Vision Sensor

SBSI/SBSC-EN

FESTO

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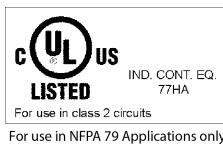
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First publication 2014

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For use in class 2 circuits

For use in NFPA 79 Applications only

Open Source License

The SBS Software makes use of a couple of third party software packages that come with various licenses. This section is meant to list all these packages and to give credit to those whose code helped in the creation of the SBS Software.

For components that reference the GNU General Public License (GPL) or the GNU Lesser General Public License (LGPL), please find these licenses and the written offer for source code in this software installation in \Festo\SBS vision sensor\Eula\OpenSourceLicenses.

The SBS firmware makes use of Linux Version 2.6.33 (Website: www.kernel.org), which is distributed under the GNU GPL version 2.

The SBS firmware makes use of x-loader, an initial program loader for Embedded boards based on OMAP processors (Website: http://arago-project.org/git/projects/?p=x-load-omap3.git; a=summary) which is distributed under the GNU GPL version 2 or higher.

The SBS firmware makes use of u-boot, an initial program loader for Embedded boards based on OMAP processors (Website: http://arago-project.org/git/projects/?p=x-load-omap3.git; a=summary) which is distributed under the GNU GPL version 2 or higher.

The SBS firmware makes use of spike Version 0.2, a SPI-driver (Website: https://github.com/scottellis/spike/blob/master/spike.c), which is distributed under the GNU GPL version 2 or higher.

The SBS firmware makes use of Busy-Box Version 1.18.1 (Website: http://www.busybox.net/), which is distributed under the GNU GPL version 2 or higher.

The SBS firmware makes use of vsftpd Version 2.0.3 (Website: https://security.appspot.com/vsftpd.html), which is distributed under the GNU GPL version 2 or higher.

The SBS firmware makes use of mtd-utils Version 1.5.0 (Website: http://www.linux-mtd.infradead.org/doc/general.html), which is distributed under the GNU GPL version 2 or higher.

The SBS firmware makes use of Boa Webserver Version 0.94.13 (Website: http://www.boa.org/), which is distributed under the GNU GPL version 2 or higher.

The SBS firmware makes use of Procps Version 3.2.8 (Website http://procps.sourceforge.net/download.html), which is distributed under the GNU GPL version 2 or higher and GNU LGPL version 2.1 or higher.

The SBS firmware makes use of GnuPG Version 1.4.10 (Website: https://www.gnupg.org/), which is distributed under the GNU GPL version 3 or higher.

The SBS firmware makes use of glibc, which is distributed under GNU LGPL version 2.1 or higher.

The SBS firmware makes use of Dropbear - a SSH2 server Version 2012.55 (Website: https://matt.ucc.asn.au/ dropbear/dropbear.html). The Dropbear SSH2 server is distributed under the terms of the Dropbear License which is a MIT/X Consortium style open source license. Please find this license in this software installation in \Festo\SBS vision sensor\Eula\OpenSourceLicenses.

Vision Sensor Configuration Studio software is based in part on the work of the Qwt project (http://qwt.sf.net).

Vision Sensor Device Manager, Vision Sensor Configuration Studio, Rescue software is based in part on the work of the Qt-project (https://doc.qt.io/qt-5/licenses-used-in-qt.html).

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Table of Contents

1 Safety notes

Before starting the SBS vision sensor, read these instructions carefully, ensure that you have understood them and comply with them at all times. The SBS vision sensor should only be connected by a qualified electrician.
Do not tamper with or make alterations on the unit!
The SBS vision sensor is not a safety-critical component and its use is prohibited under conditions where the safety of persons may depend on its function.
The IP address set for the SBS vision sensor should be marked on the enclosed label. After installation, stick the label on the sensor in a clearly visible position. The IP address of the SBS vision sensor must be used once only in any network.
For use with any listed (CYJV) cable assembly.

2 Components supplied

- SBS vision sensor including integrated illumination (or as version with C-Mount lens without illumination)
- Mounting instruction, mounting clamp, allen key, screwdriver, protective cap for Ethernet plug and protective cap for Data plug (if available).

3 Intended Use

3.1 Field of application

The SBS vision sensor is an optical sensor and uses several evaluation methods (detectors) according to the version. The product is designed for industrial use only. In residential areas it is possible that additional measures for noise suppression must be done.

Object:
The SBS vision sensor precisely detects faulty parts, parts in the wrong place, at the wrong angle or in the wrong order or a combination of all of these. Several detectors are available for inspection tasks and interpretation: e.g. Pattern matching, Contour, Brightness, Gray level, Contrast, Caliper or BLOB. The Advanced-version of the SBS vision sensor also offers alignment. All interpretation is carried out relative to the actual position and angle of the part without having to define an independent characteristic for each possible position. All interpretation is carried out relative to the actual position and angle of the part without having to define an independent characteristic for each possible position.
The Advanced-version offers also the calibration in world coordinates for measurement- and robot applications.

Code Reader:
Identification of products, components or packaging from printed or directly marked – punched or laser-etched – codes is common practice in many sectors of industry today. The Code Reader fromFesto immediately detects which part is in front of it: it can easily read numerous types of barcodes as well as printed and directly marked data matrix codes according to ECC 200 standard and this on any base (metal, plastic, paper, glass). The sensor can even routinely decipher askew or warped codes or codes on convex, reflective or transparent surfaces. The Code Reader assesses the quality of your printed or directly marked data matrix codes using standardised ISO and AIM quality parameters. This enables you to introduce early correctional measures and thus avoid rejects due to illegible codes. In addition, the sensor can also read directly printed fonts with the detector plain text reading.

Color:
The SBS Color offers powerful object detection in combination with color detection. This leads to an increased stability in several object detection applications as well as the possibility to sort colored parts which would have a similar look in gray image. Beside this even active objects (like e.g. lighting LED´s) or "non colors" like black and white can be detected.

Universal:
In the SBS Universal all functions of SBS Object, Code Reader and Color are available in combination in one device.

The SBS vision sensor range is an economic alternative to conventional image processing systems.

3.2 Requirements for use

Configuration of the SBS vision sensor requires a standard PC / notebook (at least Pentium 4, 1 GHz and 1 GB RAM), with Microsoft Windows 7, Windows 8.1 or Windows 10 with network connection with RJ-45 socket and a network with TCP-IP protocol. We recommend a Pentium 4 Dual Core › 2 GHz and 2 GB RAM, for Windows 7 or Windows 10. We recommend a screen resolution of minimum 1024 x 768 pixels. A basic knowledge of computers is also required. The SBS vision sensor is supplied with the IP address 192.168.100.100 and a subnet mask 255.255.255.0. The SBS vision sensor is operated independently of a PC or PLC. A PC / notebook is only necessary for configuration of the SBS vision sensor. Attention must be paid to sufficient and constant object illumination to ensure reproducible results and avoid malfunction. Reflections or varying incident light may affect detection results. If necessary, use an external light source and / or light-screening / shrouding devices to exclude incident light.

3.3 Functions overview

3.3.1 Characteristics SBS vision sensors: Universal

Function	Monochrome Advanced
Frames per second	40
Number of jobs	255
Alignment Number of jobs	X
Calibration in world coordinates	X
• Scaling (Measurement)	X
• Calibration plate (Measurement)	X
• Point pair list (Robotics)	X
Number of detectors	255
• Pattern matching (X-, Y- translation)	X
• Contour (X-, Y- translation and rotation)	X
• Gray level	X
• Contrast	X
• Brightness	X
• Caliper	X
• BLOB	X
• Datacode	X
• Barcode	X
• OCR	X

Function	Monochrome Advanced
• Color value	
• Color area	
• Color list	
4 digital outputs, 2 inputs, PNP or NPN	X
Free definable digital In- / Outputs, PNP or NPN	4
Free shape of ROI	X
Timeout, specified time response	X
Variable resolutions	X
Illumination quadrant controlled	X
Image recorder	X
Encoder input	X
Ethernet	X
PROFINET	X
RS422 / RS232	X
EtherNet/IP	X
Sensor monitoring by Viewer, Job-Upload	X
Sensor monitoring by SBSxWebViewer (Webviewer)	X
I/O- Extension (with Encoder-control / Profibus- Interface)	X
R3B integrated 6 / 12 mm	
R2B integrated 12 mm	
Version with C-Mount	X

3.3.2 Characteristics SBS vision sensors: Color

Function	Standard	Advanced
Frames per second	40	40
Number of jobs	8	255
Alignment	Contour only	X
Calibration in world coordinates		X
• Scaling (Measurement)		X
• Calibration plate (Measurement)		X
• Point pair list (Robotics)		X
Number of detectors	32	255
• Pattern matching (X-, Y- translation)		X
• Contour (X-, Y- translation and rotation)		X
• Gray level		X
• Contrast	X	X
• Brightness		X
• Caliper		X
• BLOB		X
• Datacode		
• Barcode		
• OCR		
• Color value		X
• Color area	X	X
• Color list		X

Function	Standard	Advanced
4 digital outputs, 2 inputs,	X	X
Free definable digital In- / Outputs, PNP or NPN	2	4
Free shape of ROI	Contour only	X
Timeout, specified time response	X	X
Variable resolutions	X	X
Illumination quadrant controlled	X	X
Image recorder	X	X
Encoder input		X
Ethernet	X	X
PROFINET	X	X
RS422 / RS232		X
EtherNet/IP	X	X
Sensor monitoring by Viewer, Job-Upload	X	X
Sensor monitoring by SBSxWebViewer (Webviewer)	X	X
I/O- Extension (with Encoder-control / Profibus- Interface)		X
R3B integrated 6 / 12 mm	X / X	X / X
R2B integrated 12 mm		X
Version with C-Mount		X

3.3.3 Characteristics SBS vision sensors: Object

Function	Standard	Advanced
Frames per second	50	50
Number of jobs	8	255
Alignment	Contour only	X
Calibration in world coordinates		X
• Scaling (Measurement)		X
• Calibration plate (Measurement)		X
• Point pair list (Robotics)		X
Number of detectors	32	255
• Pattern matching (X-, Y- translation)	X	X
• Contour (X-, Y- translation and rotation)	X	X
• Gray level	X	X
• Contrast	X	X
• Brightness	X	X
• Caliper		X
• BLOB		X
• Datacode		
• Barcode		
• OCR		
4 digital outputs, 2 inputs, PNP or NPN	X	X

Function	Standard	Advanced
Free definable digital In- / Outputs, PNP or NPN	2	4
Free shape of ROI	Contour only	X
Timeout, specified time response	X	X
Variable resolutions	X	X
Illumination quadrant controlled	X	X
Image recorder	X	X
Encoder input		X
Ethernet	X	X
PROFINET	X	X
RS422 / RS232		X
EtherNet/IP	X	X
Sensor monitoring by Viewer, Job-Upload	X	X
Sensor monitoring by SBSxWebViewer (Webviewer)	X	X
I/O- Extension (with Encoder-control / Profibus- Interface)		X
R3B integrated 6 / 12 mm	X / X	X / X
R2B integrated 12 mm		X
Version with C-Mount		X

3.3.4 Characteristics SBS vision sensors: Code Reader

Function	Standard	Advanced
Frames per second	50	50
Number of jobs	8	255
Alignment		X
Calibration in world coordinates		
• Scaling (Measurement)		
• Calibration plate (Measurement)		
• Point pair list (Robotics)		
Number of detectors	2	255
• Pattern matching (X-, Y- translation)		X
• Contour (X-, Y- translation and rotation)		
• Gray level		X
• Contrast		X
• Brightness		X
• Caliper		
• BLOB		
• Datacode	X	X
• Barcode	X	X
• OCR		X
4 digital outputs, 2 inputs, PNP or NPN	X	X

Function	Standard	Advanced
Free definable digital In- / Outputs, PNP or NPN	2	4
Free shape of ROI		X
Timeout, specified time response	X	X
Variable resolutions	X	X
Illumination quadrant controlled	X	X
Image recorder	X	X
Encoder input		X
Ethernet	X	X
PROFINET	X	X
RS422 / RS232	X	X
EtherNet/IP	X	X
Sensor monitoring by Viewer, Job-Upload	X	X
Sensor monitoring by SBSxWebViewer (Webviewer)	X	X
I/O- Extension (with Encoder-control / Profibus-Interface)	X	X
R3B integrated 6 / 12 mm	X / X	X / X
R2B integrated 12 mm	X	X
Version with C-Mount		X

4 Installation

4.1 Mechanical Installation

To ensure maximum accuracy of detection, the SBS vision sensor should be protected from vibration. Secure the supply and I/O cables with cable binders to prevent crushing or slipping. Select a position for the SBS vision sensor in which interfering factors such as slight differences in the position of the object or variations in illumination have little or no effect. Screw the SBS vision sensor onto the mounting clamp (supplied with the unit) and then onto a suitable object. Use only the Mounting bracket SBAM-C6-CP (no. 8031376) or the Mounting hinge SBAM-C6-A2-AF (no. 8058739).

