
Angled connectors can transfer large forces into the device. This can lead to mechanical destruction of the electronics.
- When using angled connectors pay particular attention to ensure that no excessive force is exerted on the connections. Attach cables in such a way that only minor forces are exerted on the connections of the Checkbox.

Note
To avoid malfunctions from electromagnetic interference:

- You can use unscreened cables up to 30 m in length for actuators and buffers.
- Only use screened cables and plug connectors for all other connections.
- Provide potential equalisation when connecting components via screened cables. The cable screening and screen connections of the Checkbox are not intended to carry compensating current caused by potential differences.
- Use large-cross-section cable that is as short as possible.
- Connect both the FE earth terminal and the cable screening with low impedance to the earth potential.
- At the FE connection on the front panel, use an earthing strap with a suitable cross section.

Note

To avoid damaging the device as a result of a voltage overshoot when switching on, please observe the following:

- Power supply is only permitted with round cables; do not use single wires.
- To avoid voltage overshoots when connecting to low impedance supplies, please pay attention to the lower inductance of the supply cable.
- To ensure optimum attenuation of the voltage overshoot, the supply cable should not be of too low an impedance. Festo therefore recommends a cross section of 1.0 or 1.5 mm²
- Observe the maximum load capacity of the cable.
- Safeguard the supply cable appropriately. Do not exceed values in data sheets. Only use regulated power supply units. First establish the secondary-side connection, then switch on the power supply unit on the primary side. Do not connect to sources when powered.

Note

For general protection of the device, and to avoid overloading the GND pins of the interfaces in particular, please observe the following:

- Do not connect any outputs in parallel.
- Do not feed any voltage into the outputs; this will annul the internal current monitoring function; if polarity reversal occurs, there is a risk that the device will be destroyed.
- Only use the GND connection of the respective plug connector or the GND of the power supply unit as the GND.
- Do not return any of the output signals at the PLC, actuator or buffer plug connector to the GND of one of the other output connectors.
- If an overload occurs, the outputs will be switched off. This also applies, if applicable, to the outputs “Error” and “Warning” of the PLC interface (see chapter 3.6). These are only intended for diagnostic purposes. To identify the operating status use the “Ready for operation” signal that operates with reverse logic. If an error occurs, this is switched off. As a result, an external control system could identify the error.
- When connecting inductive loads (solenoid coils, valves, contactors, relays, etc.), an appropriate RC element (free-wheeling diode, RC snubber, varistor, etc.) must be provided directly on the load.
- Select appropriate plug connectors and cables as well as suitable cross sections. Do not overload the cables.

Cable outside diameter	Plugs/sockets
4.0 ... 6.0 mm	PG 7
6.0 ... 8.0 mm	PG 9
10.0 ... 12.0 mm	PG 13.5

Tab. 2/1: Cable outside diameter

Connection	Plugs/sockets
Power supply socket	PG 9 or PG 13.5
Sensors, actuators	PG 7

Tab. 2/2: Connection

In order to guarantee observance of the IP protection class for the completely fitted Checkbox:

- Tighten the union nuts of the plug connectors by hand.
- Seal unused sockets with the protective caps supplied.

Caution
Long I/O signal lines reduce the resistance to interference.
- Comply with the maximum permissible I/O signal line length of 30 m.

2.3.1 Selecting the power supply unit

Warning
Electric shock

Injury to people, damage to the machine and system

- Only use PELV circuits in accordance with IEC 60204-1 (protective extra-low voltage, PELV) for the electrical power supply.
- Observe the general requirements of IEC 60204-1 for PELV circuits.
- Use only voltage sources that guarantee a reliable electric separation of operating and load voltage in accordance with IEC 60204-1.

Make sure the power supply unit fulfils the requirements specified in the Checkbox data sheet with regard to voltage, current and power.

Allow for a sufficient power reserve.

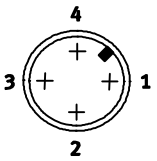
Observe the power consumption of connected consumers as well as system expansions.

2.3.2 Connection of the operating voltage

Warning
Risk of fire
- Protect the supply cable with a 4 A fast-acting fuse.

- Use an operating voltage cable with a suitable cable cross section.
- Avoid long distances between the power supply unit and the Checkbox. Long operating voltage cables reduce the voltage supplied by the power supply unit.

Connect the Checkbox to the operating voltage as follows:

Pin	24 V DC connector plug	
1	Do not connect	
2	+24 V DC, -15 % + 20 %; protect with 4 A fast-acting fuse	
3	GND	
4	FE	

Tab. 2/3: 24 V DC plug connector

Use only a 4-pin M18 socket for the power supply and connect this only to the connection for the power supply.

1. Connect the plug to the 24 V DC connection on the Checkbox.
2. Tighten the union nuts of the plug by hand.

2.3.3 Power supply for external components

When connecting the Checkbox to other devices (e.g. PLC, conveyor device) via the connections PLC, ACTUATORS or BUFFER/FEEDER, do not connect the potential at the “24 V DC” connection of the Checkbox with other plug connectors of the Checkbox.

Current-consuming devices can also be supplied with voltage via the PLC plug. Observe also the information in chapter 3.6.

2.4 Adapting system parameters with CheckKon

A password is required for CheckKon for setting the system parameters and transmitting the modifications to the Checkbox (function “Modify system”). Consult your Festo Service.

- Install CheckKon on your diagnostic PC. Installation instructions can be found in the software description.

Diagnostic mode

Start CheckKon **after** switching on the Checkbox. CheckKon switches the Checkbox to the diagnostic mode.

Note
In the diagnostic mode the Checkbox transmits additional information via the Ethernet interface.

- Do not operate the Checkbox in diagnostic mode with the full rate of parts.

In this way you can prevent parts from passing the actuator positions unchecked.

1. Adapt the Checkbox to your system requirements with the system parameters in the menu [View] [System parameter]. Also observe the instructions in the following chapters and in the software description.
2. Adapt other device settings with CheckKon accordingly, such as date and time of the device.

CheckKon shows the most important system parameters through the menu [View] [System parameter] symbol “Only important parameters”. Make sure that these parameters are adapted to your application.

3. Transfer the modified settings to the Checkbox (see software description).
4. Conclude CheckKon and with it the diagnostic mode when all settings have been completed.

Note
Faulty processing data can cause incorrect functioning of the Checkbox.

- Carry out the complete Teach procedure again if you have modified the system parameters with CheckKon (see chapter 4).

2.5 Commissioning the Checkbox

1 Illuminated push-button Start/Stop

2 Illuminated push-button Status/ Teach

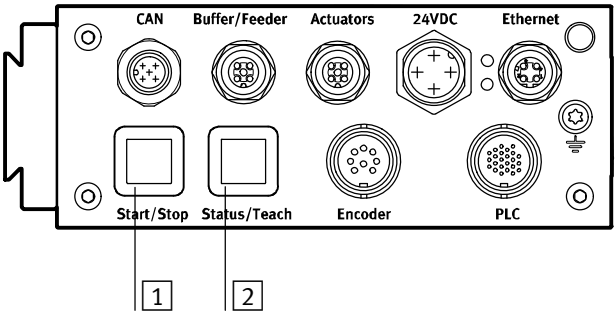


Fig. 2/5: Display and control elements

	Function
1	– Start and stop the Checkbox – Display of the switching function Start (green)/Stop (red) – - Set tolerance – Acknowledge errors – Save the Teach data
2	– Switch between RUN and Teach modes – Select the orientation in the Teach mode – Display the scan procedure – Call up system information (e.g. belt speed during operation with encoder)

Before the Checkbox is switched on the first time, make sure that you have completed the following steps:

1. Mounting of the transporting device
2. Mounting of the Checkbox on the transporting device
3. Pin 4 FE/PE connected to the 24 V DC connection in a professional manner
4. Connection of external components, if required
   Observe the instructions on connecting external components in the following chapters:
   - Chapter 3.2 “Actuators”
   - Chapter 3.3 “Buffer/Feeder”
   - Chapter 3.5 “Encoder”
   - Chapter 3.6 “PLC”

Warning
Check to see which measures are necessary for putting your machine/system in a safe state when it is switched on and off. Sudden unexpected movements of the connected actuators can cause personal injury and damage to property if e.g.

- the transporting device is moved to its initial position when the power supply is switched off,
- the transporting device starts automatically if controlled by the Checkbox when the Checkbox starts.

In order to prevent the transporting device from starting automatically when the operating voltage is switched on, observe the following:

- Select in CheckKon [View] [System parameter] ◇ System ◇ Operating modes ◆ Automatic start after power supply on = **no** (factory setting).

Switching on

1. Switch on the operating voltage for the Checkbox via the power unit.
2. Start CheckKon in order to display and set the system parameters (see chapter 2.4).
3. Start the transporting device manually if necessary.

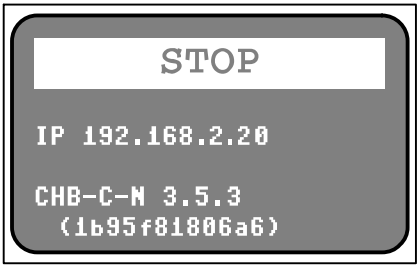


Fig. 2/6: STOP status

– Readiness to operate is signaled by the STOP status
– The IP address (factory setting: 192.168.2.20) indicates the current IP address of the device
– CHB-C-N firmware version number (3.5.3)
(Hash value of the firmware version 1b95f81806a6)

Teach mode

Scan the sample parts in the Teach mode in order to record the Teach data (see chapter 4).

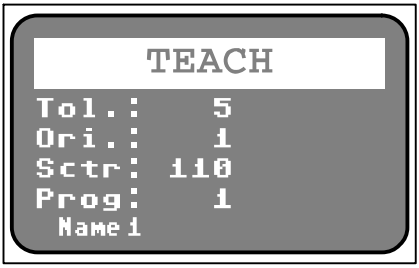


Fig. 2/7: Teach mode

- **Tol.:** Tolerance (5) indicates the standard tolerance value (= 5 %) for the selected check program
- **Ori.:** Orientation (1) indicates the orientation of the sample part to be taught
- **Sctr:** Scatter of characteristics (110) indicates the maximum value for the scatter of characteristics
- **Prog:** Check program number (1)
  - Check program name (Name 1) indicates the number and name of the selected check program

Note
The following list provides only an overview of the most important operating steps. Note the instructions on the Teach procedure in chapter 4, before starting the Checkbox in the Teach mode.

The Checkbox is ready to operate as soon as it is switched on (STOP status).

1. Press the Status/**Teach** button.
   Scan sample parts of check program 1 in orientation 1.
   The “SCTR” value of the scatter of characteristics will be shown during the scanning process (e.g. 30)

2. Press the Status/**Teach** button.
   Scan sample parts in the next orientation (2).
   Repeat the procedure for further orientations.

3. Press the Start/**Stop** button.
   The Teach data is saved and the Teach mode is concluded.

RUN mode

Evaluate the reliability of the Teach data before starting the automatic parts test.