4.1.1 Arrangement for dark-field illumination

For the prevention of direct reflections and accentuation of edges etc.
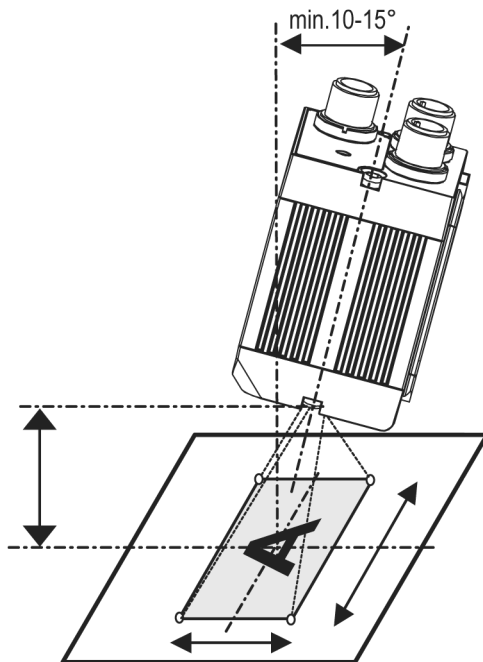
Fig. 1: Arrangement for dark-field illumination

4.1.2 Arrangement for bright-field illumination

For transmitted light / measuring tasks or for the accentuation of highly-reflective objects
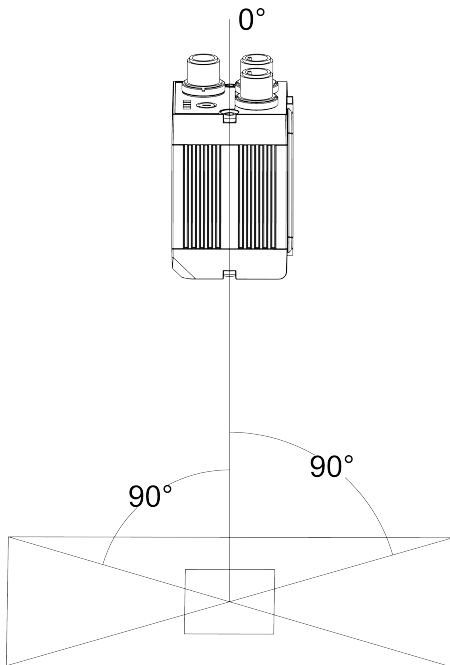
Fig. 2: Arrangement for bright-field illumination

Observe the object clearance given in the table Field of View / Working Distance.

Fine adjustment

⚠️ **Attention:**
Fine adjustment of the SBS vision sensor should not be carried out until after electrical connection and start-up (PC software installation).

4.1.3 Alignment for a vertical illumination

In order to assure the absolutely vertical alignment of the SBS to the object surface, put a piece of reflective foil or a mirror on top of the object and start the SBS operating software. For an image that is continually updated, select trigger mode "Free run" and image update: "Continuous". Then align the sensor to the reflective surface / the mirror as vertical as possible until the integrated illumination LEDs are directly dazzling in the image of the user interface (). Arrangement see Figure in chapter: Arrangement for bright-field illumination (Page 26)
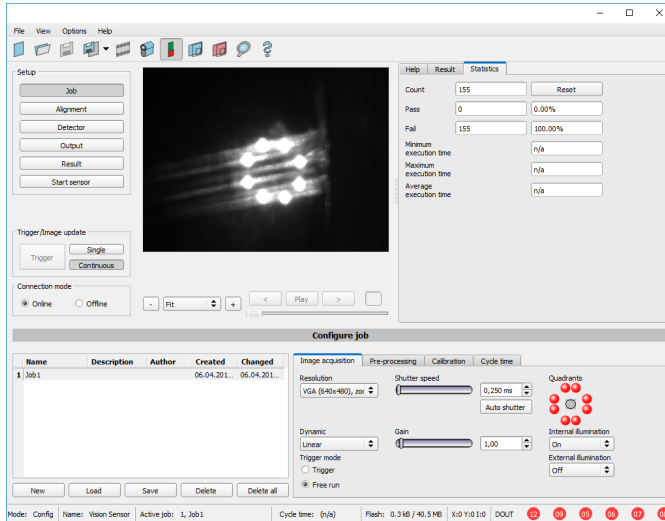
Fig. 3: Alignment for a vertical illumination

4.1.4 Assembly SBS - Mounting bracket SBAM-C6-CP
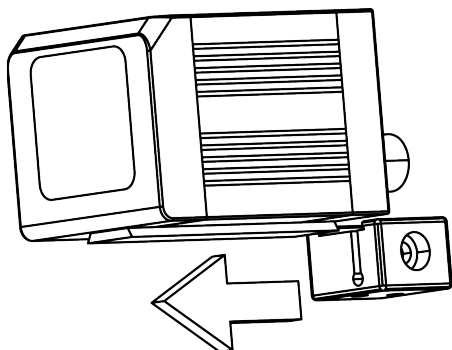
Fig. 4: Assembly SBS – Mounting bracket SBAM-C6-CP

For fixing the SBS vision sensor on a fixing system / machine housing, slide the provided dovetail Mounting bracket SBAM-C6-CP on the dovetail guide at the bottom side of the SBS and fix it at the desired position with the hexagon socket in the cross hole of the mounting bracket. Then additional mounting accessories may be attached to the mounting bracket or any other attachments may be fixed by using the tapped holeFestos in the Mounting bracket SBAM-C6-CP.

4.2 Electrical installation

The electrical installation of the SBS vision sensor must be carried out by a qualified person. When installing the SBS vision sensor, disconnect all electrical components from the power supply. When the unit is being used in a network, ensure that the network address (IP address) of the SBS vision sensor set by the manufacturer at 192.168.100.100 / Mask 24 is free and is not in use for any other unit connected to the system. If necessary, re-set the IP address of the SBS vision sensor as described in the section "Network settings". When the SBS vision sensor is in use, the protective caps supplied must be pushed onto the M12 sockets (data and LAN) which are not in use. For error free operation the length of the connecting cables must not be longer than 30 m. Failure to do this may cause malfunction.

4.2.1 Connection possibilities

For stand-alone operation (independent of PC /PLC) only connection 24 V DC is required afterstart-up.

The following figure shows the back view of the SBS vision sensor:
*A: LED display
*B: Focussing screw
*C: 24 V DC, I/O- M12 connection socket
*D: Data RS422/RS232 M12 socket
*E: LAN M12 connection socket
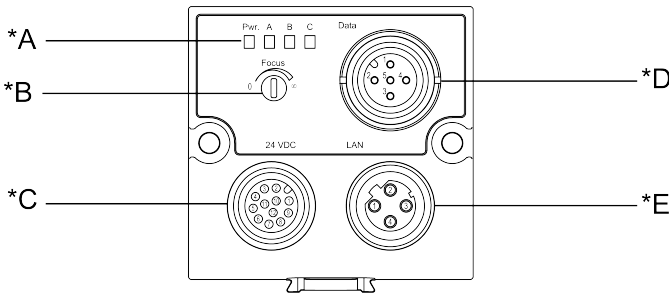
Fig. 5: Connectors SBS
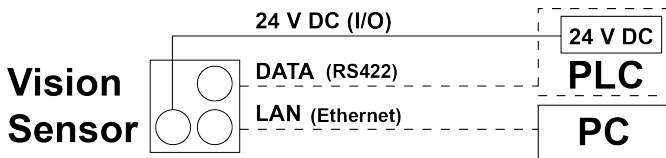
Fig. 6: Connection SBS

4.2.1.1 LED Display

Name	Color	Meaning
Pwr.	green	Operating voltage
A	yellow	Result 1
B	yellow	Result 2
C	yellow	Result 3

All LED´s are set without taking into account any timing function (e.g. Trigger delay)

4.2.1.2 Focus

Focussing screw to adjust focus.
Focus: Clockwise = higher distance
Counter Clockwise = lower distance

4.2.1.3 24 V DC connection

M12 Connection socket for 24 V DC voltage supply and digital I/O.
PIN assignment see: PIN assignment, connection 24 V DC

4.2.1.4 LAN Connection

M12 Connection socket for Ethernet connection.
For the exact plug connection see . PIN assignment, connection LAN
Use only the correct network cables.

4.2.1.4.1 Direct connection of the SBS vision sensor to a PC (recommended)
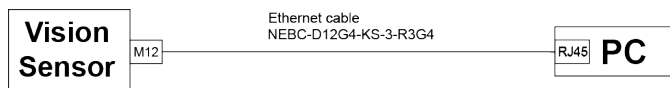
Fig. 7: Direct connection SBS ↔ PC

4.2.1.4.2 Connection of the SBS vision sensor to a PC via a network:
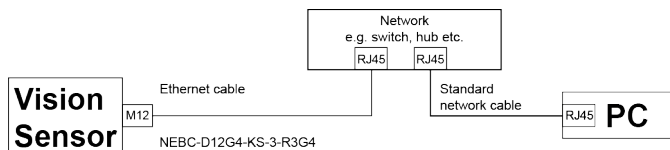
Fig. 8: Connection via a network

4.2.1.5 Data Connection

M12 Connection socket for DATA serial interface.
PIN assignment see: PIN assignment DATA *A)

4.2.1.6 Plug connections

All pin assignments and signals are referring to the view from the sensor.

4.2.1.6.1 PIN assignment, connection 24 V DC

PIN	Color	Use
1	BN	+ Ub (24V DC)
2	BU	GND
3	WH	IN (external trigger)
4	GN	READY [1]
5 [2, 5]	PK	IN/OUT (Advanced: encoder B+)
6 [2, 5]	YE	IN/OUT
7 [2]	BK	IN/OUT, LED B[4]
8 [2]	GY	IN/OUT, LED C[4]
9	RD	OUT (external illumination)
10	VT	IN (Advanced: encoder A+)
11	GYPK	VALID [3]
12	RDBU	OUT (ejector, max. 100mA), LED A[4]

[1] Ready: Ready for next ext. trigger Trigger.
[2] Switchable input- output
[3] VALID: shows available results
[4] All LED´s are set without taking into account any timing function (e.g. Trigger delay)
[5] Not available with all Standard types

For shielded cables use shield, extensively connected.

4.2.1.6.2 PIN assignment, connection LAN

(M12) 4 pin	Signal
1	TxD+
2	RxD+
3	TxD-
4	RxD-

4.2.1.6.3 PIN assignment DATA *A)

PIN	Color	Use RS422	Use RS232
1	brown	RxD+	Rx
2	white	RxD-	NC
3	blue	TxD+	NC
4	black	TxD-	Tx
5	gray	GND	GND

*A) Not with Object-, Color-Standard version

For shielded cables use shield.

4.2.1.6.4 Exemplary connection plan and software settings for the following setup:

- Power supply
- Trigger
- 1x digital output
- Encoder
- Ethernet to PC or PLC
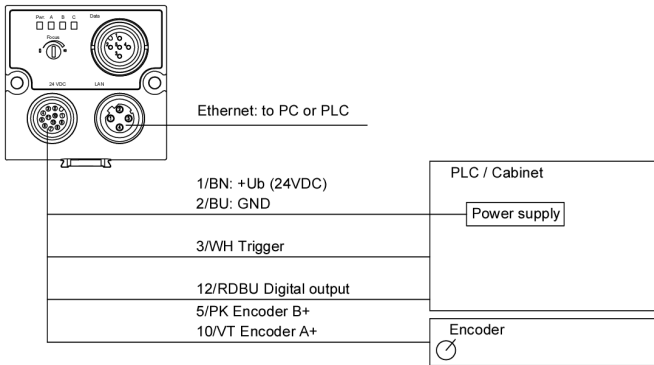
Fig. 9: Exemplary connection plan

4.2.1.6.5 Electrical connection supply voltage and shield
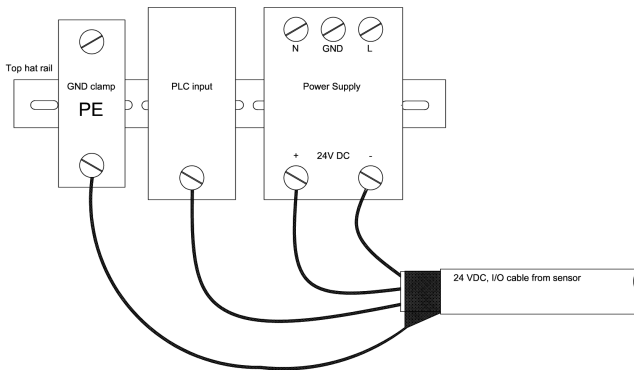
Fig. 10: Electrical connection, supply voltage 24 V DC in cabinet with shield

4.2.1.6.6 Electrical connection PNP / NPN
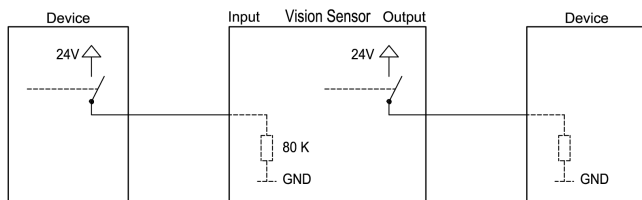
Fig. 11: Connection example SBS in PNP mode. In- / outputs switch to +24 V
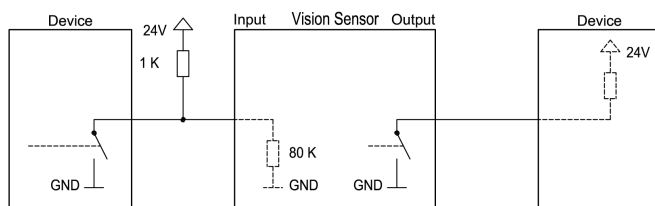
Fig. 12: Connection example SBS in NPN mode

As the inputs refer to ground, an additional pull-up resistor may be required in order to increase the input voltage to 24 V when unswitched. The outputs switch to ground.

4.3 Network settings, Short reference

The following instructions indicate how to change the network configuration of the PC and the SBS vision sensor. If incorrect settings are used, the network connections in the computer may be lost. To be on the safe side, note the former settings for later use if required. Following this procedure, it may be necessary to re-start the system. In order to determine which IP addresses are allowed in your network or locally in your PC, and to carry out the necessary settings on your PC, contact the system administrator beforehand. The illustrations, dialogues and menus originate from the operating system Microsoft WindowsXPTM. The illustrations are similar in other operating systems.

4.3.1 Basic settings for PC and SBS vision sensor

To configure the SBS vision sensor with a PC it is essential that a network board and the TCP/IP LAN- connection is installed on the PC (This also applies when the PC is not connected to a network). The SBS supports the automatic recognition of the Ethernet transmission rate, but 100 MBit at the most. The internet protocol IPv4 must be activated. There are two alternatives to configure and parametrize the SBS vision sensor.

Also see chapter Network connection

4.3.2 Direct Connection - Setting the IP Address of the PC

To connect the SBS vision sensor to a PC via Ethernet the IP addresses of both devices have to correspond. The default IP of the SBS vision sensor is 192.168.100.100 with Subnet mask 24 / 255.255.255.0. To establish a direct connection, the PC must be set to a corresponding, fixed IP address like follows.

1. Click on Start / Control Panel / Network Connection / LAN Connection / Properties, the window "Local Area Connection Properties" opens.

2. In the list "This connection requires following elements" select the option "Internet Protocol (TCP/IP)" and then click the button "Properties".

3. In the following window set the desired IP address of the PC and the sub-network data.

4. Confirm entries with OK.

Example:

The SBS vision sensor is pre-set to IP address 192.168.100.100 and subnet mask 255.255.255.0. In this case, the IP address may be set to any value between 192.168.100.1 and 192.168.100.254, with a subnet mask 255.255.255.0, with the exception of the sensor IP address (192.168.100.100).
To alter the sensor's IP address, see chapter Sensor's network settings (Page 61). Please do also not use the addresses .0 and .255 as these addresses are reserved for network infrastructure devices such as servers, gateways, etc.
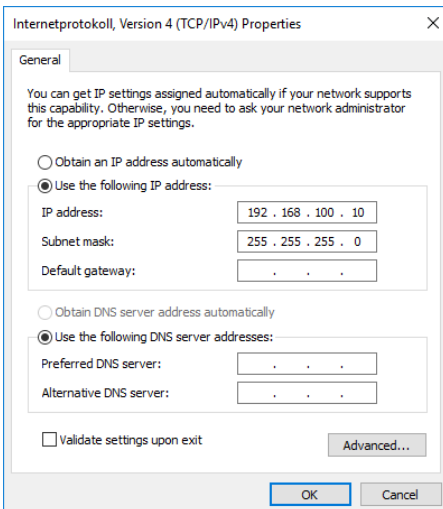
Fig. 13: PC IP Setup

4.3.3 Network Connection - Setting the IP address of the SBS vision sensor

Before connecting the sensor in the network, check with the network administrator whether the sensor's address has already been assigned (default: 192.168.100.100 with subnet mask 255.255.255.0). This can otherwise cause network failure. The set IP address is to be noted on the enclosed SBS vision sensor label. The label is then to be stuck on the sensor in a clearly visible place after installation.

Network connection speed:

The sensor must only be operated with 100MBit/full-duplex when using VGA resolution (or higher) and Vision Sensor Visualisation Studio.

Sensor's IP still free:

Connect sensor to network and then set the sensor's IP to match the PC according to the administrator's specifications, as follows, beginning with 2.

Sensor IP already assigned:

1. First connect sensor and PC directly and set an authorised IP address in the sensor.
2. Connection via the network can then be carried out. First ensure electrical connection and installation of PC software has been completed. To set the IP address on the SBS vision sensor, the following steps are to be carried out in the PC software:
    a. Start Vision Sensor Device Manager.
    b. Select the required SBS vision sensor from the active sensor list.
    c. Set sensor's new IP address with the "Set" button. The IP address is assigned by your system administrator. The PC's IP address is shown in the status bar under the buttons. Please note: some PC's have more than one Ethernet connection i.e. wireless and wired LAN connections.
    d. Select the sensor and connect via Vision Sensor Configuration Studio or Vision Sensor Visualisation Studio.
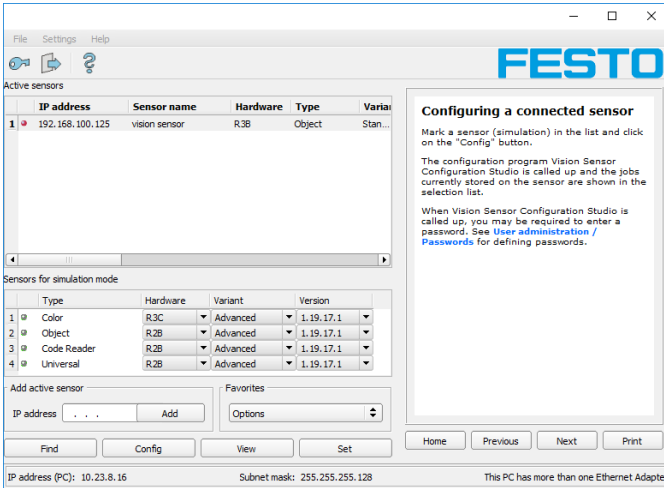
Fig. 14: Vision Sensor Device Manager

Modification of the standard gateway enables operation in different sub-networks. Only alter this setting after consultation with your network administrator. Automatic integration of a new computer or sensor in the existing network without manual configuration is possible through DHCP. Normally, automatic supply of IP address must only be set on the sensor, the client. When the sensor is started in the network, it can obtain the IP address, net mask and gateway from a DHCP server. Activation of DHCP mode is carried out via the "Set" button by activating the checkbox "DHCP". As one and the same SBS vision sensor can thus have different IP addresses at different times, a sensor name must be attributed when activating the DHCP. Should several SBS be in one network, different names must be used.
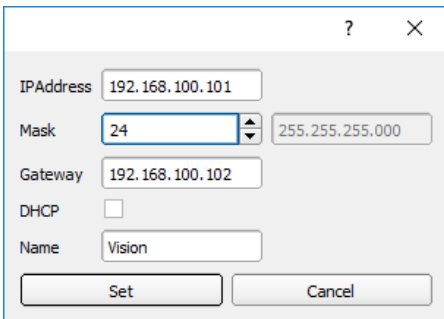
Fig. 15: SBS IP Setup

If a SBS with DHCP is switched on in a network without a DHCP server, the SBS automatically sets the IP address to 0.0.0.0. This can be the case, e.g. in the case of power/server failure or the restart of the system after shutdown as the DHCP server may boot slower than the SBS. Make sure that the SBS is only switched on when the DHCP server is available.

5 SBS – Operating- and configuration software - Overview

5.1 Structure of SBS Software

The SBS Software is organized into the following three modules:

- **Vision Sensor Device Manager**
  This module is for selection of a sensor, or a sensor simulation model, for configuration with the "Vision Sensor Configuration Studio" tool or display (monitoring) with the "Vision Sensor Visualisation Studio" tool. System settings such as IP addresses, firmware updates can be modified here, as well as password and user rights.
- **Vision Sensor Configuration Studio**
  This module contains comprehensive functions for setting up sensors and configuring inspection tasks (jobs). If password protection is activated, you need the authorization of the user group Administrator for the configuration.
- **Vision Sensor Visualisation Studio**
  This module displays images and results. You can use it to monitor / check sensors. In addition, extensive archiving functions are available. Compared to Vision Sensor Configuration Studio it offers only limited configuration options. If the password protection is activated, the authorization of the user group is "Administrator" or "Worker".
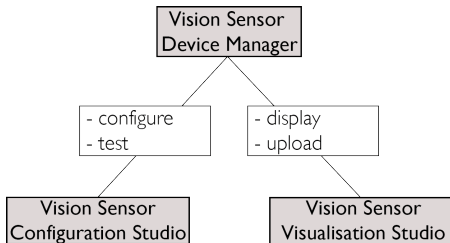
Fig. 16: Software structure

The latest www.festo.com versions for free download are available at SBS Software

5.2 Vision Sensor Device Manager
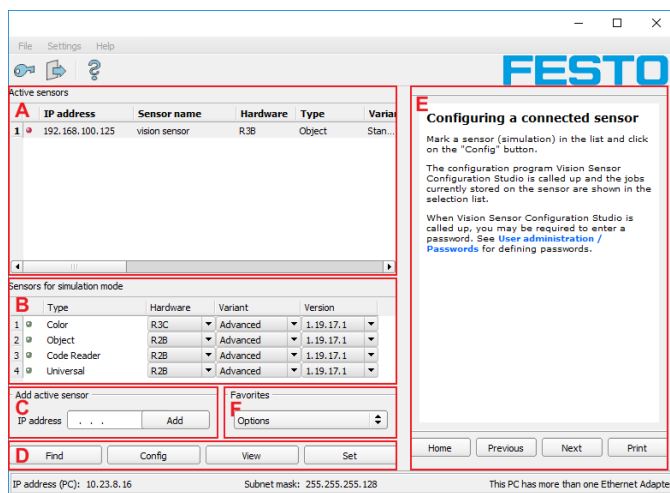
Fig. 17: Vision Sensor Device ManagerOverview

A) Active sensors

This list displays all of the SBS vision sensors available on the network that can be controlled from the PC.

B) Sensors for simulation mode

All the SBS vision sensors available for offline simulation are displayed here.

C) Add sensors via IP address

Sensors, which are not visible after starting the software or after clicking the "Find" button in , can be add manually with their IP address, if they are available in the network (e.g. after a gateway) and if the IP address is well-known. Via clicking the button "Add" such sensor can be found and are added to the list of active sensors, in order to edit them.

D) Functions

- **Find**

  Activates another search procedure on the network to locate products

- **Config**

  Configures a connected sensor or a sensor simulation = Vision Sensor Configuration Studio

- **View**

  Displays image or result data from a connected sensor = Vision Sensor Visualisation Studio

- **Settings**
  Edits network settings such as the sensor's IP address etc.

E) Context

Context sensitive help

F) Favorites

The SBS vision sensors can be stored as favorites. The favorites are used for quick access and for managing the SBS vision sensors.

5.3 Vision Sensor Configuration Studio
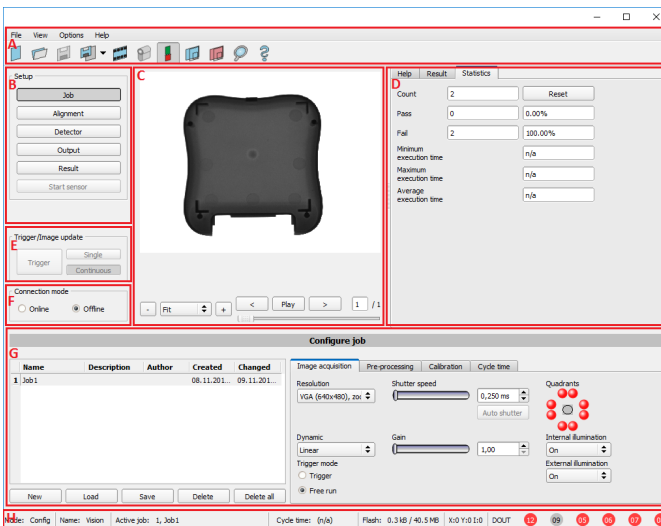
Fig. 18: Vision Sensor Configuration Studio Overview

The fields are:

A) Menu and tool bar

B) Setup

SBS – Operating- and configuration software – Vision Sensor Configuration Studio, all functions (Page 67)

C) Image

Image output with graphically adjustable operating and search zones as well as zoom function also filmstrip navigation

D) Help, Result, Statistics

- Help: Context-sensitive help for the current topic
- Result: Detector results for selected parameters
- Statistics: Display statistics on evaluation and execution time

E) Image acquisition mode
Switch-over between continuous (free run) and single image mode with trigger input (either from sensor or via onscreen button)

F) Connection mode
Switch-over between online and offline mode (sensor present or simulation without sensor)

G) Job selection
Changing variable content relating to action in set-up navigation, for setting of associated parameters.

H) Status bar
Different status information including Mode / Name of SBS / Active job. In Run Mode: Cycle time / cursor x/y location and pixel intensity / individual I/O on /off indication (like configured in "Output/Digital output").