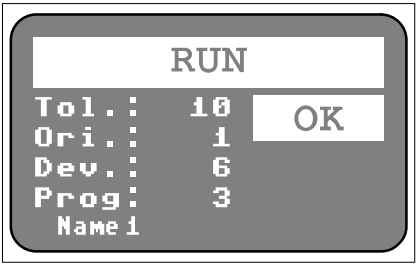


Fig. 2/8: RUN mode

Note
The following list provides only an overview of the most important operating steps.

- Note the instructions on the test procedure in chapter 5, before starting the Checkbox in the RUN mode.

The Checkbox is ready to operate (STOP status)

1. Press the **Start**/Stop button
   Presetting: Check program 1; tolerance 5 % (for influence and setting the tolerance, see chapter 5.3).
2. Check the inspection part deviation “Dev” and the inspection part orientation “Ori” (see chapter 5.4).
3. If necessary, correct the system settings with CheckKon. Only modify system parameters/system data if the Checkbox is in its STOP status.
4. Conclude CheckKon when all the settings have been completed.

Note
Faulty processing data can cause incorrect functioning of the Checkbox.

- Carry out the complete Teach procedure again if you have modified the system parameters with CheckKon.

Switching off

Switch the Checkbox to the STOP status before switching it off:

1. Press the Start/**Stop** button.
2. Switch off the operating voltage.

2.6 Error diagnostics

The Checkbox indicates operating errors as follows:

– The Checkbox switches automatically to the STOP status.

– The illuminated pushbuttons on the Checkbox flash.

– The display shows the error code “Error” including an explanation in English (for an overview of the types of error see appendix A1).

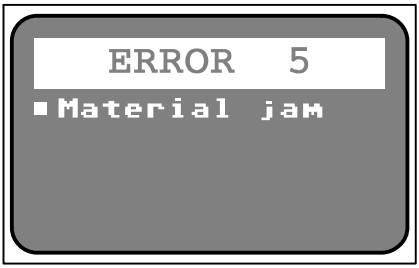


Fig. 2/9: Example: Error message “Error 5”

– **ERROR** error number (5)

– The error description (Material jam) provides a brief textual description for the corresponding error number and information concerning remedial measures

Push-button	Status		Significance
Start/ Stop		Flashes red	Error message / warning
Status/ Teach		Flashes yellow	

Tab. 2/4: Error display

The Checkbox cannot be started again until the fault has been eliminated:

1. Eliminate cause of malfunction
2. Acknowledge error message: Press the Start/Stop button
3. Start Checkbox: Press the **Start**/Stop button

Additional information:

– Details on the fault codes and instructions on eliminating faults can be found in appendix A.1.

– The CHB-C-N also signals faults at the PLC connection via O/17 (error) and, if applicable, O/23 (warning) (see chapter 3.6.6).

I/O module

Chapter 3

Contents

3.1 Interfaces

1 Buffer/Feeder
2 Actuators
3 Ethernet
4 Encoder
5 PLC

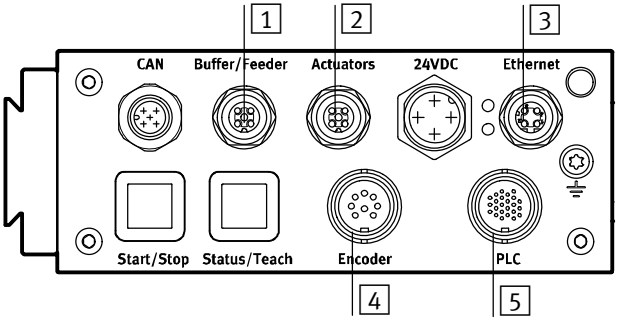


Fig. 3/1: The I/O module of the CHB-C-N

	Function
1	– Connection of 1 buffer zone sensor for controlling the flow of parts to the next machine – 24 V power outputs for controlling the supply system (small parts conveyor) and the transport system (transporting device)
2	– 24 V power outputs of a maximum of 3 actuators for sorting out the tested conveyed parts
3	– Connection of a diagnostics PC for system diagnosis, visualizing and optimizing the test procedure
4	– Connection of a rotary pulse generator for determining the speed of the conveyor system
5	– Connection of 2 buffer zone sensors for controlling the flow of parts to the next machine – 24 V power output for controlling the supply system (small parts conveyor) and the transport system (transporting device) – I/O signals for process monitoring and higher-order control or for controlling a downstream-switched machine – Optional fourth actuator output (configuration-dependent)

Power supply

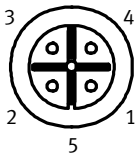
Observe the instructions on supplying power to external components in chapter 2.3.3 and chapter 3.6.

For electrical properties of the I/O signals, see Technical data (appendix A.5).

3.2 Actuators

Note
To avoid malfunctions from electromagnetic interference:
- Use cables with a maximum length of 30 m

Connection assignment

Actuators connection socket		
O/1	Actuator 3	
O/2	Actuator 2	
3	GND	
O/4	Actuator 1	
5	Do not connect	

Tab. 3/1: 24 V DC plug connector

Position of the actuators

The arrangement of the actuator positions and their allocation is to be planned in such a way that ensures proper segregation of the tested parts. The actuator positions and their relative arrangement along the transporting device are to be adapted to the lengths of the tested parts and the inspection task.

If a part has already passed an actuator position before the assignment according to the inspection result is present, the CHB-C-N changes to its error state.

Despite an apparently correct configuration of the actuator positions, it may be the case that good parts are ejected at the defective parts actuator. A possible cause for this may be an excessively long period of evaluation for the tested part.

To ensure that a defective part cannot accidentally pass the inspection as a good part, all inspection parts are marked as defective parts directly after the scanning procedure. However, if the subsequent quality calculation takes longer than the inspection part needs to reach the position of the defective part actuator, a reassignment to another actuator is no longer possible. In this case, the inspection part is ejected at the defective part actuator regardless of the quality decision. This also means that the separation of parts in the displayed inspection result (on the LCD display and in CheckKon, if connected) deviates from the actually performed separation of parts.

Controlling the actuators

Note
If there is a failure in the power supply to the CHB-C-N or to the actuators when the transporting device is running, this can result in:

- Parts passing the actuator positions unchecked
- The actuators being unable to sort out checked parts.

Check the measures which are required on your machine/system in order to prevent incorrectly oriented parts or defective parts from unintentionally reaching the next machine in the event of such operating faults.

Input I/19 is provided on the PLC connector to monitor the pneumatic supply for the actuators. An “External error”, which switches the Checkbox to its error state, can be triggered via this input.

The CHB-C-N can control up to four actuators for sorting out good parts, incorrectly oriented parts and defective parts. Possible actuators are e. g. shunts, reversing stations or air nozzles which sort out the parts at certain positions on the transporting device depending on the inspection result. The number and assignment of the actuator positions may vary

depending on application. The assignment of the actuator positions can be adapted with the CheckKon software.

Example configuration: Transporting device with 2 blow-out nozzles (see Fig. 1/1)

The compressed air valves of the blow-out positions must be connected directly with the outputs for actuators 1...2. These outputs are set to + 24 V DC if the parts test delivers the following result:

– Incorrectly oriented or superfluous (good) part

– Defective or foreign part

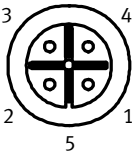
If the CHB-C-N recognizes an inspection part as a good part, the signal actuator 3 will be set from the rest potential 0 V to + 24 V DC and the good part will be output at the end of the transporting device.

Output	Signal level [1] (example configuration)
Actuator 1	The + 24 V DC signal is present when the inspection part passes the actuator position for incorrectly oriented or superfluous good parts.
Actuator 2	The + 24 V DC signal is present when the inspection part passes the actuator position for defective or foreign parts.
Actuator 3	The + 24 V DC signal is present when the inspection part passes the actuator position for good parts (here: The end of the transporting device).
Actuator 4	Optionally available on the PLC interface (configuration-dependent: Actuator / counter reading reached)
[1] The duration of the signal corresponds to the time required for the part to reach the air jet nozzle.	

3.3 Buffer/Feeder

Note
To avoid malfunctions from electromagnetic interference:
- Use cables with a maximum length of 30 m

Connection assignment

BUFFER/FEEDER connector socket		
O/1	24 V DC / Box ready – Reference voltage for sensors (switched off in Stop status) – Operating status – Control for transporting device (e.g. conveyor belt)	
O/2	Feeder Control of the small parts conveyor (e.g. upstream feeder bowl)	
3	GND Reference voltage for sensors	
I/4	Buffer Buffer zone sensor 1	
5	Do not connect	

Tab. 3/2: BUFFER/FEEDER connector socket

Direct connection can also be made with a Festo Duo cable (accessories ➔ www.festo.com/catalogue).

Identification of the Duo cable	
Signal x	Buffer zone sensor 1
Signal x + 1	Small parts conveyor (feeder)

Controlling the small parts conveyor (feeder)

To enable controllers of small parts conveyors with a 24 V DC enable input to switch the conveyor device on and off:

1. Connect the output pin O/2 and GND, pin 3 of the buffer/ feeder connector to the enable input.
2. Select the function Active = On = 24 V DC on the controller.
3. Connect the buffer zone sensor to the Checkbox at input I/4 and GND of the buffer/feeder connector.

Controlling the buffer zone sensor (buffer)

If the buffer zone sensor is triggered in the run mode, “BUF” will appear in the display.

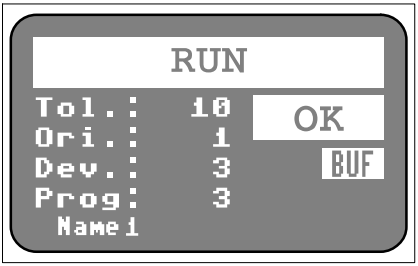


Fig. 3/2: Buffer zone full

- **BUF** signals the status “Buffer zone full”
- If the buffer zone is emptied, “BUF” will disappear from the display

Note
Only in this way is the Checkbox ready to operate:

- Leave unused sensor inputs open if the buffer zone sensor inputs have been configured according to the default settings.

Otherwise, the display will show the operating status “BUF”, although the buffer zone is free. All good parts will be returned. The small parts conveyor is switched off after 30 s (standard setting).

Signal duration

In order to avoid unnecessary switching movements, the Checkbox reacts only after a certain signal duration to the sensor signals for “Buffer zone full” and “Buffer zone empty”.

Modification of the signal duration with CheckKon in the menu [View] [System parameter] ◇ System ◇ Transporting systems ◇ Continuing systems ...◆ Minimum sensor signal duration for status:
Buffer zone full: 1.0 s (0.1 s ... 180 s)
Buffer zone empty: 1.0 s (0.1 s ... 180 s)

Sensor type

The CHB-C-N is factory preset for use with a buffer zone sensor, the sensor output of which lies at a potential of **0 V** (i.e. no conveyed part in front of the sensor) in the rest state. This corresponds to the parameter setting in CheckKon: Buffer zone sensor types = active HIGH (24 V)

Note
You can optimize the operational safety of your supply system as follows:

- Use sensors which have a sensor output with a potential of 24 V DC in the rest state
- Adapt the setting of the sensor type with CheckKon.

You can then prevent the system from becoming blocked e.g. in the event of a broken cable.