5.4 Vision Sensor Visualisation Studio
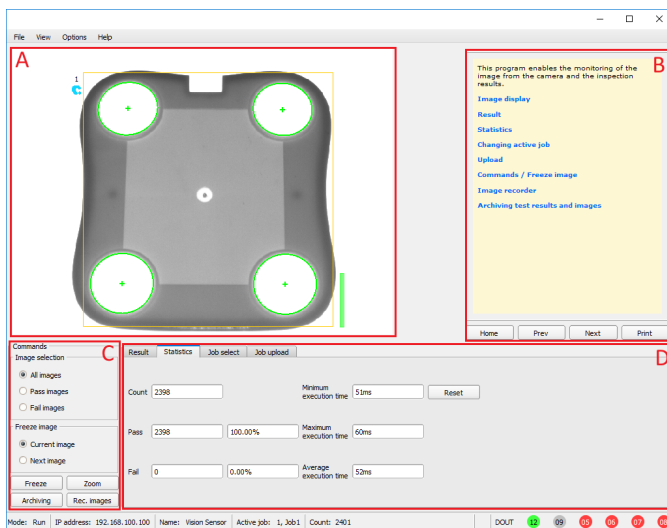
Fig. 19: Vision Sensor Visualisation Studio Overview

A) Image display

B) Context

Context sensitive help

C) Commandos

Commands for displaying, transferring and archiving images.

D) Job and result display

These tabs can display (statistical) results, switch jobs, and load jobs / job sets from Vision Sensor Visualisation Studio to the sensor.

5.5 Context help

For all software functions a context sensitive help page is available and displayed as soon as a function is selected.

All available help pages can be viewed by pressing the Help- button ("?" symbol) or by double click to the online help window. There you also can do a keyword search.

In comparison to the context help the size of this help window can be enlarged to view longer text more comfortable.

Used open source software: Open Source License (Page 3)

6 SBS – Operating- and configuration software – Short introduction

This short guide explains the procedure for setting an example inspection task on the SBS vision sensor.
Exemplary inspection with the object sensor.

6.1 Starting the SBS Software

To start the SBS Software click to the desktop icon "SBS vision sensor".

Fig. 20: Icon SBS

6.2 Vision Sensor Device Manager - Open sensors or sensor simulation / Passwords

In this program, you can select a sensor or a sensor simulation for configuration or display (monitoring) and carry out different basic settings.

6.2.1 Configuring or displaying sensors

In order to open a sensor for configuration or display, select with a single left mouse click the required sensor in the "Active sensors" list. Then, with a click on the button "Config", the Vision Sensor Configuration Studiomodule "" **star**ts. With the buttonVision Sensor Visualisation Studio "View" t**he module "**" starts.

Sensor simulation

To open a sensor for offline simulation, select the required sensor in the "Sensors for simulation mode" list, then click on the button "Config" to start the module "". Then, with a click on the button "Config", the module "Vision Sensor Configuration Studio" starts.

6.2.2 Passwords

When first started-up after installation, password entry is completely deactivated and auto login is preset to administrator. If parameter settings are to be protected from unauthorised access, passwords should be given for the "Admin" and "User" password levels, see below. This can be called up via the menu bar File / User administration or via the button with the key symbol in the toolbar.

Fig. 21: Password button

6.2.3 Password levels

Password level	Vision Sensor Device Manager	Vision Sensor Configuration Studio	Vision Sensor Visualisation Studio
Administrator password	all functions	all functions	all functions
Worker password	all functions except • Config • Settings • Update	none	all functions, including Job Upload and Image Recorder
User (without any password)	all functions except • Config • Settings • Update	none	only display of images, inspection results and statistics

In order to be able to use the function "Config" after the allocation of passwords, it is now necessary to login by clicking on the toolbar login button, and then entering the assigned password.

Fig. 22: Login button
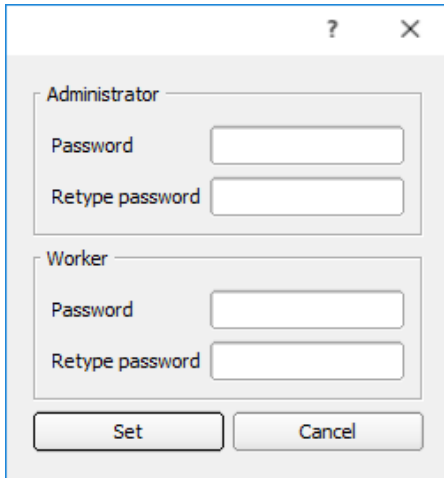
Fig. 23: Password input

Allocating an empty password means the password can be confirmed without any further entry. Activation of the "Deactivate password request" checkbox, permanently deactivates password request.

If passwords have been assigned and then forgotten, it is possible to reset passwords to delivery status by reinstalling the software on the local PC.

6.3 Vision Sensor Configuration Studio: Setting sensor

With this program, you can configure your SBS for one or several jobs in six simple logical operating steps.

6.3.1 Configuring a job

For Job- setup: in Setup/Job edit or generate a new job.
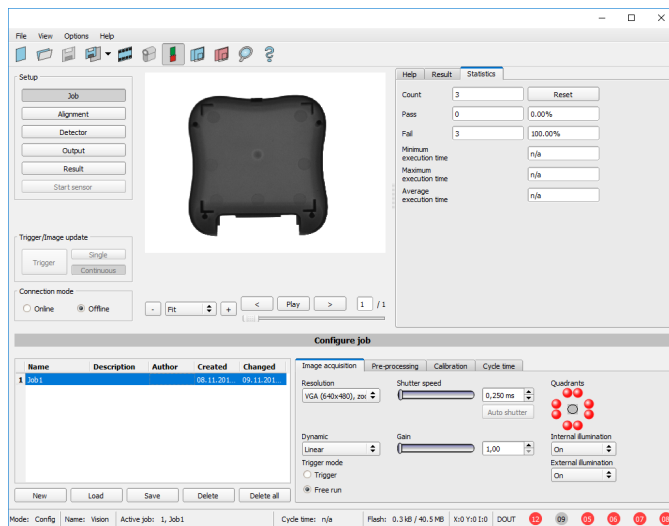
Fig. 24: Vision Sensor Configuration StudioJob

Here, new jobs are created and several jobs are managed. In addition, here all global settings that are valid for the entire inspection task, such as Shutter speed, gain, illumination settings, etc. made.

One job contains all settings and parameters necessary to perform a specific inspection task.

- The following basic image settings should first be made to ensure a high-contrast and sharp image:
  - Image brightness: Set shutter or amplification, see Job/Image acquisition
  - Image sharpness: Focus setting via the screw on the back of the SBS camera itself
- When delivered, the factory settings are trigger mode = "free run" (see Job/Image acquisition) and image acquisition mode = "continuous". A new image is continuously displayed for easier focus and brightness set up.

- The subsequent setting of alignment and detectors should preferably be carried out in single image mode, as all settings are then based on a master image and image collection is not continuously carried out. Alignment and multiple different detectors (depending on the type of sensor max.
- 32 or 255 detectors) can subsequently be defined within one job to solve an inspection task.

There is the possibility to save a job as a template. To do this, right-click on the job in the job list and select "Save as template". For each new job, the settings and detectors are then copied from the job template. In the job list, the job template is identified with a "T" (Template). The job template cannot be edited. To remove the job template, right-click on the template and select "Remove".

6.3.2 Alignment settings

Alignment compensation can be necessary for objects whose position varies on the screen. Three different detection methods (alignment detectors) are available for this purpose.

Alignment is optional.
After selection of the alignment method, set the working zones on the parameter to be used for alignment tracking by adjusting the graphic frame to the appropriate position and size on the image. The associated parameters are displayed on the bottom right-hand side and can also be adjusted there. Alignment, when used, affects the positions of all the detectors subsequently defined in this job. In this example, the outside contour is used for alignment and the plug can be found either by contour or by pattern matching. If the angular rotation of the object can vary also, the contour method must be used.
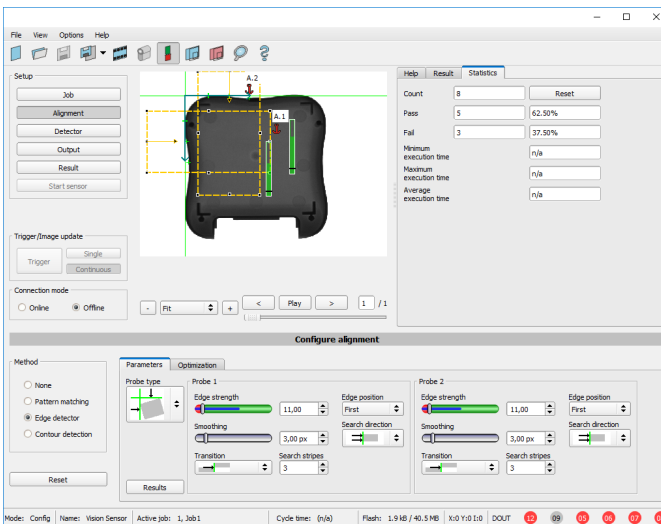
Fig. 25: Vision Sensor Configuration Studio Alignment

6.3.3 Detector settings

Different detectors can be selected and adjusted to solve an inspection task. First the required detector is selected in the dialog box shown below.
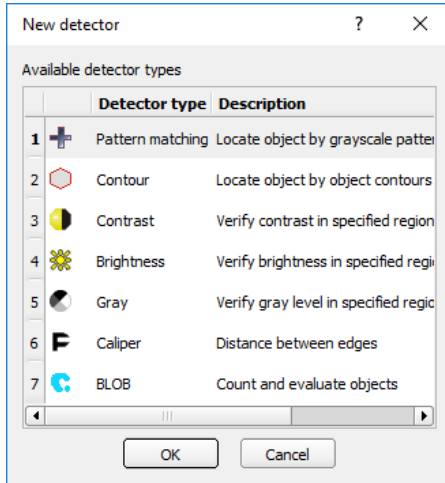
Fig. 26: Detector list, Object sensor

Then the working and search zones are graphically set on the screen. If "teach zones" (red outline) exist, they are taught immediately after completion of the settings. All the detectors defined in this job are shown in the bottom left-hand corner. The parameters of the currently selected detector are shown in the bottom right-hand corner and can be adjusted there. If other parameters are to be checked on the same part, many other detectors can be created as described above by clicking on "New". In the example two brightness detectors are defined to check the presence of metal contacts in a plastic connector housing.

- Detector 1: contact found (brightness value is in defined range as the shiny metal contact is mounted) result positive.
- Detector 2: contact not found (brightness value out of defined range, as only weak reflection from the black plastic housing background) result negative.
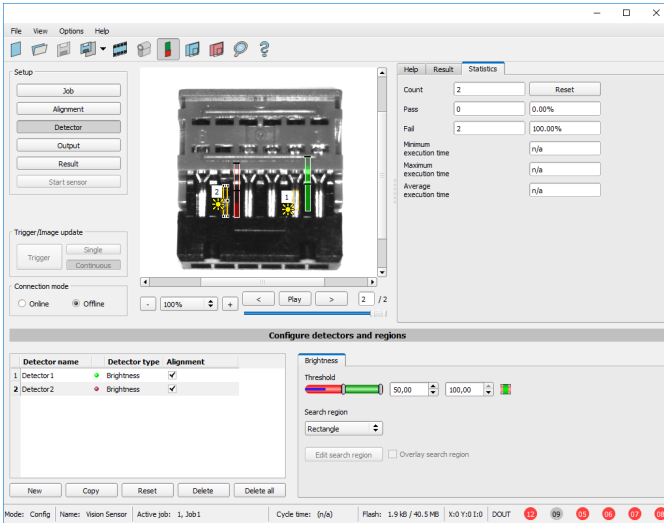
Fig. 27: Detector settings

6.3.4 Output, I/O and data output

The output module enables different settings of digital inputs/outputs and data output.

Select and activate the interfaces in the different tabs. Logically connect detector results and assign to the available I/O's.

In order to enable the output of serial result data, select the required interface and compose data string.
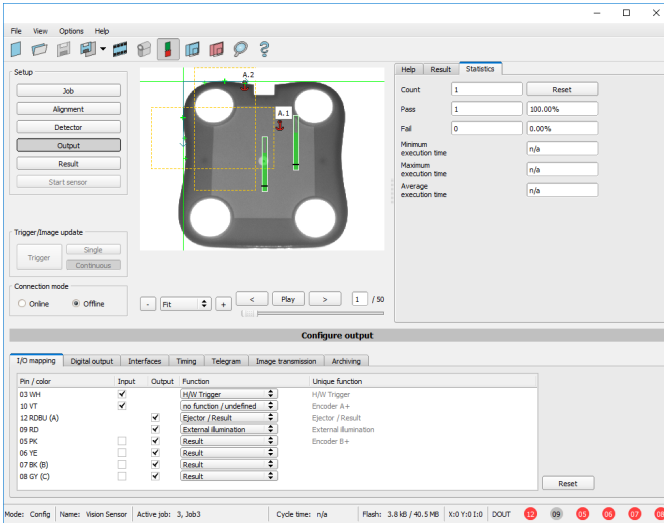
Fig. 28: Output, digital and data

Setting possibilities in the different tabs:

- **I/O mapping**
  Settings for the I/O Hardware configuration
- **Digital Output**
  Selection of digital signal outputs and definition and assignment of logical connection using the Boolean results of all detectors. Definition of complex logic connections via table or via input of a logical formula.
  A different logical connection can be assigned to each available digital output.
- **Interfaces**
  Selection, setting and activation of the individual interfaces
- **Timing**
  Setting of delay times: trigger delay, result delay and duration of result
- **Telegram**
  Setting and preview of data output string via RS422 or Ethernet

Selection of: binary or ASCII protocol, header and / or trailer, standard contents and / or flexible, combinable, special individual data from the individual detectors.
Any number of individual results from all the defined detectors can be freely arranged in an output string.

6.3.5 Result

With this function, an inspection is carried out on the PC for control purposes, using all the settings made. All the results are produced and displayed just as on the sensor. However e.g. execution times will not be updated as these values are only informative when implemented on the sensor itself. See next step: "Start Sensor".
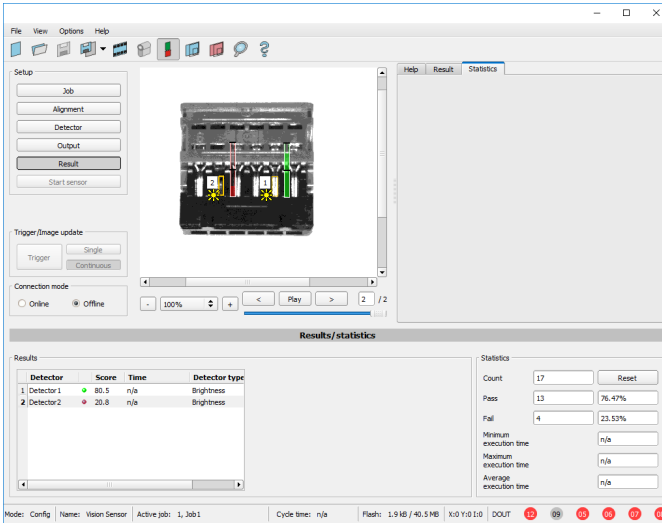
Fig. 29: Result display

6.3.6 Start Sensor

When this function is activated, all settings are transferred to the sensor, stored in the flash memory and carried out in e.g. in free run or in triggered mode according to the settings made. All information in the list of detectors, result field or under "Statistics" is updated here. If using "triggered mode" then a trigger will be required from the external control system, alternatively a 'software' trigger can be sent using the "Trigger" button the left hand side of the image area.
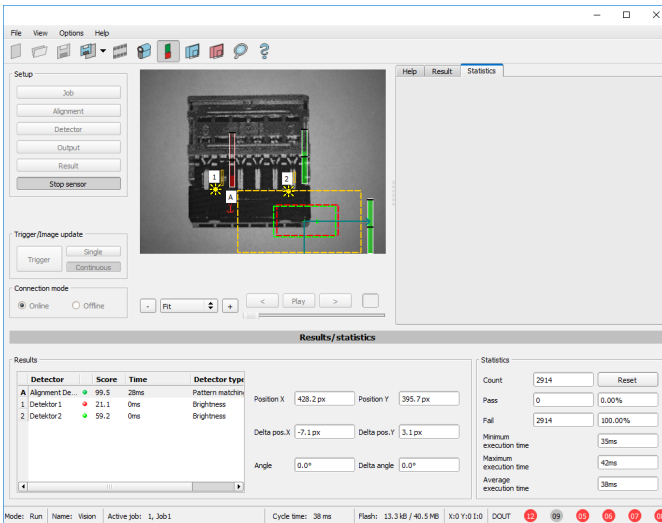
Fig. 30: Start sensor

6.4 Vision Sensor Visualisation Studio, display images and results

This program enables the monitoring/inspection of the connected sensor and the analysis of inspection results.

Click the **"View"** button in the Vision Sensor Device Manager software to start the Vision Sensor Visualisation Studio module.

The current image is displayed with the drawings for alignment and the detectors (if "image transmission = active" is activated in the configuration module under Job/General).
The tab **"Result"** shows the individual detectors with their results and the overall result.
The tab **"Statistics"** shows further statistical results.
The **"Freeze image"** button enables result-controlled images (e.g.: bad part) to be kept on the display.
"Zoom" enlarges images.
With **"Archive images"**, images and result data, as previously set under "File/Configure archiving", can be archived on the hard disk of a connected PC, with or without numerical result data.
With **"Rec. images"** the last 10 images can be retrieved from the .
In the tab **"Job"**, it is possible to switch between jobs present on the sensor.
In the tab **"Upload"**, further, previously defined jobs or whole job sets can be loaded from the viewer on to the sensor.

7 SBS – Operating- and configuration software – Vision Sensor Device Manager, all functions

In this program you can select a sensor or sensor simulation for configuration or display (monitoring) and carry out different basic settings:

- Active sensors (Page 55)
- Sensors for simulation mode (Page 56)
- Find / Add active sensor (Page 57)
- Configuring a connected sensor (Page 60)
- Vision Sensor Visualisation Studio, display images and results (Page 53)
- Sensor's network settings (Page 61)
- Update / Firmware update (Page 63)
- User administration / Passwords (Page 61)
- Favorites (Page 57)
- Auto Start Up (Page 64)
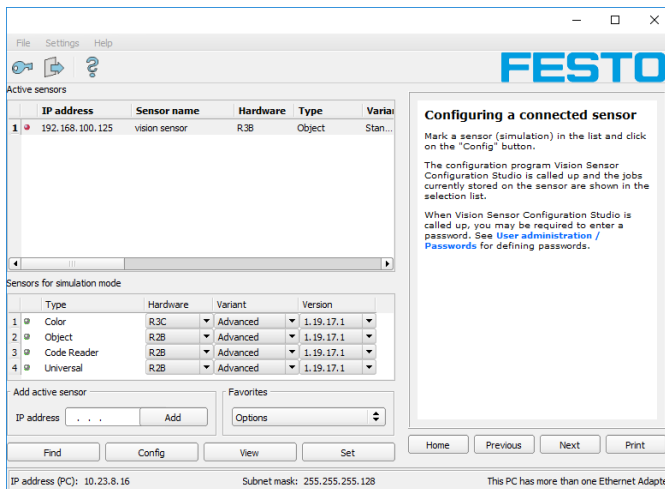
Fig. 31: Vision Sensor Device Manager

If the "Configure" function is not accessible (button inactive), login (button with door- / arrow-symbol) with password entry is required. If you do not know the password, please contact the administrator.

7.1 Active sensors

All sensors available on the connected network are displayed in the selection list Active sensors.

Configuring a connected sensor (Page 60) (call up Vision Sensor Configuration Studio)

Display images and result data (Page 60) (call up Vision Sensor Visualisation Studio)

Significance of parameters displayed

Parameter	Significance
IP address	Sensor´s IP address in the network
Hardware	Hardware (e.g. R3B, R2B, ...)
Sensor type	Sensor type (Object, Color, Code Reader)
Variant	Sensor- sub variant (Advanced ...)
Version	Firmware version
Mode	Operating mode (Run, Config or Offline)
Sensor name	Name of sensor
Manufacturer	Name of manufacturer
Mac-Address	Sensor´s Mac address
Subnet mask	Sensor´s subnet mask
Gateway	Standard gateway
DHCP	DHCP active / inactive
Operating system	Type of operating system
Operating System Version	Version of operating system
Platform	e.g. SBS
Hardware	Hardware version
RAM	RAM size
Flash	Flash size

Please note:

- If no entries are shown in the list, even though a sensor is connected, you can refresh the list with the "Find" button or manually "Add" the IP address of the product.
- If no sensor is connected, simulations of different sensor applications are available in the Sensors for simulation mode (Page 56) list such as 'Object' sensor.

Via the button "details" (at the right, upper corner of the parameter list of "Active Sensors") a detailed list of all SBS parameters is accessible.

Property	Setting
IP address	192.168.100.125
Hardware	R3B
Sensor type	Object
Variant	Standard
Function restric...	-
Firmware version	1.18.19.2
Mode	Run
Sensor name	vision sensor
Manufacturer	Festo
MAC address	00-0E-F0-01-10-04
Subnet mask	255.255.0.0
Gateway	192.168.100.1

Copy | Ok
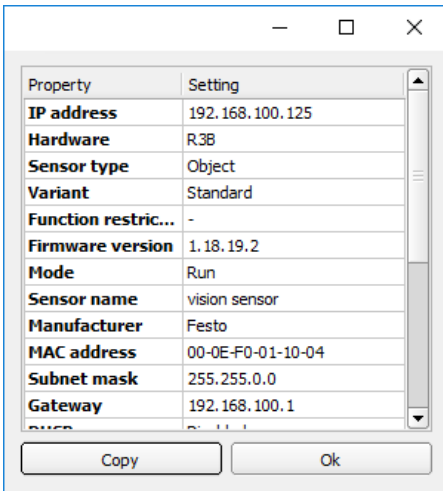
Fig. 32: Sensor properties

7.2 Sensors for simulation mode

In order to access the simulation mode, select the required sensor type with a double click and press "Config" button (call up Vision Sensor Configuration Studio).

Function of parameters displayed

Parameter	Function
Type	Sensor type (e.g. Object, Color, Code Reader, ...)
Hardware	Hardware type (e.g. resolution, monochrome or color version)

Parameter	Function
Version	Firmware version
Variant	Sensor- sub variant (e.g. Advanced …)

If the function "Config" is not accessible (button inactive) a Login (button with door / arrow symbol) with password input is necessary. If you do not know the password please contact your administrator.

7.3 Find / Add active sensor

If no sensors are shown in the list Active sensors, even though a sensor is connected, please follow these steps:

Find / search sensor:

To search for sensors which are connected directly to the PC, or which are available in the network, click button "Find".

Add active sensor:

If you know the IP-address of a sensor, please enter it into the field IP-address and click button "Add".

Now the sensor appears in the list and can be accessed for e.g. Config or View.

If the function "Config" is not accessible (button not active / grayed out) a Login with password input is necessary. If you do not know the password please contact your site systems administrator.

7.4 Favorites

The favorites are used for quick access and for managing the SBS vision sensors. The following parameters can be selected for the favorites.

Right-click on active sensors in Vision Sensor Device Manager:
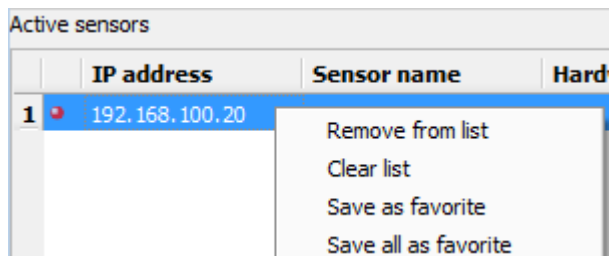
Fig. 33: Parameter favorites with right-click on active sensors

Parameter	Function
Remove from list	Removes the selected sensor from the "Active sensors" list.
Clear list	Clears the complete list "Active sensors".
Save as favorite	The selected sensor is saved as a favorite.
Save all as favorite	Saves all sensors in the "Active sensors" list as favorites.

"Favorites" in Vision Sensor Device Manager:
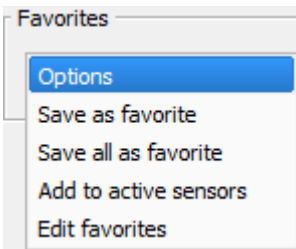
Fig. 34: Options Favorites

Parameter	Function
Save as favorite	Opens the "Save as favorite" window where a desired location can be selected in the tree structure in which the sensor from the "Active sensors" list is to be saved as favorite.
Save all as favorite	Opens the "Save all as favorite" window where a desired location can be selected in the tree structure in which all the sensors from the "Active sensors" list are to be saved as favorite.
Add to active sensors	Opens the "Add to active sensors" window where a sensor/ sensor group can be selected that is to be added to the "Active sensors" list.
Edit favorites	Opens the "Edit favorites" window in which the sensor groups can be edited.

Edit favorites - create groups

In the left window area, the sensors are divided into groups via a tree structure, e.g. according to production sites and production lines. In the right window area, the sensors below a selected group are listed in tabular form, e.g. group "Favorites" shows all sensors.
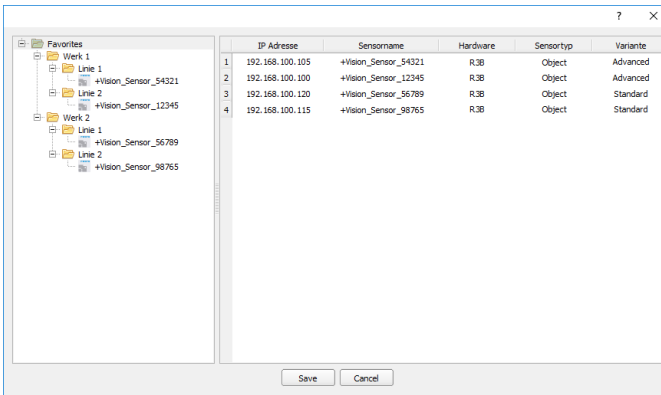
Fig. 35: Group configuration

The favorites are stored in the installation path of the SBS vision sensor on the PC as an XML file. The file is located under: "Festo/SBS vision sensor/Vision Sensor Device Manager/Data". It can be exchanged between different PCs.