Modification of the sensor type with CheckKon in the menu [View] [System parameter]: ◇ System ◇ Transporting systems ◇ Continuing systems ...◇ Buffer zone sensor types

Sensor type		**Function** Buffer zone with one sensor
Active HIGH (24 V) 1)	**Active LOW (0 V) 2)**	
Sensor 1 LOW	Sensor 1 HIGH	The sensor does not register a conveyed part. The small parts conveyor is/remains switched on.
Sensor 1 HIGH	Sensor 1 LOW	The buffer zone is full. “BUF” appears in the display. Good parts are returned. When the preset time e. g. 30 s has expired, the small parts conveyor will be switched off; the transporting device still runs.
1) factory presetting 2) to be set with CheckKon		

Information on dimensioning the buffer zone can be found in chapter 1.5.

3.4 Ethernet interface

Note
- Use a screened cable with a maximum length of 70 m
- Use a screened plug connector to ensure continuous contact between the screening and the Checkbox.
- Connect the screening of the Ethernet cable with low impedance to earth potential.

Note
Unauthorised access to your Checkbox can result in damage or malfunctions.
- Ask your system administrator how you should protect your network against unauthorized access, e.g. with a firewall.

Note
With an active connection to the Checkboxes in the network, large amounts of data can be transmitted, depending on the mode of operation. This places a considerable burden on the network between the PC and Checkbox.
A direct connection is therefore preferable.
- If in doubt, ask your network administrator whether corresponding band widths are available for you or what an optimum network structure for you should look like.
- Comply with the necessary system requirements.

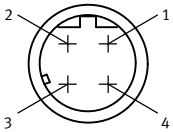
To commission the Checkbox you will need to create a connection between your PC and the Checkbox via Ethernet.

For special requirements in an industrial environment, use a screened flexible Ethernet round cable of category 5, which will fulfil your requirements as regards resistance to oil, bending radius, permitted bending cycles, etc. Connections: M12 socket, 4-pin, d-coded and RJ45 plug

Ethernet connection

The connection to the PC and displays or higher-order controllers can be established via the Ethernet interface. To permit a connection, several prerequisites with regard to the device's network address and the PC must be fulfilled.

The network properties of the device can be adapted using the Festo Field Device Tool (FFT). Factory setting of the IP address: 192.168.2.20.

Pin	Signal	M12 Ethernet connection socket [1]	
1	TD+	Transmitted data +	
2	RD+	Received data -	
3	TD-	Transmitted data –	
4	RD-	Received data –	
Metal covering		Screening (shield)	
[1] d-coded			

Tab. 3/3: Pin allocation of the Ethernet interface

The Ethernet interface of the Checkbox complies with the standards 10BaseT/100BaseTX for 100 Mbit/s networks.

LED	Status	Description
Green (speed)		10Base-T
		100Base-TX
Yellow (Link)		No Link
		Link
		Traffic

Tab. 3/4: LED function

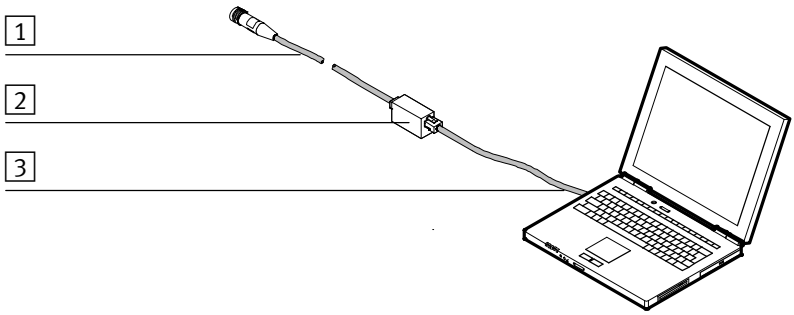
Connection via hub or switch

Recommendation: Use network components which support data rates of at least 100 Mbits/s.

If using a router, make sure that this is set so that the multicasts of address 239.255.2.3. are passed on. This address is used to search for devices in the network. If the routers are not configured accordingly, the devices cannot be found using the search function. If in doubt ask your network administrator.

Direct connection with the PC

If the network connection of the PC does not support automatic adaptation of the send and receive cable (AUTO MDI-X), you will require a crossover cable and a cable coupling in addition to the original cable.



1 Original cable
e.g. NEBC-D12G4-KS-3-R3G4,
Order no. 8031121

2 Cable coupling

3 Crossover cable

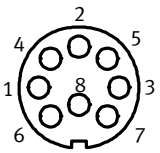
Fig. 3/3: Direct connection to the PC

3.5 Encoder

Festo generally recommends connecting an encoder.

Note
- Only use a screened cable.
- Connect the screening at both ends to earth potential with low impedance.

If high demands are placed on the accuracy of the length of the inspection part, you can connect a rotary pulse generator to the ENCODER connection for determining the speed of the transporting device (accessories
➔ www.festo.com/catalogue).

Pin	ENCODER connector socket	
Interface for rotary pulse generator as per RS 485 specification		
1	A+	
2	n.c.	
3	B+	
4	A-	
5	B-	
6	5 V supply [1)]	
7	GND	
8	n.c.	
[1)] Maximum loading 180 mA		

Tab. 3/5: ENCODER connector socket

Note
Observe the following when connecting a rotary pulse generator:

- Do not connect the potentials of the ENCODER connection with other potentials.
- Use only suitable rotary pulse generators, e.g. encoders from the Festo product range.

Display of the belt speed

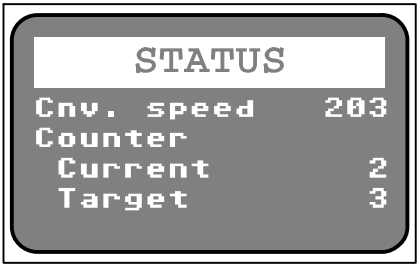


Fig. 3/4: Belt speed

- Press and hold the Status/Teach button in the RUN mode.
- **Cnv. Speed**: Belt speed (203) shows the current speed of the conveyor belt in mm/s (only in Encoder mode)

3.6 PLC

Note
- Only use screened cables.
- Connect the screening to earth potential with low impedance.

Observe the following when connecting a higher-order controller:

- Use a PLC cable with 24-pin plug.
- Connect the cables of the PLC according to the cable assignment in appendix A.4.
- Make sure that the maximum resultant current of 0.9 A at the PLC connection is not exceeded.

Reference voltage

The reference voltage is available at pin 4 (GND) and pin O/7 (+24 V). Fuse: 700 mA, self-resetting.

Pin	Reference voltage
4	0 V e. g. as reference potential for the PLC/reference voltage buffer zone sensors
O/7	+24 V DC e. g. as voltage supply for opto-isolated PLC I/O module, signal level after boot procedure = HIGH

Tab. 3/6: Reference voltage

Load voltage

Consumers can be supplied with power via pin 4 (GND) and pin O/7 (+24 V) under the following condition:

- Load output O/7 with maximum 700 mA.

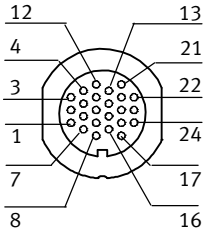
I/O functions of the PLC interface		Pin
Remote Start	Start/stop mode	I/6
	Saving teach data	
Selection of the check program	External type selection: Bit 0	I/20
	External type selection: Bit 1	I/5
	External type selection: Bit 2	I/13
	External type selection: Bit 3	I/10
Locking the control panel	Button lock	I/11
Controlling the transfer position[1] for:		
– Good parts	Actuator 3	O/3
– Defective/foreign parts	Actuator 2	O/2
– Incorrectly orientated or superfluous good parts	Actuator 1	O/1
	Actuator 4 (target number reached)	O/22
Controlling the parts supply	Buffer zone sensor 1	I/12
	Control of the small parts conveyor (e.g. upstream feeder bowl)	O/8
	Operating status, control of the transporting device (e.g. conveyor belt)	O/21
Error messages	Fault status 1: “Error” status signal	O/17
[1] Configurable allocation		

Tab. 3/7: I/O functions of the PLC interface

Special functions of the PLC interface [1]		**Pin**
Error messages	Fault status 0: Warning	O/23
Monitoring the buffer zones and controlling the parts supply with switch hysteresis.	Buffer zone sensor 2 [2]	I/13
Additional inspection of material properties which are not checked during contour registering (e.g. by metal detector or colour sensor or vision system for additional inspection of the part from above). Downstream-switched test function, i.e. only good parts are checked.	External sensor [3] [4]	I/10
Input I/19 is provided on the PLC connector to monitor the pneumatic supply for the actuators. An “External error”, which switches the Checkbox to its error state, can be triggered via this input.	External error	I/19
Counting function[1] [3] If the counting function is deactivated, output O/22 is available as a fourth actuator.	Start new counting cycle Target number reached	I/18 O/22

[1] Deactivated at the factory. Functions can be activated and adapted with CheckKon.
[2] Can be set optionally with CheckKon, preset to “External type selection: Bit 2”.
[3] Counting function and special function “External sensor” cannot be used at the same time.
[4] Can be set optionally with CheckKon, preset to “External type selection: Bit 3”.

Tab. 3/8: Special functions of the PLC interface

Electrical properties of the PLC interface	
Inputs: – Input current: ‹ 30 mA – Logical “1”: U_{in} › 15 V – Logical “0”: U_{in} ‹ 5 V **Outputs:** – Max. current load per channel: 700 mA – Max. resultant current of all outputs: 0.9 A – PNP switching	

Tab. 3/9: Electrical properties of the PLC interface

3.6.1 Start/Stop mode

The controller of the CHB-C-N requires that

– the power supply for the CHB-C-N is applied

– the boot procedure has been completed (O/7 = HIGH)

– the signals for selecting the inspection program are stable (see chapter 3.6.2).

The Checkbox is started with a signal sequence (pulse) at pin I/6 LOW⇢HIGH⇢LOW and is stopped again with the signal sequence LOW⇢HIGH⇢LOW (recommended pulse length 500 ms).

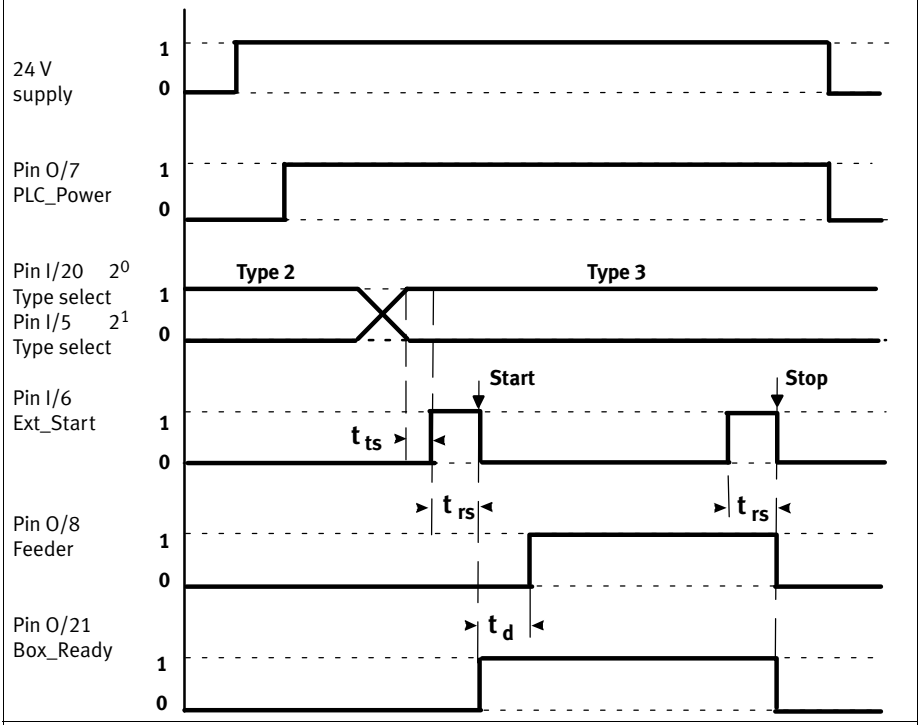
Pin	Signal sequence	Significance
I/6	LOW⇢HIGH⇢LOW	Starts the Checkbox
	LOW⇢HIGH⇢LOW	Stops the Checkbox

Tab. 3/10: Signal sequence with Start/Stop mode

With varying manual operation or control via the I/O module, pressing the Start/Stop button corresponds to the signal change LOW ⇢ HIGH ⇢ LOW.

The modification of the operating status with Start or Stop is sent to the controller via O/21.

Pulse-time diagram
Timing requirement to the higher-order controller



0.2 s ‹ t_{rs} ‹ 1 s
t_{ts} = min 0.1 s
t_d = duration of the switch-on delay

rs = remote start
ts = type select
d = delay

Tab. 3/11: Pulse-time diagram: Timing requirement to the higher-order controller

3.6.2 Selection of the check program

For automatic changing of the check program via the PLC:

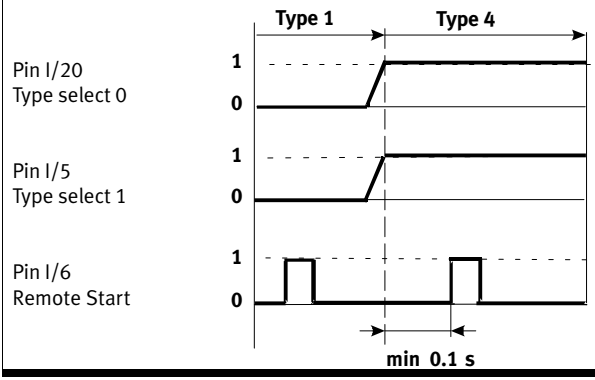
- Switch the CHB-C-N to the stop status.
- Set the signals at the inputs in accordance with the binary coding of the desired check program. (see following tables).

A maximum of 4 check programs can be addressed via the inputs I/20 and I/5. The signals must be applied permanently before the CHB-C-N starts again.

Binary coding **Check program 1..4**	**I/20** **2^0**	**I/5** **2^1**
1	LOW	LOW
2	**HIGH**	LOW
3	LOW	**HIGH**
4	**HIGH**	**HIGH**

Tab. 3/12: Binary coding of check program 1..4

Pulse-time diagram (with max. 4 check programs)
Check program change 1 ⇢ 4



Tab. 3/13: Pulse-time diagram: Check program change 1 ⟶ 4

The inputs I/13 and I/10 are used before leaving the factory for addressing a maximum of 16 check programs. Optionally you can use the inputs for evaluating a second buffer zone sensor (switching hysteresis) or an external sensor (e.g. for colour testing).

- Use CheckKon to modify the setting of the following parameters in the menu [View] [System parameter] in accordance with the following table:
  - ◇ Transporting systems ◇ Continuing systems ◇ Number of buffer zone sensors
  - ◇ System ◇ Operating modes ◇ Extended influence of the parts type assignment ◇ Input for external signal ◆ External signal input activated

Optional pin assignment **Setting in CheckKon**	**I/20**	**I/5**	**I/13**	**I/10**
◆ Number of buffer zone sensors=**2** ◆ External signal input activated=**yes**	**maximum 4 check programs**		Buffer zone sensor 2	External sensor
	Ext. type selection bit 0	Ext. type selection bit 1		
◆ Number of buffer zone sensors=**1** ◆ External signal input activated=**yes**	**maximum 8 check programs**			External sensor
	Ext. type selection bit 0	Ext. type selection bit 1	Ext. type selection bit 2	
Factory setting: ◆ Number of buffer zone sensors=**1** ◆ External signal input activated=**no**	**maximum 16 check programs**			
	Ext. type selection bit 0	Ext. type selection bit 1	Ext. type selection bit 2	Ext. type selection bit 3

Tab. 3/14: Maximum number of check programs

The Checkbox can internally store up to 256 check programs. Only the first 16 check programs can be selected via the PLC interface. Access to all 256 check programs is only possible in CheckKon via system parameters.

Binary coding **Check program 1..16**	**I/10** **2^3**	**I/13** **2^2**	**I/5** **2^1**	**I/20** **2^0**
1	LOW	LOW	LOW	LOW
2	LOW	LOW	LOW	**HIGH**
3	LOW	LOW	**HIGH**	LOW
4	LOW	LOW	**HIGH**	**HIGH**
5	LOW	**HIGH**	LOW	LOW
6	LOW	**HIGH**	LOW	**HIGH**
7	LOW	**HIGH**	**HIGH**	LOW
8	LOW	**HIGH**	**HIGH**	**HIGH**
9	**HIGH**	LOW	LOW	LOW
10	**HIGH**	LOW	LOW	**HIGH**
11	**HIGH**	LOW	**HIGH**	LOW
12	**HIGH**	LOW	**HIGH**	**HIGH**
13	**HIGH**	**HIGH**	LOW	LOW
14	**HIGH**	**HIGH**	LOW	**HIGH**
15	**HIGH**	**HIGH**	**HIGH**	LOW
16	**HIGH**	**HIGH**	**HIGH**	**HIGH**

Tab. 3/15: Binary coding of check program 1..16

3.6.3 Counting function

The setting for the target number and orientation is specified for each check program, and must be configured in Check-Opti ([View] [Teach-data], button “Counter configuration”).

Counting

Depending on the setting in CheckOpti, only good parts in the target Orientation (Ignore Orientation = deactivated - no checkmark) or good parts in all taught orientations (Ignore Orientation = activated - checkmark) will be counted.

If counting is interrupted, e.g. by pressing the Start/**Stop** button, the current counter reading will be reset to zero.

Note
When the CHB-C-N is switched off (operating voltage off), counting will be interrupted. The current counter readings will be deleted. When the CHB-C-N is switched on, a new counting cycle is started.

- After stopping or switching off the CHB-C-N, remove all good parts from the parts output. You will then avoid incorrect numbers of items when the CHB-C-N is switched on again.

If the set target number of a check program is reached, all further good parts of the check program up to the moment when the small parts conveyor is switched off will be returned to the conveyor at the actuator position for superfluous good parts. Defective parts will be output further at the relevant position.

To set the switch-off delay for the small parts conveyor when the target number is reached: CheckKon Menu [View] [System parameter] ◇ Transporting systems ◇ Supply system... ◆ Switch-off time when counter status is reached = 30 s (0.1 s...1800 s).

When the last good part of a counting procedure reaches the position for the counter reading signal, the output O/22 on the PLC connection will be set from LOW⇢HIGH (“Target

number reached”). The current counting procedure is ended. “CTR” appears on the display

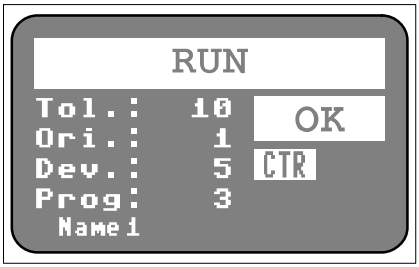


Fig. 3/5: Counter reading reached

- **CTR** signals the status “counter reading reached”
- If the counter reading is reset, the CTR display will disappear

All subsequent good parts will be returned to the small parts conveyor. When the time preset with CheckKon has expired, the small parts conveyor will be switched off.

The current counter reading and the target counter reading can be displayed by pressing the Teach/Status button while the device is in the Run mode.

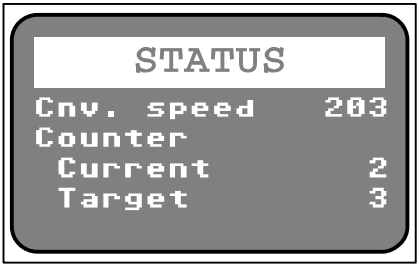


Fig. 3/6: Counter reading

- **Cnv. Speed**: Belt speed (203) shows the current speed of the conveyor belt in mm/s (only in Encoder mode)
- **Counter**
  - **Current** Current counter reading (2)
  - **Target** Target counter reading (3)

In order to start a new counting procedure, the CHB-C-N requires the signal “Start new cycle” from the higher-order controller. In order to start the counting cycle, the signal LOW⇢HIGH⇢LOW must be present at input I/18.

During the pulse length t_{sc} good parts will still be returned. The new counting cycle starts with the falling edge at I/18 (see following table).

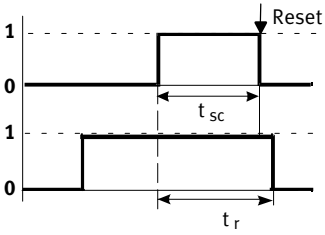
Pin	Signal level	Significance
I/18	LOW⇢HIGH⇢LOW	Starts new counting cycle
O/22	HIGH	Preselected counter reading reached
	LOW	Preselected counter reading not yet reached.

Tab. 3/16: Signal sequence for controlling the counting procedure

Pulse-time diagram
Control of counting

Pin I/18
Start new counting cycle
t_{sc} › 15 ms

Pin O/22
Preselected counter reading reached



sc = start counting cycle
r = reset

Tab. 3/17: Pulse-time diagram: Control of the counting procedure

3.6.4 Actuators

Note
This chapter contains supplementary information on controlling the actuators via the PLC interface. Note also the instructions and information in chapter 3.2.

Internal activation

The outputs of actuators 1 ... 3 at the PLC connection are controlled internally in parallel with the ACTUATORS connection. The outputs are therefore switched simultaneously.

Actuators		PLC	Function
3	●—●	4	GND
O/4	●—●	O/1	Actuator 1
O/2	●—●	O/2	Actuator 2
O/1	●—●	O/3	Actuator 3
---	●—●	O/22	Actuator 4 / Counter reached

Tab. 3/18: Internal activation of ACTUATORS-PLC

If the counting function is deactivated, the output of actuator 4 is available at the PLC connection.

Monitoring

Input I/19 is provided on the PLC connector to monitor the supply of pneumatic actuators. An “External error”, which switches the Checkbox to its error state, can be triggered via this input, e.g. via a pressure sensor.

Runtime performance

Observe the following when evaluating the output signals “Actuator...” via a higher-order controller:
In the event of a high cycle rate and/or a short distance between inspection parts, parts can be ejected at a preceding actuator, even though previously checked parts have not yet reached a subsequent actuator. This delay arises due to a (long) distance between the actuator positions.