Examples of applying the favorites:

Example 1:

SBS vision sensors which are integrated in different networks can be viewed and managed locally in Vision Sensor Device Manager (see also the following figure). The sensors can be added to the "Active sensors" list by entering the IP address in the field "Add active sensor". The sensors are subsequently managed via the favorites. The sensors can be added to favorites by "Vision Sensor Device Manager/Favorites/Saves as favorite". Within the favorites the sensors can be assigned to different groups.
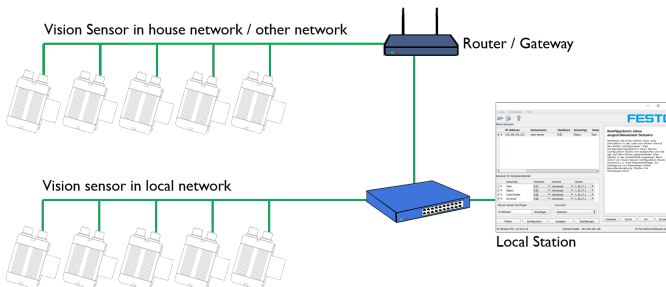
Fig. 36: Example 1 - SBS vision sensors in different networks

Example 2:

Multiple stations are on the same local network. All users have access to all SBS vision sensors, although only a few SBS vision sensors are relevant for their work (see also the following figure). In conjunction with the "Auto Start Up" function (see also Auto Start Up (Page 64)), it is possible that only a certain selection of SBS vision sensors (favorites) is displayed. To do so, the sensors must be added to the favorites and divided into groups. Subsequently a group of favorites can be selected in the Auto Start Up file. The users now only have access to the relevant sensors when opening Vision Sensor Device Manager via the Auto Start Up file.
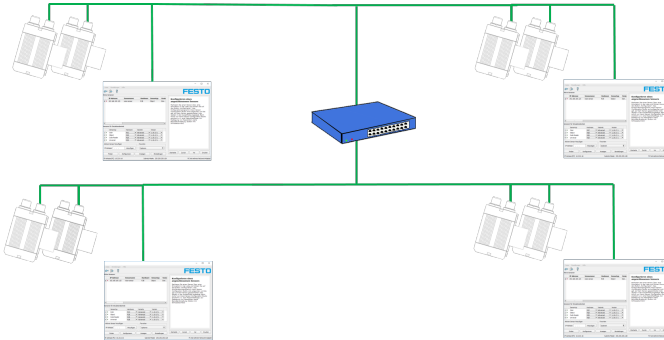
Fig. 37: Example 2 - Favorites in the Auto Start Up file

7.5 Configuring a connected sensor

Mark a sensor (simulation) in the list and click on the "Config" button. The configuration program Vision Sensor Configuration Studio is called up and the jobs currently stored on the sensor are shown in the selection list. When Vision Sensor Configuration Studio is called up, you may be required to enter a password. See User administration / Passwords (Page 61) for defining passwords.

See chapter: SBS – Operating- and configuration software – Vision Sensor Configuration Studio, all functions

7.6 Display images and result data

Mark a sensor in the list and click on the "View" button. The Vision Sensor Visualisation Studio program is opened up and images and measurement results from the active jobs are displayed on screen.

Please note:
Calling up Vision Sensor Visualisation Studio does not affect operation of the selected sensor.
See chapter: SBS – Operating- and configuration software – Vision Sensor Visualisation Studio, all functions

7.7 Sensor's network settings

You can change the network settings of the selected sensor with the Set button. The IP address, subnet mask, standard gateway, DHCP and sensor name can be set here. The PC's IP address and subnet mask are displayed below in the Vision Sensor Device Manager status bar. The address structure must be correct in order to be able to connect the sensor to the PC. The sensor's IP address etc. can therefore be modified accordingly here if necessary. Please contact your site administrator for the definition of network parameters. Further information on this subject can be found in the chapter Network settings, Short reference and Network connection. If "DHCP = active" is selected, a unique name must be given for the sensor as the IP address is newly assigned each time the sensor starts up and can thus change. You require administrator authorization for these functions (see user administration).

Fig. 38: Vision Sensor Device Manager, IP- Setup

See chapter: Network settings, Short reference and Network connection

7.8 User administration / Passwords

The SBS configuration distinguishes between three user groups, which have different authorisations:
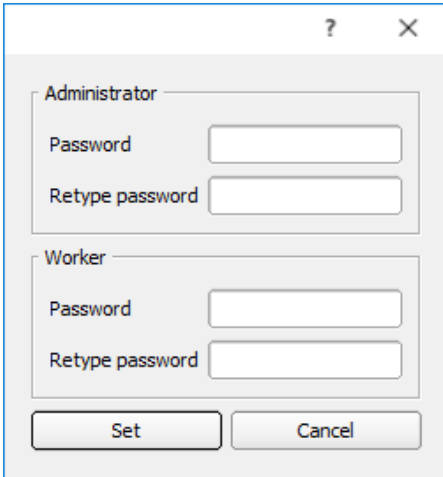
Fig. 39: Vision Sensor Device Manager, Password input

Password level	Vision Sensor Device Manager	Vision Sensor Configuration Studio	Vision Sensor Visualisation Studio
Administrator password	all functions	all functions	all functions
Worker password	all functions except • Config • Settings • Update	none	all functions, including Job Upload and Image Recorder
User (without any password)	all functions except • Config • Settings • Update	none	only display of images, inspection results and statistics

After software installation, login is automatically carried-out when the application is called-up, without password request. No passwords are assigned.

Define passwords:

Select file user administration in the File menu or click on in the toolbar to assign passwords for the administrator and user categories. Once a password has been entered, a logout is

automatically carried out, i.e. input of the new password is now necessary. Assigning an "empty" password, enables entry by simply confirming with OK.

Fig. 40: Password button

Login / Logout

After the definition of passwords a login is necessary, e. g. for the configuration of a sensor. To do this, click on the login button in the toolbar, enter the specified password and confirm with "OK". If the "deactivate password request" box is ticked, the password is no longer requested when the application is next started. To log off the user group, click on the logout button.

Fig. 41: Login button   Fig. 42: Logout button

7.9 Update / Firmware update

You can update the firmware of the selected sensor through the menu item "Vision Sensor Device Manager/File/Update" (see following figure). The appropriate firmware update file mFestoust first have beenFesto obtained via download from the website or from Support. Select the appropriate firmware file in the file dialogue box that opens and follow the instructions. Do not disconnect the power to the sensor during this process unless prompted by the onscreen instructions.
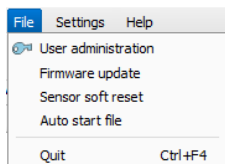
Fig. 43: Vision Sensor Device Manager, Firmware update

Attention:
Before executing the firmware update please create a current backup!
Use the menu item "Vision Sensor Configuration Studio/File/Save job set (Backup) ..." to save the job sets (see following figure).
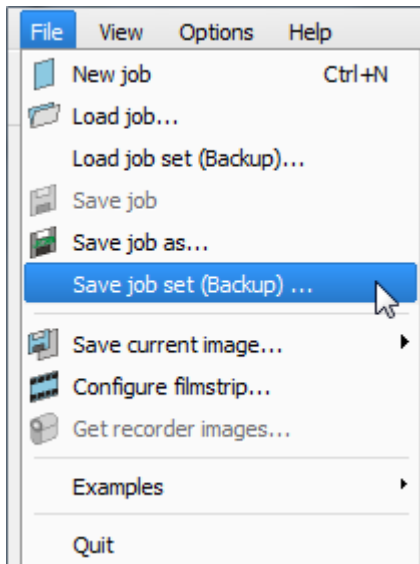
Fig. 44: Backup, save job set

7.10 Auto Start Up

Auto Start Up enables the automatic start of the SBS Software. For this purpose, a batch file is created, which can be stored in the windows system folder "Startup" so that it can be called up automatically every time the PC is started. The Auto Start up file window is divided into the areas: mode, window settings and user.

Sequence

1. Open the Auto Start Up file in the Vision Sensor Device Manager module with the file path: Vision Sensor Device Manager/File/Auto Start Up file.

2. In the "Mode" area, determine the modules of the SBS Software that are to be started automatically.

3. In the window settings, select the view of the module: Normal or panel mode (fullscreen, without title bar).

4. In the "User" area, define the user for the Auto Start Up file. For more information about the authorization function see User administration / Passwords (Page 61).

5. Select the "Save" button and save the batch file (.bat) to the desired destination. For an automatic start when the PC boots, the file must be stored in the windows system folder "Startup".

6. Close the SBS Software.
7. Execute the batch file. The SBS Software is started according to the settings.
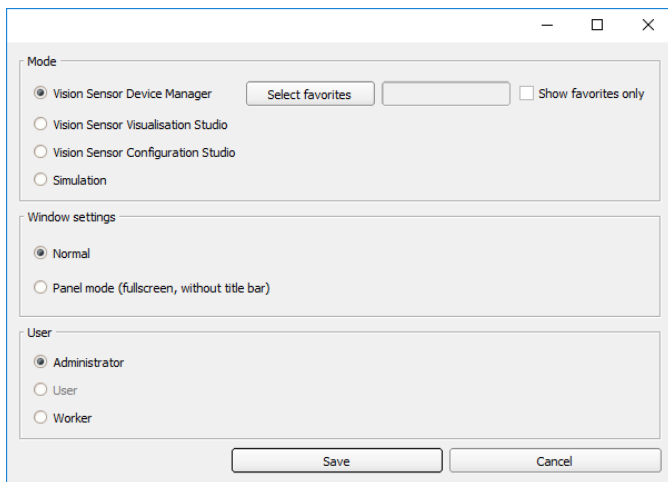
Fig. 45: Auto Start Up file

The following parameters can be configured in the "Auto Start Up" window:

Mode	
Parameter	**Function**
Vision Sensor Device Manager	Modules of the SBS Software which are to be opened automatically in the Auto Start Up file. For the start of the simulation mode, the model variant which is currently selected in Vision Sensor Device Manager (marked in blue) is used.
Vision Sensor Visualisation Studio	
Vision Sensor Configuration Studio	
Simulation	
Select favorites	With this parameter, a favorite group can be added to the Auto Start Up file.
Show favorites	If the parameter "Select favorites" is selected, the "Active sensors" list is

Mode	
Parameter	**Function**
only	cleared and then only filled with the selected favorites.

Window settings	
Parameter	**Function**
Normal	The selected SBS Software module is opened normally in the Auto Start Up file with the title bar.
Panel Mode (fullscreen, without title bar)	The selected SBS Software module is opened in the Auto Start Up file in fullscreen without a title bar. Typical application for touch screen panel PCs.

User	
Parameter	**Function**
Administrator	The selection of the user depends on the rights that the user should have within the Auto Start Up file. For more information about the authorization function see User administration / Passwords (Page 61).
User	
Worker	

8 SBS – Operating- and configuration software – Vision Sensor Configuration Studio, all functions

With this program, you can configure your SBS vision sensor for one or several jobs in six logical operating steps.

- Setup Jobs (Inspection tasks) (Page 67)
- Setup Alignment (Page 97)
- Setup Detectors (Page 123)
- Setup Output (Page 222)
- Setup Result (Page 252)
- Setup Start sensor (Page 258)

Other program functions:

- Trigger settings (Page 259)
- Connection mode (Page 260)
- Simulation of jobs (offline mode) (Page 276) using series of images
- Creating filmstrips (Page 268) Image recording for analysis or simulation purposes.
  Use of Vision Sensor Configuration Studio may require password entry (administrator user group). See User administration / Passwords
- Image recorder (Page 280)

To obtain a continuously updated live image even without trigger, carry out the following (if necessary temporary) settings:

- Set to **free run** in "Job/Image acquisition"
- Set to **continuous** in "Trigger / collect image" User interface and operating procedure

8.1 Setup Jobs (Inspection tasks)

A job contains all the settings and parameters required to carry out a certain inspection task.
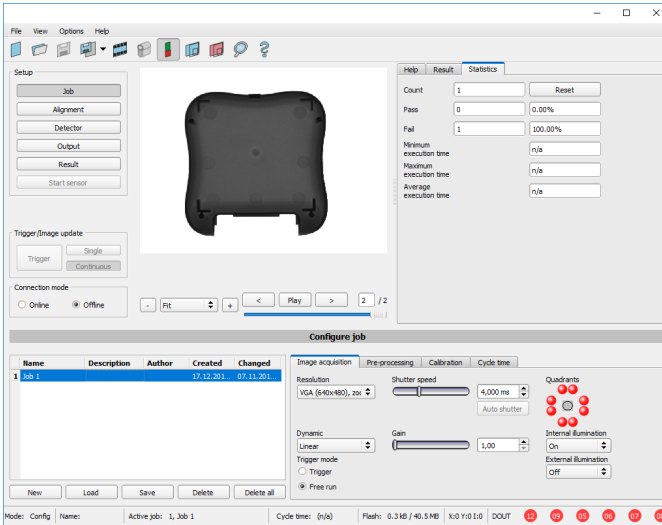
Fig. 46: Vision Sensor Configuration Studio Job

8.1.1 Creation, modification and administration of jobs

A selected job (marked in the list) can be modified by entering parameters in both tabs of the configuration window:

If there is no job entry in the list, you must create a new job first.

Creating a new job:

1. Click on the button "New" underneath the job selection list. A new job entry appears in the list.
2. Edit the entry with a double click on the respective line (Name, Description, Author):

Further functions:

Function	Description
New	Defines a new job
Open	Loads a job from the PC
Save	Saves the selected job on the PC
Delete	Deletes the selected job from the list

Function	Description
Delete all	Deletes all the jobs in the list
Protect	Protects the job / job set with a password

All the functions described can also be carried out using the File menu.