3.6.5 Buffer zone sensors/small parts conveyor

Note
This chapter contains supplementary information on controlling the small parts conveyor and the buffer zone sensors via the PLC interface. Note also the instructions and information in chapter 3.3.

Internal activation

The I/O signals for buffer zone sensors and the small parts conveyor at the PLC connection are controlled internally in parallel with the BUFFER/FEEDER connection. The outputs are therefore switched simultaneously

BUFFER FEEDER		PLC	Function
O/1		O/21	– 24 V reference voltage for buffer zone sensors – Operating status – Control of the transporting device
O/2		O/8	24 V power output for controlling a small parts conveyor (feeder)
O/3		O/4	0 V reference voltage for buffer zone sensors
I/4		I/12	Buffer zone sensor 1
---		I/13	Buffer zone sensor 2

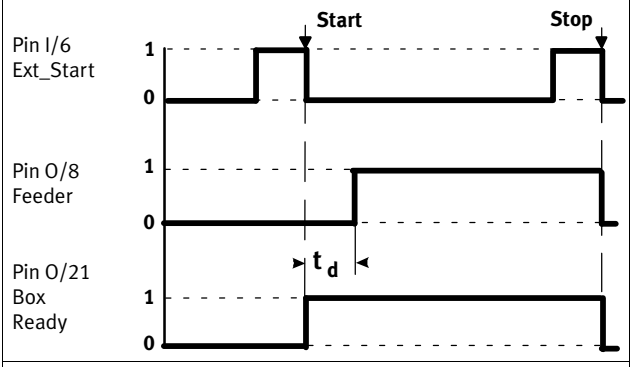
Tab. 3/19: Internal activation of BUFFER/FEEDER-PLC

Switch-on delay of the small parts conveyor

After starting, the Checkbox triggers the actuator for sorting out the defective parts. This is to ensure that no (unchecked) parts are located on the transporting device. This results in a delay of a few seconds between the external Start command

(I/6) and the switch-on signal for the small parts conveyor (O/8). The duration of this delay depends on ambient parameters, e.g. transporting speed and geometrical variables.

Pulse-time diagram
Controlling the small parts conveyor



Tab. 3/20: Pulse-time diagram: Control of the small parts conveyor

Buffer zone sensors

With CheckKon, the CHB-C-N can be configured for operation either with one buffer zone sensor or for switching delay of the small parts conveyor with two buffer zone sensors (Fig. 3/7): Menu [View] [System parameter] ◇ Transporting systems ◇ Continuing systems ◆ Number of buffer zone sensors = 1 (2).

The maximum number of check programs is reduced to 4 with the setting “Number of buffer zone sensors = 2” (see chapter 3.6.2).

1 Buffer zone
2 Transporting device
3 Sensor 2
4 Sensor 1

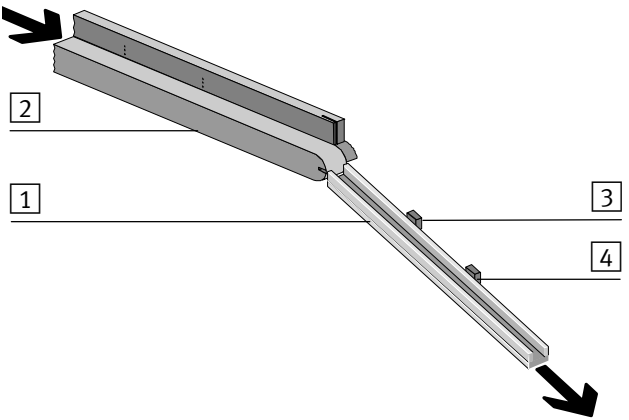


Fig. 3/7: Buffer zone check with switching delay

Sensor type		**Function** Buffer zone with one or two sensors
Active HIGH (24 V) 1)	**Active LOW (0 V) 2)**	
Sensor **1** LOW	Sensor **1** HIGH	The sensor does not register a conveyed part. The small parts conveyor is/remains switched on.
Sensor ... 3) HIGH	Sensor ...3) LOW	The buffer zone is full. “BUF” appears in the display. Good parts are returned. The small parts conveyor is switched off after the preset time; the transporting device still runs.
1) Factory presetting 2) To be set with CheckKon 3) with buffer zone monitoring – with one sensor: Sensor **1** – with two sensors: Sensor **2**		

Tab. 3/21: Sensor function

3.6.6 Fault messages

The Checkbox signals malfunctions at pin O/17 and O/23. The fault message is acknowledged with a pulse at pin I/6.

Pin	Signal sequence	Significance
I/6	LOW⇢HIGH⇢LOW, LOW⇢HIGH⇢LOW	Delete faults

Tab. 3/22: Signal sequence: Delete faults

Evaluation of the output signals takes place e.g. with the aid of a machine light:

Light	Significance	O/17	O/23
Red	Fault present	**HIGH**	LOW
Yellow	A warning is present	LOW	**HIGH**
Green	Faultless operation	LOW	LOW

Tab. 3/23: Fault display (example)

3.6.7 Locking the control panel

Via pin I/11, the buttons Start/Stop and Status/Teach on the CHB-C-N can be locked against unauthorized actuation. The Checkbox can then be started or stopped only via pin I/6. A change to the TEACH mode is not possible.

Pin	Signal level	Significance
I/11	HIGH	Button lock
	LOW	Button release

Tab. 3/24: Signal level: Control panel lock

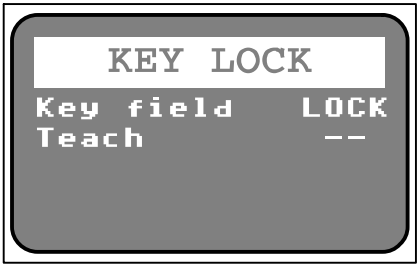


Fig. 3/8: Key field locked

- **Key field** Key field lock (LOCK) appears when the Start/ Stop button or the Teach/Status button is pressed.
- **Teach** Teach button lock (--) is deactivated
- The display appears for 1.5 s and then reverts back to the original operating status display

Setting the control panel lock with CheckKon

The Status/Teach button can also be locked via CheckKon. Only the Start/Stop button can then be enabled at I/11.

Fig. 3/9: Status/Teach button locked

- **Key field** Key field lock (--) is deactivated.
- **Teach** Teach button lock (LOCK) appears when the Status/Teach button is pressed
- The display appears for 1.5 s and then reverts back to the original operating status display

The Status/Teach button remains locked until the function is switched off again in the CheckKon menu [View] [System parameter]: ◇ System ◇ Operating modes ◆ Lock the Teach button = Off.

Teach parts

Chapter 4

Contents

4.1 Preparing the Teach procedure

If you are using the CheckKon/CheckOpti software packages: Please also note the instructions in the software descriptions on how to prepare the teach procedure.

Features and properties of the conveyed parts

The Checkbox registers conveyed parts as 2-dimensional, black and white profile pictures (parts contour). Features for distinguishing various good parts are derived from the parts contour. As a rule, discoloration or surface faults (e.g. scratches) do not influence the test result in this recognition procedure.

The features of the conveyed part relevant for distinguishing, as well as for determining the orientation and quality, must be recognizable for the Checkbox:

- Use the Checkbox preferably for testing rotation-symmetrical small parts.
  The testing of non-rotation-symmetrical parts is only possible if a pre-orientation of the conveyed parts is carried out with the small parts conveyor.

The conveyed part must be fed through in a safe manner on the transporting device:

The length, diameter and height of a conveyed part must be suitable for the CHB-C-N.

The conveyed part must be supplied in a stable orientation (it must not roll away or vibrate).

The conveyed part must be able to be sorted reliably by the actuators.

As standard during the Teach procedure, the parts are sorted out at the first actuator position. This is to ensure that no sample parts are transported by mistake to the next machine in the process.

Note
Check in the test mode whether the actuators used (e.g. air nozzles) can reliably sort out large conveyed parts made of heavy materials with streamlined form. This is to ensure that no sample parts are transported by mistake to the next machine in the process.

Selecting the sample parts

- Provide sample parts for each check program as follows:
  - The sample parts show all the characteristics which a part classified as “Good” should possess.
  - If possible, use various sample parts with the usual scatter of characteristics. (Recommendation: min. 6 sample parts). With the scatter of characteristics, you determine the extent to which the inspection parts classified as “Good” may differ from each other.

Diagnostics mode

- Start CheckKon in order to display and set the system parameters during the Teach and RUN modes.

When CheckKon is started, it carries out a system test and switches the Checkbox automatically to the diagnostic mode.

Note
In the diagnostic mode the Checkbox transmits additional information via the diagnostic interface.

- Do not operate the Checkbox in diagnostic mode with the full parts rate.

In this way you can prevent parts from passing the actuator positions unchecked.

4.2 The teach procedure

In the Teach mode the Checkbox learns all the features for the parts test (Teach data) when scanning sample parts.

Carry out the Teach procedure as realistically as possible. Use, for example, the transporting device and feed intended for the later RUN mode (if necessary activate with CheckKon: [View] [System parameter] ◇ Transporting systems ◇ Supply system... ◆ Activate supply system in Teach mode ...).

The following functions of the Teach procedure can also be carried out via the PLC interface:

– Start/stop mode

– Selection of the check program

– Saving of the Teach data.

• Set the desired check program via the PLC interface

Additional information can be found in chapter 3.6

• Scan the sample parts of the check program one after the other in all intended orientations (max. 8), as described below.

Scanning sample parts in orientation 1

1. Press the Status/**Teach** button to switch the Checkbox to the Teach mode.

Fig. 4/1: Teach LOCK

If “Teach LOCK” is shown in the display, it means the Status/Teach button is locked and the Teach mode cannot be started. The CHB-C-N remains in its stop status.

- Switch off the Teach button lock with CheckKon: [View] [System parameter] ◇ System ◇ Operating modes =... ◆ Lock the Teach button = Off.

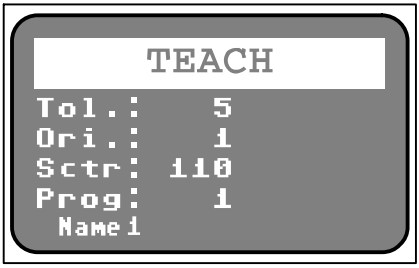


Fig. 4/2: Teach

2. Scan different sample parts of check program **1** in orientation 1 (nominal orientation). The Status/Teach button lights up briefly when the sample part is registered.

- Pay attention to the positioning of the sample parts (see chapter 4.2.1).
- While scanning, observe the displayed Sctr value for the scatter of characteristics (see chapter 4.2.2).

- Repeat the procedure until the Sctr value remains almost constant.

If a part has been incorrectly positioned (Sctr value changes erratically):

- Press the Start/**Stop** button to conclude the Teach procedure.
- Repeat the entire teach procedure for the check program.

Scanning the sample parts in further orientations

3. To scan another orientation, press the Status/**Teach** button to scan the next orientation or proceed to step 5 to the conclude the Teach procedure.
4. Scan the sample parts of check program **1** in orientation 2 and, as required, in the next orientation as described from point 2 onwards.

Saving the Teach data and concluding the Teach procedure

Only save the Teach data when the sample parts of a check program have been taught in all intended orientations.

5. Press the Start/**Stop** button.
   The Teach data is saved and the Teach mode is concluded.

After saving, carry out the following steps:

- Check the Teach procedure in the test mode with regard to orientation and quality as described in chapter 5.
- Keep a record of your work.

Register the next check program in a further Teach procedure:

- Address the next check program via the PLC inputs (chapter 3.6.2).
- Repeat all steps as from point 1.

4.2.1 Positioning the sample parts

The sample parts should be positioned exactly like the parts to be tested later.

– Place the sample parts on the transporting device one after the other.

– Place the parts on the belt as they are fed later.

In cases where particularly different variations of the ascertained parts contour (view) are permitted or possible in an orientation, you should show the “extreme” variations or as many different variations as possible during the teach procedure.

- Show at least 10 parts of the current parts type per orientation.
- Use different parts if possible, although if necessary the same part can be shown several times.

The check program is not registered completely until the Checkbox has recorded all intended orientations. For reliable testing, the ascertained features of the individual orientations must be clearly distinguished.

- Make sure in particular that orientation 1 (target orientation) differs clearly in at least one feature from all the other orientations.

4.2.2 Observing the scatter of characteristics

Observe the display when scanning the sample parts. It specifies the maximum value of the scatter of characteristics for the current feature which differs to the greatest extent (Sctr value).

The following factors influence the scatter of characteristics:

– Parts geometry

– Different contours of the part, depending on the rotation angle around the longitudinal axis (e.g. with springs, screws)

– Different positioning on the transporting device.

If the displayed Sctr value changes erratically, the conveyed part may have been positioned incorrectly. If the value only changes slightly, a sufficient scatter of characteristics in the current orientation has generally been achieved. The optimum situation is when the curve of the values changes at first considerably and then becomes increasingly more constant.

Small values indicate narrow manufacturing tolerances and a steady supply of parts. Very large values indicate that the taught sample parts differ greatly from each other with regard to their properties. If the (good) parts are allowed to differ greatly from each other, the Teach procedure can nevertheless still be continued.

Sctr value	**Significance**
‹ 10	Sample parts are very similar in all features
› 30	Large scatter of at least one feature
A detailed description of the computational algorithm of the scatter of characteristics can be found in Appendix A.3.2.	

Tab. 4/1: Sctr value (scatter of characteristics)

Checking parts

Chapter 5

Contents

5.1 The test procedure

During the automatic parts test, a reliable grading of the parts to be tested must be achieved with respect to orientation and quality (e.g. dimensions specified have been observed).

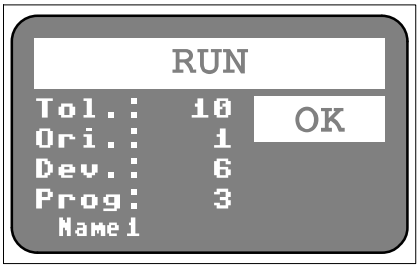


Fig. 5/1: Overall result OK

- **Tol.:** Tolerance (10) indicates the current tolerance value of the selected check program
- **Ori.:** Orientation (1) indicates the detected orientation of the checked part
- **Dev.:** Deviation (6) indicates the largest detected deviation of the calculated features in percent
- **Prog:** Check program number (3)
  - Check program name (Name 1) indicates the number and name of the selected check program
- **OK** indicates the overall test result (GOOD) in text form

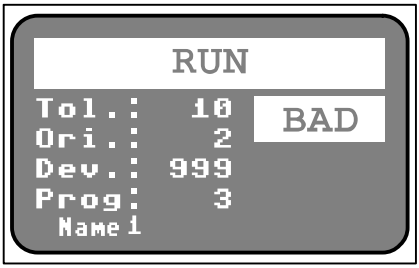


Fig. 5/2: Overall result BAD

- **BAD** indicates the overall test result in text form, **Dev.:** ›100

The following functions can only be carried out via the PLC interface:

– Selection of the check program

– Advanced test with external sensor

– Reset counter

– Monitoring of the buffer zone with switch delay.

Additional information can be found in chapter 3.6.

- Evaluate the reliability of the Teach data in the test mode (chapter 5.2), before you begin with the automatic inspection of workpieces.
- Protect the Teach data against undesired modification:
  - By using the control panel lock (see chapter 3.6.7)
  - With the CheckKon software: [View] [System parameter] ◇ System ◇ Operating modes ... ◆ Lock the Teach button = On.

5.2 Test mode

The Teach procedure is concluded and the Checkbox is ready to operate (Stop status).

Set the desired check program via the PLC interface (chapter 3.6.2).

1. Provide inspection parts for each check program.
   - Use good, defective and incorrectly oriented parts from the parts assortment.
   - Use the supply system
   - Check a sufficient number of parts in order to obtain a reproducible result (approx. 100).
2. Press the **Start**/Stop button (RUN mode). Test parts with the factory-set tolerance of **5 %**.
3. Position the inspection parts as they are fed later. If possible, use the transporting device intended for the inspection of workpieces. The inspection parts should be positioned (at random), as in normal operation.

If the supply of parts is interrupted for a prolonged period, the Checkbox will display error message Error 5 and it will stop automatically (see chapter 2.6 and appendix A.1.2).

4. Check the test results e.g. according to the following points of view: Have the orientations been recognized correctly? Is the grading of the parts recognized as good / defective correct?
5. Check the correct output at the output positions for good, defective or incorrectly oriented parts with as many inspection parts as possible.
6. Use the sample parts to check the sample parts with regard to their grading. If you have also tested faulty parts, check whether these have actually been recognized as defective.

If too many good parts have been graded and sorted as “defective”:

- Increase the tolerance (see chapter 5.3).
- Repeat the Teach procedure with more sample parts, using the transporting device intended for the RUN mode. (see chapter 4).

7. Observe the display on the Checkbox.

■ ■ ■

If the quality check and the position recognition for the parts assortment is not satisfactory, you can use additional operating parameters and tools with CheckOpti, in order to optimize the test results. Please consult your local Festo Sales Engineer.

Terminate the test mode when all settings have been completed and the checked parts have been graded reliably with regard to orientation and quality:

8. Press the Start/**Stop** button to switch the Checkbox to the Stop status.

9. Conclude the diagnostic mode. Close CheckKon (and CheckOpti).

5.3 Influence of tolerance

Band width

When a new check program is taught, the features of all scanned parts are recorded. The values of the registered features differ individually from each other. For each feature, there is a value range (band width) in which inspection parts are graded as “Good”. You can influence this band width by means of the tolerance setting. Inspection parts, the features of which lie within the band width or in the subsequent tolerance range, are still accepted as good parts.

With 0 % tolerance, only those parts with features which lie exactly within the band width of the scanned sample parts will be accepted as good parts. Set therefore at least 1 % tolerance. This will ensure that good parts will be classified correctly even if their positions deviate minimally.

Setting the tolerance

The setting is implemented in the Stop status.

1. Press the Start/**Stop** button to switch the Checkbox to the Stop status.

Fig. 5/3: Tolerance display

- **Tol.:** The tolerance setting mode can be accessed by pressing and holding the Start/Stop button. The current tolerance value (10 %) is displayed.
- **Prog:** Check program number (1) indicates the number and name of the selected check program

2. Press and hold the Start/Stop button while gradually increasing the tolerance value by repeatedly pressing the Teach/Status button, e.g. from **5** to **10** %:

Setting range	0 ... 20 %
Setting steps	1 %
Standard setting	5 %
Recommendation for setting steps	at least 1 %

3. Release the Start/Stop button when the desired value has been set.

The selected value will be added automatically to the data of the check program and saved.

Optimisation

Ascertain the optimum tolerance setting, particularly with critical conveyed parts in the test mode. Use CheckOpti to optimize the settings. Use one of the following methods:

- Empirical setting:
  Vary the tolerance so that the test of a large number of parts produces correctly recognized good and defective parts.
- Setting corresponding to inspection part deviation:
  - Select sample parts which are suitable as reference for good or defective parts. The recognition-specific features should lie if possible in the limit range good/ defective.
  - Vary the tolerance so that the following inspection part deviation is shown when the limit sample part is scanned:
    ‹ 100 limit sample part “good”
    › 100 limit sample part “defective”

5.4 Evaluation of the test results

5.4.1 Checking the features

The individual features of the inspection parts differ from the average values of the sample part features. The Checkbox ascertains the feature which differs most (maximum deviation) for each inspection part.

The inspection part deviation will be displayed during the test procedure. Detailed instructions on inspection part deviation (arithmetical algorithms) can be found in appendix A.3.3.

Value	**Evaluation**	**Comment**
≤ **100**	Good part	The smaller the value, the more accurately the inspection part corresponds to the sample parts.
> **100**	Defective part	The greater the value, the less the inspection part corresponds to the sample parts.
Display range: 0 to 999		

Tab. 5/1: Inspection part deviation

5.4.2 Checking the orientation

The Checkbox ascertains during the test procedure whether the orientation of the last scanned inspection part can be assigned to the orientations of the sample part.

Maintenance

Chapter 6

Contents

Warning
Risk of injury
- During maintenance procedures, make sure that no danger is caused by the controlled peripheral equipment and that the device is switched off.

Caution
Risk of injury, damage to components
- When mounting and removing, make sure nothing can fall
- Only carry out recommissioning procedures when fully mounted

Caution
Damage to components.
- Before carrying out mounting, installation and/or maintenance work, always switch off the power supply.

Note
Damage to the glass surfaces can result in operative malfunctions of the Checkbox.
- Consult your Festo Service in case of damage.

The Checkbox has been designed for rough industrial environments and is distinguished by its high reliability, robust structure and long service life. Special maintenance work is not necessary.

6.1 Cleaning

Fixed cleaning intervals are not specified. The frequency of cleaning depends on the conditions of use at your location.

Caution
Glare and eye irritation

- Clean the Checkbox only in the switched-off state.

With plastic parts, do not use solvent-containing or abrasive cleaning agents, which can damage the surfaces. Use only mild cleaning agents free of solvents.

- Remove dirt from the housing, operating elements and conveyor belt with a soft moist cloth.

Note
Faultless functioning of the Checkbox optics can only be guaranteed if the glass surfaces are clean and not scratched. Make sure that the glass surfaces are not scratched; do not use any abrasive cleaning agents.

Clean the glass surfaces on the prism supports if they are dirty or if there are dirt deposits on them:

- With clean, unlubricated compressed air
- With a soft, moist cloth and non-abrasive cleaning agents.

You will then avoid damage which could lead to malfunctioning of the Checkbox.

6.2 Replacing the prism module

Caution
Glare and eye irritation
- Only operate with correctly mounted prisms.

If the prism module has been mechanically damaged, a replacement may be required. Scratches or dents in the glass can impair operation.

Check the line display in the “Grey value line” window with the CheckKon software before and after the replacement. This allows you to assess whether the new prism module satisfies the requirements of your application after mounting. Important factors to note are the lower and upper limit of visibility and the brightness level.