Fig. 47: Vision Sensor Configuration Studio job list

If the sensor's memory capacity is exhausted and no further jobs can be loaded on to the sensor, the color of the remaining memory display in the status bar changes to red.

Additional information:

Load and save jobs and job sets (File) (Page 262)

Protect job set ... (File) (Page 263)

8.1.2 Tab Image acquisition

The basic parameters for image acquisition are determined in the tab Image acquisition.

Set image sharpness with the focus setting screw on the back of the SBS vision sensor.

Parameter	Functions and setting possibilities
Resolution	Available resolutions: R3B: WVGA (736x480), VGA (640x480), QVGA (320x240), QQVGA (160x120) R3C: WVGA (736x480), VGA (640x480), QVGA (320x240) R2B: SXGA (1280x1024), VGA (640x480), QVGA (320x240) R2C: SXGA (1280x1024), VGA (640x480) For time-critical applications or for compatibility reasons, a lower resolution can be selected.

Parameter	Functions and setting possibilities
	When the resolution is altered, all the detectors previously defined are deleted!
Zoom (R2B only)	Via the Zoom function different fields of view / image zones can be selected
Dynamic	Optimization of characteristics of image capturing: "Linear" means linear response curve(behaves like SBS-products with no dynamic image capturing), "High" means better graduation in bright areas of the image (avoids override).
Trigger mode	Select trigger mode (SBS in triggered or free run mode). In case of triggered mode, trigger can be done by hardware-trigger (Pin 03 WH) or over one of the data interfaces. In free run the SBS continuously captures images and processes evaluations.
Shutter speed	Parameter for control of image brightness. Image brightness preferably should be set with "Shutter speed". Only in case that it's not possible to achieve the required image brightness this way use the slider "Gain" (Default value of Gain = 1). With fast moving objects a high shutter value can cause blurring of the image. Exposure can be set automatically with the Auto-Shutter button. Maximum shutter value is 100 ms. Maximum duration of internal illumination pulse is 8 ms. Shutter timers longer than 8 ms just make sense, if internal and external illuminations are used.
Gain	Parameter for control of image brightness. Set image brightness preferably with shutter speed first, and only if necessary in a second step with gain (Default value of Gain = 1).
Quadrants (illumination)	By click on the LED single quadrants of illumination can be switched off. This function may avoid reflections at low working distances.
Internal illumination	Switch internal illumination (on, off).
External illumination	Selection for external lighting (on / off / permanent) The external lighting is switched via pin 09 RD.

To obtain a continuously updated live image even without trigger, carry out the following (if necessary temporary) settings:

Set to **free run** under "Job/Image acquisition"

Set to **continuous** under "Trigger / collect image"

8.1.3 Tab White balance

White balance is necessary for compensation of image colors.
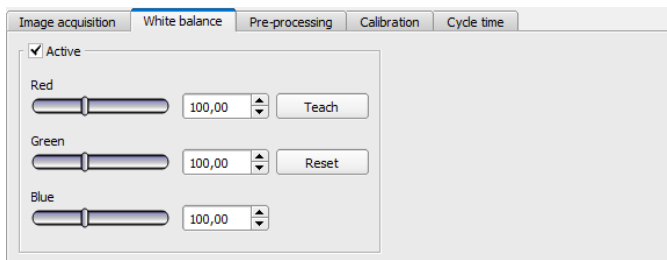
Fig. 48: Job, tab White balance

Parameter	Function
Red	Mean value of red channel in image
Green	Mean value of green channel in image
Blue	Mean value of blue channel in image
Teach	Execution of white balance, for white balance there has to be a homogeneous, white area below the camera.
Reset	Reset values

8.1.4 Tab Pre-processing

In the Preprocessing tab you can filter and rearrange the images taken by the sensor before analysis.

- Up to 5 filters and one arrangement filter can be used, which are processed in the selected sequence.
- All detectors (alignment and standard detectors) will work with the preprocessed image (not with the original image)
- Especially morphological operations (Dilation and Erosion) can lead to improvements by combining them e.g. by processing Erosion and Dilation one after another – or in reverse order.

Example:- Black points in front of a bright background can be eliminated, if a sequence of dilation and erosion is processed.

The following arrangements are available for image improvement:

Arrangement type	Effect
Rotation 180°	Rotation of image for 180°
Mirror	Vertical mirroring
Flip	Horizontal mirroring

The following filters are available for image improvement:

Filter type	Effect
Gauss	Image is smoothed using a gaussian filter mask. This can be applied for reduction of disturbances, suppression of disturbing details and artifacts and smoothing the image.
Erosion	Extension of dark zones, elimination of light pixels in dark zones, elimination of artifacts, division of bright objects. Each gray value is replaced by the minimum gray level found inside the filter mask (e.g. 3x3).
Dilation	Extension of light zones, elimination of dark pixels in light zones, elimination of artifacts, division of dark objects. Each gray value is replaced by the maximum gray level found inside the filter mask (e.g. 3x3).
Median	Each gray value is replaced by the median value of the pixels found inside the filter mask (e.g. 3x3). Typical applications include noise reduction, especially for local bright or dark pixels ("salt-and-pepper"-noise).
Mean	Each gray value is replaced by the average gray value of the pixels found inside the filter mask (e.g. 3x3). This can be applied for reduction of disturbances, suppression of disturbing details and artifacts and smoothing the image.
Range	Each gray value is replaced by the range value (maximum gray level − minimum gray level) of the pixels found inside the filter mask (e.g. 3x3). Typical applications include the detection and enhancement of edges and the improvement of local image contrasts.
Standard deviation	Each gray value is replaced by the standard deviation of the pixels found inside the filter mask (e.g. 3x3). Typical applications include the highlighting of surface defects or edges.

Filter type	Effect
Edge detection (Sobel)	Result image contains edges detected using the Sobel-algorithm (compare image processing literature also). Typical applications include the detection and enhancement of edges and the improvement of local image contrasts or the detection of surface defects.
Multiplication	The gray value of each pixel is multiplied by the choosen multiplier (2x, 4x, 8x, 16x). Values are clipped to 255.
Inversion	Inversion of image

The effect of an active filter is immediately visible in the image. The larger the filter core is selected, the stronger the effect of the filter. The filters are used in the order listed from top to bottom.

Configuring filters:

1. Select the filters in the required order, via the pop-up menus in the column Filter.
2. Enter the size of the filter kernel in the pop-up menu in the column Property. If the setting is "Off", the respective filter is deactivated.
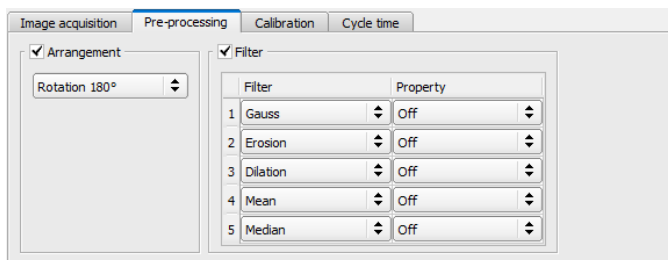
Fig. 49: Tab Pre-processing

8.1.5 Tab Calibration

The function "Calibration" transforms the image coordinates (pixel) into world coordinates (e.g. millimeter). When activated all position and distance data is calculated in the selected unit.

8.1.5.1 Select the calibration method

The calibration methods are divided into two application areas: "Measurement" and "Robotics".
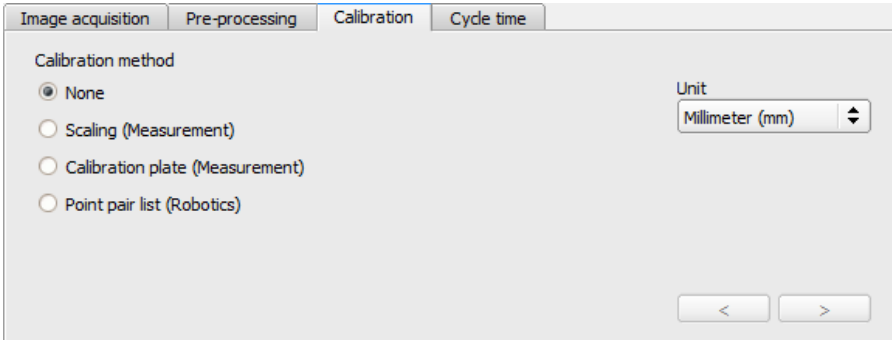
Fig. 50: Select the calibration method

Parameter	Function
Calibration method	Selection of a calibration method: • None: Calibration not active, coordinate determination, display and output in pixels (px) • Measurement: Calibration methods for applications in the field of measurement and testing • Robotics: Calibration methods for applications in the field of robotics
Unit	Desired unit for world coordinates. The following units are available: • mm (millimeter) • cm (centimeter) • m (meter) • in (inch)
"> " / "< "	Go to next / previous step

Calibration method measurement

Method	Function
Scaling (Measurement)	The calibration method "Scaling" serves relative calculation of distances in world coordinates (mm).

Method	Function
- Relative calculation of distances in world coordinates - limited accuracy	This is realized with a simple factor. There is only one factor for both coordinate axis X and Y. The advantage is the very simple function, but accuracy is limited. Errors caused by tilt angle against perpendicular view to the measurement plane or by lens distortion are not corrected by this method. World coordinates are not absolute. The coordinate values refer to the principal point in left, upper corner or the field of view. **Example:** Determination of distances between two objects in mm (Limited accuracy). Additional information:Calibration method Scaling (Measurement) (Page 78)
Calibration plate (Measurement) - Relative calculation of distances in world coordinates - high accuracy	The calibration method "Calibration plate (Measurement)" serves relative calculations of distances in world coordinates (e.g. mm). This is done by image capturing of a calibration plate. By using a large number of points, the known, exact relative position of the points on the plate, this method provides a high accuracy. Errors caused by scaling, x- and y- axis separately, tilt angle against perpendicular view to the measurement plane or by lens distortion are all corrected by this method. World coordinates are not absolute. The coordinate values refer to the principal point in left, upper corner or the field of view. Beside coordinates, distances are also calculated in world frame. **Example:** Determination of distance between two objects in millimeter. (high accuracy) **Additional information:**Calibration method Calibration plate (Measurement) (Page 80)

Calibration method robotics

Method	Function
Point pair list (Robotics) Absolute calculation in world coordinates, in a user defined reference system, e.g. robot coordinate system	The calibration method "Point pair list" serves absolute calculation of positions in world coordinates (e.g. mm). Errors caused by scaling, x- and y- axis separately, tilt angle against perpendicular view to the measurement plane or by lens distortion are all corrected by this method. **Example:** Determination of absolute positions of objects in world coordinates in millimeter (e.g. robot coordinate system) This is realized by the image capturing of a calibration part which is placed by the robot in the field of view. A point pair is set by: - Image coordinate by graphical input in the image, or by numerical input of a value - World coordinate by numerical input given from the robot controller This sequence is done till the desired number of point pairs is achieved in the list. **Additional information:** Calibration method Point pair list (Robotics) (Page 83)

Please note:

All position values and measurement results are corrected. Not to cause longer cycle time the image data are not transformed / displayed rectified. This way a high execution speed, even with calibration active, is provided.

Activation of Calibration is done in two steps:

1. Selection of calibration method:
   Go to next / previous step with buttons **[‹], [›]** on the right hand side of the calibration tab
2. Execution of selected calibration method
   As soon as a calibration method is selected, on the left side in tab "Calibration" the status LED is shown. If calibration is active other functions like detectors can only be processed successfully, if calibration is valid.

Color significance status LED

Color	Status-LED	Point in image and in point pair list:
Green	Calibration valid	Points accurately positioned
Yellow	Calibration valid	Points not accurately positioned
Red	Calibration not valid	/

Please note:

- Scaling, only green is possible: Default- or input value result in scaling factor. No error determination possible.
- Point Pair list (Robtics): With a new job appears green. Default values (9 points) result in correct default calibration.
- Calibration plate (Measurement): With a new job appears red, as so far no calibration with calibration plate happened.

Calibration effects the following detectors / alignments

Detector	Result value
Contour	Center coordinate x, y, angle
Pattern matching	Center coordinate x, y, angle
Caliper	Center coordinate x, y, distance
BLOB	Center of gravity-/ center coordinate x, y; width, height, angle

Alignment	Result value
Contour	Center coordinate x, y, angle
Pattern matching	Center coordinate x, y, angle
Edge detection	Center coordinate x, y

8.1.5.2 Calibration measurement

8.1.5.2.1 Calibration method Scaling (Measurement)

The calibration method "Scaling (Measurement)" serves relative calculations of distances in world coordinates (mm). This is realized with a simple factor for both coordinate axis X and Y. The advantage is the very simple function of the scaling process, although accuracy is limited.
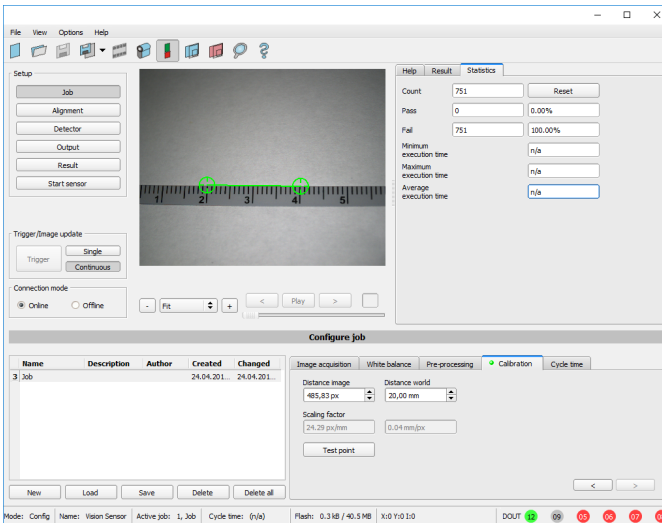
Fig. 51: Calibration method, "Scaling (Measurement)"

Example: Determination of distance between two objects in millimeter.