Replace the prism module as follows:

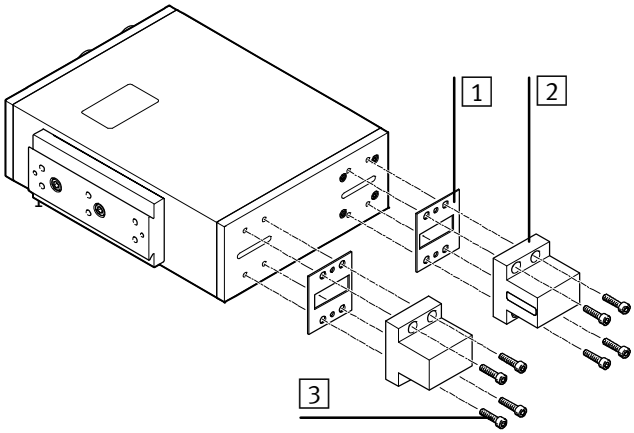


Fig. 6/1: Prism module

1. Remove the screws (3). Leave the sealing rings in place.

2. Remove the prism supports (2) and sealing elements (1).
3. Mount new prism supports and sealing elements.
4. Lightly secure the prism supports in place with the screws.
5. First, align the prism supports on the illumination side and the sensor side so they are roughly perpendicular and central to the outer lines of the housing, and then lightly tighten the screws.

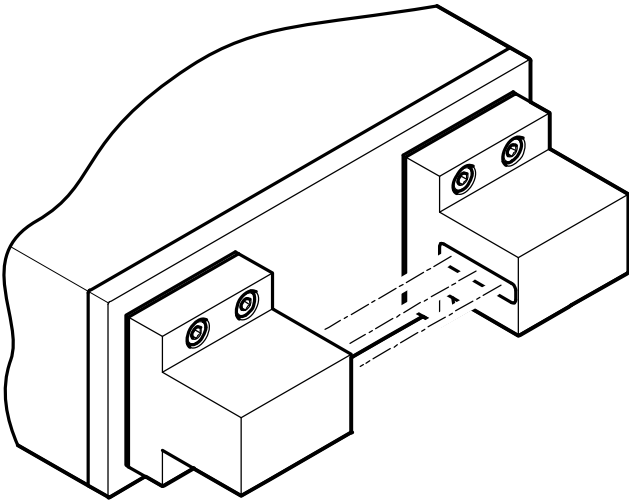


Fig. 6/2: Incidence of light on the sensor

6. Align the prism support on the illumination side so that the light falls centrally on the prism on the sensor side; hold a piece of paper in front of the prism on the sensor side, for example, to facilitate this. Then screw the prism in place on the illumination side.
7. Screw the prism support in place on the sensor side.
8. Check the line display with CheckKon.

If the line display is not optimal:

9. Loosen the screws on the sensor side slightly.
10. Twist and/or move the prism support slightly.
11. Repeat steps 7 and 8.

Technical appendix

Appendix A

Contents

A.1 Operating malfunctions

A.1.1 General fault finding

Problem	Cause	Action
Device does not function, both illuminated push-buttons are flashing.	Ambient, setting, data or hardware fault	1. Identify fault coding in appendix A.1.2. 2. Eliminate fault. 3. Acknowledge with the Start/Stop button.
Good inspection parts are sorted as defective parts.	– Tolerance set too low – Incorrect check program selected or incorrect parts types supplied	– Increase tolerance and repeat Teach procedure with more sample parts.
		– Select the correct check program.
Defective inspection parts are accepted as good parts by the device.	– Tolerance is set too high – Deviations are not recognisable for the Checkbox	– Reduce tolerance – with CheckOpti: Optimize the Teach data
– CTR display – Good parts are blown back into the small parts conveyor in all orientations.	The preselected counter status is reached and is not reset by the external controller.	– Check connection to controller. – Check PLC program in the controller.
– Response time point/duration of the actuators is not correct.	Checkbox runs in the diagnostic mode	– with CheckKon: Switch from the diagnostic mode to the operating mode, or – Conclude CheckKon/ CheckOpti.

Tab. A/1: Faults and remedies

A.1.2 Fault messages and warnings

The Checkbox stops automatically if there is a malfunction. When the cause of the malfunction has been eliminated, error messages/warnings must be acknowledged before the Checkbox can start again.

1. Eliminate cause of malfunction
2. Acknowledge error message: Press the Start/Stop button
3. Start Checkbox: Press the **Start**/Stop button

Faults are displayed depending on the customer-specific design of the Checkbox or configuration with CheckKon (see following table):

Note
If fault messages and warnings are deactivated, undefined operating states and malfunctioning can occur in the event of a fault. Before deactivating, check whether additional measures are necessary for avoiding faults.

Code	Cause	Action
The error messages marked in grey can be activated/deactivated with CheckKon.		
1	External fault	– Check signal at PLC connection, input “External fault”: HIGH = no external fault LOW = external fault
2	Visual fault: – Glass surfaces on the prism supports are dirty or defective – Jam of parts in front of the visual channel	– Remove dirt with a soft cloth and non-abrasive cleaning agent or blow dirt off the glass surfaces with unlubricated compressed air – If the glass surfaces are defective: Consult your Festo Service
	– Glass surface misted due to large differences in temperature between Checkbox and the environment	– Avoid large differences in temperature
	– The camera registers the lower range of the transporting device	– With CheckKon: Correct the setting of the picture limits Correct the line rate or increase the encoder frequency/ line frequency ratio
	– Maximum parts length exceeded	
5	Material jam: The Checkbox has not received any conveyed parts for at least 30 seconds[1)] 1) Duration variable, can be set with CheckKon	– With manual feed: Acknowledge faults, supply further inspection parts or stop the Checkbox. – With automatic supply: Fill up small parts conveyor, check feed path for material jam, acknowledge fault.
6	Maximum permitted parts length exceeded. This is only displayed if the corresponding error handling function is switched on in CheckKon.	– With CheckKon: Set the parameter “Max. parts length” correctly – Set the conveyor device so that the parts follow each other at a recognizable distance.
7	Max. number of forced terminations exceeded. This is only displayed if the corresponding error handling function is switched on in CheckKon.	– With CheckKon: Set the parameter “Max. number of forced interruptions” correctly

Code	Cause	Action
8	Only for operation with encoder: Transporting device blocked or encoder does not turn.	Checkbox has no control over the conveyor device – Check the mounting and installation of the encoder.
12	Inner temperature outside the permitted range.	– Check ambient temperature – Avoid heating from outside, e.g. from sun radiation
14	Only for operation with encoder: Conveyor speed for the set encoder frequency/line frequency ratio of the camera too high.	– Reduce conveyor speed – With CheckKon: Adapt encoder frequency/line frequency ratio
16	Parts rate too high (for evaluation).	– Reduce conveyor speed – Reduce parts rate – Simplify the inspection task of the active check program
17	Parts rate too high (for processing).	– Reduce conveyor speed – Reduce parts rate – Reduce line rate or increase encoder frequency/line frequency ratio
18	Conveyed part has missed the actuator position.	– Arrange the actuator positions according to the part lengths to be tested at a sufficient distance from the Checkbox For operation without encoder: – With CheckKon: Set the “Speed” parameter correctly For operation with encoder: – With CheckKon: Set the parameter “Encoder pulses per 1 mm transport path” correctly
20	The nominal orientation cannot be distinguished from other orientations, because e.g.: – The parts orientations were swapped by mistake during the Teach procedure, or – The nominal orientation is too similar to other orientations.	– Repeat Teach procedure. Pay attention to the positioning of the sample parts in accordance with the orientation shown. – Optimize Teach data with the CheckOpti software.
40	Check program cannot be read/found.	– Delete the check program with the CheckKon software and repeat the Teach procedure

Code	Cause	Action
43	Check program is not compatible with the firmware. At least one of the following checks has not been passed: – Check program may be used with the firmware version – Settings for the tools are compatible with the firmware version	– Use a compatible Teach data format – Repeat the Teach procedure.
45	Check program could not be activated/loaded.	– New attempt after Stop
46	Insufficient memory, operation cannot be executed.	– Reduce the size of the active test program
50	Supply voltage fault: The fault occurs when the supply voltage drops below the minimum value for at least 10 ms. During this period of 10 ms, the behavior of the outputs is undefined, as their output voltages are directly dependent on the supply voltage.	– Make sure the power supply is stable
51	Overload: – Transgression of the maximum permissible output current at a minimum of one of the outputs – Transgression of the maximum permissible resultant current at one of the outlet ports: Actuator, Buffer or PLC – Transgression of the maximum permissible resultant current of all outputs	– Check the max. load current at the outputs

Tab. A/2: Error codes

Other error states

Error status	Cause	Action
...BUF, although the buffer zone is not full. Good parts are blown back into the small parts conveyor in all orientations.	– Control line is defective or incorrect pin assignment at the BUFFER/FEEDER connection – Incorrect sensor type is set.	– Make sure that circuitry is correct at the BUFFER/ FEEDER connection – With CheckKon: Change sensor type.
...Error 2, although the conveyed part length is shorter than maximum length permitted.	– Conveyed part has lots of holes or is semi-transparent – Conveyor speed has been changed.	With CheckKon: – Increase conveyor speed – Increase exposure time, division factor – Vary the grey-value threshold – Limit field of vision of camera – Activate filter function.
...Error 2 appears in the morning although the Checkbox functioned faultlessly the day before.	– High fluctuations in temperature e.g. between day and night – Transporting device has been replaced.	– With CheckKon: Set the picture limits.

Tab. A/3: Other error states

A.2 Status displays on the device

Pushbutton	Status		Significance
START/STOP		Continuous red light	Checkbox is in the – RUN mode or – TEACH mode
		Continuous green light	Checkbox is ready to operate (Stop status)
STATUS/TEACH		Flashes yellow	New part passes the camera
START/STOP STATUS/TEACH	 	Flashes red Flashes yellow	Malfunction

Tab. A/4: Illuminated pushbutton

A.3 Examples for calculation of the features

A.3.1 Band width and tolerance

The band width B specifies how far the value of the feature may vary upwards or downwards.
The tolerance T specifies the percentage increase in the band width of each feature, related to the average value of the feature.

$$C_{max\,tol} = C_{max} + A \times \frac{T}{100}$$

$$C_{min\,tol} = C_{min} - A \times \frac{T}{100}$$

$$B = C_{max\,tol} - C_{min\,tol}$$

$$= C_{max} - C_{min} + \frac{2 \times T \times A}{100}$$

$$\rightarrow T = \frac{B - (C_{max} - C_{min})}{2 \times A} \times 100$$

A	Average value of the feature
B	Band width
C_{max}	Feature maximum
$C_{max\,tol}$	Upper limit of the band width incl. tolerance
C_{min}	Feature minimum
$C_{min\,tol}$	Lower limit of the band width incl. tolerance
T	Tolerance

Example

Ascertaining the band width for the feature “Length” of a conveyed part with a set tolerance of 5 %.

Conveyed part lengths [mm] ascertained during the Teach procedure for 5 sample parts: 60 60 61 65 60

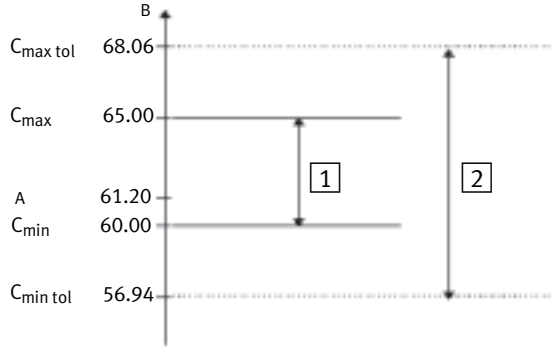
This means:

A	= 61.2 mm	Average value of the length
C_{max}	= 65 mm	Length, maximum
C_{min}	= 60 mm	Length, minimum
T	= 5 %	Tolerance

$$B = C_{max} - C_{min} + \frac{2 \times T \times A}{100}$$

$$B = (65 - 60) + \frac{2 \times 5 \times 61,2}{100}$$

$$B = 11,12$$



1 Band width of the conveyed part length

2 Band width at 5 % tolerance

Result: All conveyed parts with a length of 57 ... 68 mm are classified as good parts. The Checkbox ascertains appropriate value ranges for each feature.

A.3.2 Scatter of characteristics

$$S = \frac{C_{max} - C_{min}}{A} \times 100\ \%$$

A	Average value of the feature
C_{max}	Feature maximum
C_{min}	Feature minimum
S	Scatter of characteristics

Example

Ascertaining the scatter of characteristics for the feature “Length” of a conveyed part.

The following values are taken from the example “Band width”:

A	= 61.2	Average value of the length
C_{max}	= 65	Length, maximum
C_{min}	= 60	Length, minimum

$$S = \frac{65 - 60}{61,2} \times 100\ \%$$

$$S = 8,2\ \%$$

A.3.3 Inspection part deviation

Calculating the deviation D for C ‹ A

$$D = \frac{C_{actual} - A}{C_{min\ tol} - A} \times 100\ \%$$

A	Average value of the feature
C_{actual}	Current feature measurement
$C_{min\ tol}$	Lower limit of the band width incl. tolerance
D	Feature deviation

Example

Ascertaining the deviation for the current feature “Length” of a conveyed part C_{actual} = 61 (C ‹ A)

The following values are taken from the example “Band width”:

A	= 61.2	Average value of the length
$C_{min\ tol}$	= 56.94	Length, lower limit
C_{actual}	= 61	Length, current value

$$D = \frac{61 - 61,2}{56,94 - 61,2} \times 100\ \%$$

$$D = 4,7\ \%$$

Calculating the deviation D for C › A

$$D = \frac{C_{actual} - A}{C_{max\ tol} - A} \times 100\ \%$$

A	Average value of the feature
C_{actual}	Current feature measurement
$C_{max\ tol}$	Upper limit of the band width incl. tolerance
D	Feature deviation

Example

Ascertaining the deviation for the current feature “Length” of a conveyed part C_{actual} = 64 (C › A)

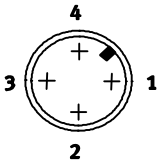
The following values are taken from the example “Band width”:

A	= 61.2	Average value of the length
$C_{max\ tol}$	= 68.06	Length, upper limit
C_{actual}	= 64	Length, current value

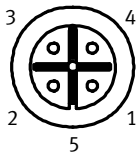
$$D = \frac{64 - 61,2}{68,06 - 61,2} \times 100\ \%$$

$$D = 40,8\ \%$$

A.4 Connections

Pin	24 V DC connector plug	
1	Do not connect	
2	+ 24 V DC, -15 % / +20 %; protect with 4 A fast-acting fuse	
3	GND	
4	FE	

Tab. A/5: 24 V DC connector plug

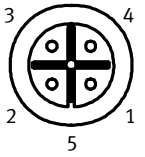
Pin	BUFFER/FEEDER connector socket	
O/1	24 V DC/Box ready – Reference voltage for sensors, switched off in Stop status – Operating status – Control for transporting device	
O/2	Feeder Control of the supply system (small parts conveyor)	
3	GND Reference voltage for sensors	
I/4	Buffer zone sensor 1	
5	Do not connect	

Tab. A/6: BUFFER/FEEDER connector socket

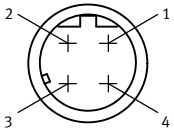
Direct connection can also be made with a Festo Duo cable (accessories ➔ www.festo.com/catalogue).

DUO cable marking	
Signal x	Buffer zone sensor 1
Signal x + 1	Small parts conveyor (feeder)

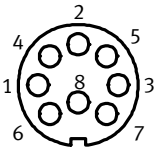
Tab. A/7: DUO cable marking

Pin	ACTUATORS connection socket	
O/1	Actuator 3	
O/2	Actuator 2	
3	GND	
O/4	Actuator 1	
5	Do not connect	

Tab. A/8: ACTUATORS connection socket

Pin	Signal	M12 Ethernet connection socket [1]	
1	TD+	Transmitted data +	
2	RD+	Received data +	
3	TD-	Transmitted data –	
4	RD-	Received data –	
Metal covering		Screening (shield)	
[1] d-coded			

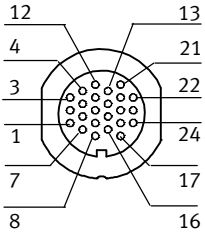
Tab. A/9: Ethernet connector plug

Pin	ENCODER connector socket [1]	
1	A+	
2	n.c.	
3	B+	
4	A-	
5	B-	
6	5 V supply [2]	
7	GND	
8	n.c.	

[1] Interface for rotary pulse generator as per RS 485 specification
[2] Maximum power rating 180 mA

Tab. A/10: ENCODER connector socket

PLC connector socket



Pin	Cable colour	Signal	Function
O/1	White	OUT24_Act1	Actuator 1
O/2	Brown	OUT24_Act2	Actuator 2
O/3	Green	OUT24_Act3	Actuator 3
4	Yellow	GND_NT	0 V / reference voltage for buffer zone sensors
I/5	Grey	IN24_TypeSel1	External program selection: Bit 1
I/6	Pink	IN24_Ext_Start	Save the Start/Stop mode and the Teach data

PLC connector socket				
O/7	Blue	OUT24_PLC_Power	Reference voltage +24 V DC (Signal level after Boot procedure = HIGH)	
O/8	red	OUT24_Feeder	Controlling the small parts conveyor	
I/9	Black	IN24_Res4	Do not connect	
I/10	Violet	IN24_Ext_Sensor	External sensor 1)2)	External program selection: Bit 3
I/11	Grey/pink	IN24_Key_Inhibit	Button lock	
I/12	Red/blue	IN24_Jam1	Buffer zone sensor 1	
I/13	White/green	IN24_Jam2	Buffer zone sensor 2 1)	External program selection: Bit 2
O/14	Brown/green	OUT_24_Res3	Do not connect	
I/15	White/yellow	IN24_Res1	Do not connect	
O/16	Yellow/brown	OUT24_Res2	Do not connect	
O/17	White/grey	OUT24_Error	Fault status 1: “Fault” status signal	
I/18	Grey/brown	IN24_Counter-Rst	Start new counting cycle	
I/19	White/pink	IN24_Ext-Fault	External fault E01 1)	
I/20	Pink/brown	IN24_TypeSel0	External program selection: Bit 0	
O/21	White/blue	OUT24_BOX_READY	24 V DC reference voltage for buffer zone sensor / ready status / control of the transporting device	
O/22	Brown/blue	OUT24_Counter-fin	Target number reached	Actuator 4
O/23	White/red	OUT24_Warning	Fault status 0: “Warning” status signal 1)	
O/24	Brown/red	OUT24_Res1	Do not connect	

1) Functions with a grey background have been deactivated at the factory and can be activated and adapted with CheckKon.
2) The counting function and the special function “External sensor” cannot be used at the same time.

Tab. A/11: PLC connector socket

Internal wiring			Function
ACTUATORS		**PLC**	
3	●—●	4	GND
O/4	●—●	O/1	Actuator 1
O/2	●—●	O/2	Actuator 2
O/1	●—●	O/3	Actuator 3
---	●—●	O/22	Actuator 4[1)] / Counter reached
BUFFER/FEEDER		**PLC**	
O/1	●—●	O/21	– 24 V reference voltage for buffer zone sensors – Ready for operation – Control of the transporting device
O/2	●—●	O/8	24 V power output for controlling a small parts conveyor (feeder)
3	●—●	4	0 V reference voltage for buffer zone sensors
I/4	●—●	I/12	Buffer zone sensor 1
---		I/13	Buffer zone sensor 2
[1)] If the counting function is deactivated, the output of actuator 4 is available at the PLC connection.			

Tab. A/12: Internal wiring of the connections

A.5 Technical data

General information	
Temperature ranges – Ambient temperature – Storage temperature	 –5 °C ... +50 °C with 1 A load –5 °C ... +45 °C with 3 A load [1)] –20 °C ... +70 °C
Ambient conditions	Dry Screened from extreme external light sources Cleanest possible ambient air
Protection against electric shock (Protection against direct and indirect contact)	PELV (Protective Extra-Low Voltage)
CE marking (see declaration of conformity)	In accordance with EU EMC Directive
Max. permissible I/O signal line length	30 m
Max. permissible Ethernet signal line length	70 m
Vibration and shock – Vibration resistance – Shock resistance	 Severity level 2 in acc. with EN-60068 Part 2-6 / FN 942017-4 Severity level 2 in acc. with EN-60068 Part 2-27 / FN 942017-5
Protection class (plug connector inserted or provided with protective cap)	IP64
Electrical data – Nominal DC operating voltage – Permissible voltage fluctuations – Current consumption with load-free outputs – Internal fuse protection	 24 V -15 % / +20 % 400 mA 4 A fuse
Interfaces – Connection for encoder – Ethernet connection	according to RS 485 specification Ethernet interface 100 MBit/s
[1)] Observe chapter 2.2 **“Mounting”, “Temperature”** section	

Tab. A/13: Technical data: General

Dimensions	
Height (without plug)	241 mm
Width	60 mm
Length	164 mm
Inside passage of the visual channel	59.2 mm
Inside height of the visual channel	40 mm

Tab. A/14: Technical data: Dimensions

Electrical properties of the I/O signals	
Outputs	– All outputs electronically limited to max. 700 mA – Max. resultant current at “PLC” connection: 0.9 A – Max. resultant current at the Actuator, Buffer connections: 1.9 A – Max. resultant current of all outputs: 3 A

Tab. A/15: Technical data: Electrical properties

Camera and lighting	
Resolution	2048 pixels or 14 µm * 14 µm
Line rate	1000 ... 8500 Hz

Tab. A/16: Technical data: Camera and lighting

Properties of conveyed parts	
Component range	Rotationally symmetrical parts and pre-oriented parts of any shape
Min. part length	1 mm
Max. part length	Dependent on belt speed and required resolution
Part diameter	0.5 ... 25 mm

Tab. A/17: Technical data: Features of conveyed parts

A.6 Accessories

Please select the appropriate accessories from our catalogue (www.festo.com/catalogue).

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Appendix B

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