Parameter Scaling

Parameter	Function
Distance image	Distance in image in pixel (px), by graphical or numerical input
Distance world	Corresponding distance in world by numerical input (in previously selected unit, e.g. mm)
Scaling factor	From above mentioned settings "Distance image" and "Distance world" resulting scaling factor e.g. [x] px/mm or [y] mm/px
Test point	Test point (graphically or values input) is for the user to check calibration of known points / dimensions around the image to confirm satisfactory setting of the scaling factor.
" > " / " < "	Go to next / previous step

Please note:

- Please take care that the optical axis of the sensor is aligned perpendicularly to the measurement plane. This avoids different distortion in x and y axis. Errors caused by tilt angle against perpendicular view to the measurement plane or by lens distortion are not corrected using this method.

- For setting up; place a object with known dimensions (e.g. gauge block) in the field of view.
  Position the both graphical, green crosshairs in the image to the points of the object with a known dimension / distance. The distance in image pixels between the both centres of the crosshairs is displayed in the field "Distance image".
  Now type the known distance in world in field "Distance world" (e.g. in mm). The scaling factor is calculated and displayed. From now on positions and distances are displayed and transferred in world coordinates.

- The size of a crosshair in the field of view can be adjusted as desired. For this purpose, the desired crosshair point must be selected by mouse click, and the size can then be increased or decreased by means of the scroll wheel of the mouse.

- World coordinates are not absolute. The coordinate values refer to the principal point in left, upper corner or the field of view. Beside coordinates, distances are also calculated in world frame.

- This kind of calibration is suitable for standard lenses, integrated or C-mount. However it´s not suitable for telecentric lenses.

8.1.5.2.2 Calibration method Calibration plate (Measurement)

The calibration method "Calibration plate (Measurement)" serves relative determination of e.g. distances in world coordinates (e.g. mm). This is done by image capturing of a calibration plate with one single click!
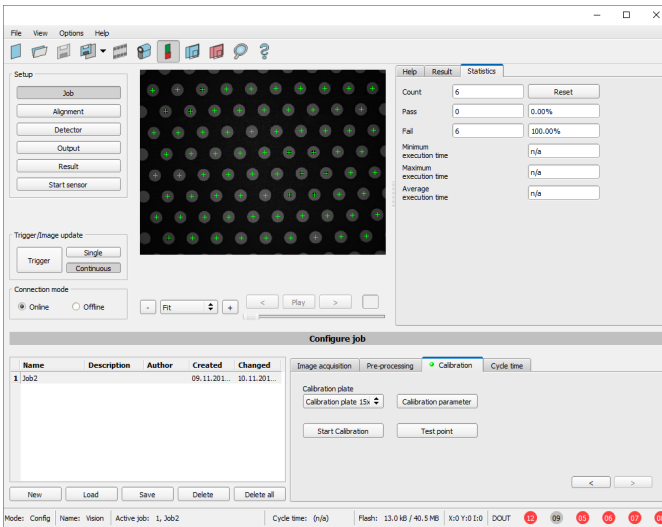
Fig. 52: Calibration method, Calibration plate (Measurement)

Example: Determination of distances between two object in mm (high accuracy).

Sequence calibration via calibration plate

Previously the focus and the shutter of the sensor, and the desired unit must be selected.

1. Use the "Calibration Parameter" button to set the Z-Offset.

2. Place the calibration plate that the field of view is completely covered (see also: Calibration method Calibration plate (Measurement) (Page 80), and Types / sizes of calibration plates (Page 83)).

3. Select the corresponding calibration plate (size and type) via the list box "Calibration plate".

4. With a click to the button "Start Calibration" all visible points of the calibration plate are determined, all detected are marked, and the calibration is calculated.

Parameter Calibration plate (Measurement)

Parameter	Function
Calibration plate	Here the used calibration plate (size and type / number of points) is selected (See also: Advices on optimized use of the calibration plate / boundary conditions (Page 87) and Types / sizes of calibration plates (Page 83)).

Parameter	Function
Calibration parameter	If given, here the z-offset between calibration and measurement plane can be set. Also different read only parameters, as well as deviation parameters are shown in this dialog (see also: Calibration, Calibration parameter (Page 89)).
Start Calibration	Calibration is started. All visible points of the calibration plate are determined, all detected are marked, and calibration is calculated.
Test point	A test point can be set in the image, whose world coordinate values for test and control purposes are displayed in the Test point window.
› / ‹	Go to next / previous step

Please note:

- The sensor can be mounted in any alignment / **Pose** referred to the measurement plane. Anyway a close to perpendicular alignment should be preferred, as this causes less distortion and this way less error correction is needed.
- World coordinates are **not absolute**. The coordinate values refer to the principal point in left, upper corner or the field of view. Beside coordinates, distances are also calculated in world frame.
- This kind of calibration is suitable for standard lenses, integrated or C-mount. It's not suitable for telecentric lenses.
- Normalization: Independent of the position and orientation in which the calibration plate is detected, the coordinate origin always lies in the upper left corner of the field of view (image and world). The zero-degree direction and the positive X-axis point to the east.

Advices on the optimized use of the calibration plate / boundary conditions can be found at: Advices on optimized use of the calibration plate / boundary conditions (Page 87)

Types / sizes of calibration plates

Sizes of calibration pattern	Number of points
50 mm x 37.9 mm	15 x 13
100 mm x 75.8 mm	15 x 13
200 mm x 151.7 mm	15 x 13

In the installation folder: Festo/SBS vision sensor/Documentation/... the available calibration plates can be found as .pdf-file. This can be printed on paper or any other medium. Please consider the setting "actual size", that print out is not scaled. The length of the long edge of the plate must correspond exactly to the number in the name of the plate.

8.1.5.3 Calibration robotics

8.1.5.3.1 Calibration method Point pair list (Robotics)

The calibration method "Point pair list (Robotics)" is used to determine absolute positions in world coordinates (e.g. mm).
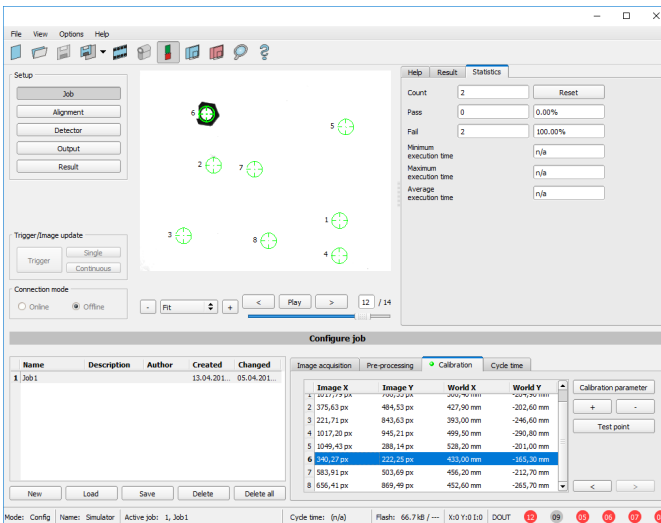
Fig. 53: Calibration method, Point pair list (Robotics)

Example: Determination of absolute positions, and orientation of objects in world coordinates in mm (e.g. robot coordinate system).

Motivation / Benefit

After calibration of the sensor via point pair list, the position of the part to 'pick' is available directly in the absolute coordinate system of the robot!
All errors like scaling, perspective and lens distortion are corrected. In robotics pick and place applications, the robot can now pick the part with the sensor provided robot coordinate values.
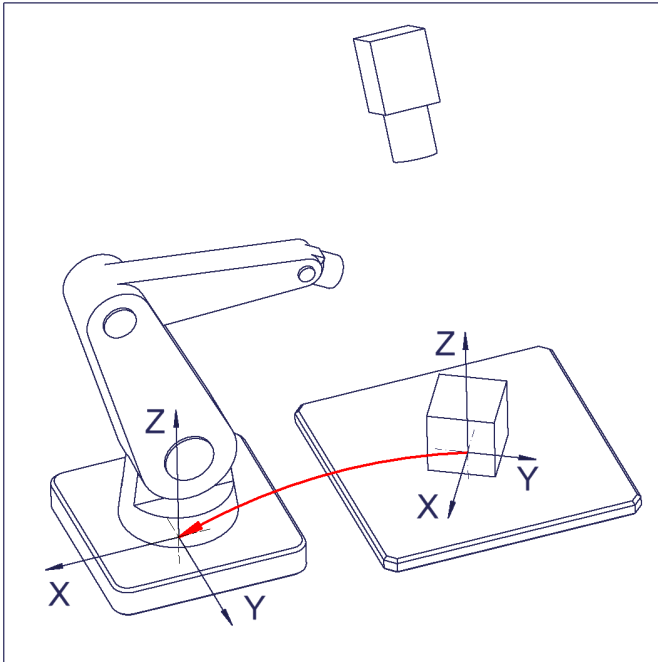
Fig. 54: Position of part to pick directly in robot coordinate system!

Sequence calibration via point pair list

Prior to this, the sensor must be focused, have the correct shutter speed set and the desired unit must be selected.

1. Select the calibration model (with / without correction of the lens distortion), and adjust the Z-Offset if necessary.
2. Select line 1 in list box "point pair list".

3. Place calibration part (preferably flat, symmetric, e.g. similar plain washer) at the exact known world coordinate (e.g. with robot).

4. Place graphically the corresponding crosshair in the image (no. "n" corresponding to line "n" in point pair list) exactly in the center of the calibration object. If necessary zoom image.
Alternatively: use "Snap- Function", that means: right click somewhere inside the calibration part. This way the center of gravity of the calibration part is automatically determined.
The size of the crosshair can be determined via the scroll wheel of the mouse
Preferably use point symmetric calibration parts, as then the center of gravity is independent from orientation. With calibration parts which are not point symmetric please take care that the same orientation is always used (not available with color sensors).
Result: Values of image coordinates in pixel "Image X" and "Image Y" are automatically set in line "n".

5. Now type in the corresponding, known world coordinates in the field "World X" and "World Y" (with e.g. robot: the values displayed in the robot controller).

6. Repeat steps 2-5 as long as the desired number of point pairs is achieved. If more lines are necessary press "+", to delete lines press "-" (min. 6 points, recommended ›10 points).

Automated calibration, see also:

Parameter point pair list (robotics)

Parameter	Function
- Image X **- Image Y** Values in point list	Coordinate values in pixels (px) in the image, via exact graphical positioning of the crosshair to the center point of the calibration part which is placed exactly in world coordinates. Or: use "Snap- Function", that means: right click somewhere inside the calibration part. This way the center of gravity of the calibration part is automatically determined (recommended). ⓘ **Please note:** The snap-function is not available at the color sensors R3C and R2C.
- World X **- World Y** Values in point list	Coordinate values in selected unit (e.g. mm), by direct numerical input of the values in the point pair list. In case of e.g. Robotics Pick & Place these values can be taken from the robot controller when placing the calibration part in the field of view.

Parameter	Function
Calibration parameter	**Calibration model:** With or without correction of lens distortion. **Z- Offset:** (if offset is given) Offset between calibration plane and measurement plane **Different read only parameters** Of the regression calculation and error values. See chapter: Calibration, Calibration parameter (Page 89)
"+" / "-"	Add or delete one line / point. Delete affects the highlighted line.
Test point	A test point can be set in the image, whose world coordinate values for test and control purposes are displayed in the Test point window.
"> " / "< "	Go to next / previous step

Please note:

- The sensor can be mounted in any alignment / pose referred to as the measurement plane. Anyway a close to perpendicular alignment should be preferred, as this causes less distortion and this way less error correction is needed.
- The **accuracy** of the calibration first depends on the quality / accuracy of the point position and secondly on the sufficient number of points. If the calibration is not accurate (yellow points) this can be improved by better precision of position input of the single points.
- This kind of calibration is suitable for standard lenses, integrated or C-mount. It´s not suitable for telecentric lenses.
- The size of a crosshair in the field of view can be adjusted as desired. For this purpose, the desired crosshair point must be selected by mouse click, and the size can then be increased or decreased by means of the scroll wheel of the mouse.

Minimum required number of point pairs is "6" points.

The minimum necessary number of points for calibration via point pair list is 6 points. With minimum this number of points false inputs (like x and y interchanged) can be found by high error values in dialog "Calibration parameters" Calibration, Calibration parameter (Page 89), (if <= 5 points the error values are always = 0, as no errors can be calculated).

To show the quality of point position (how good point positions match with calculated point positions) the points are displayed in the following colors (only meaningful if there is a minimum of 6 points).

Color significance of graphical points in image and lines in Point pair list:

Color	Significance
Green	Calibration valid, points accurately positioned
Yellow	Calibration valid, points not accurately positioned
Red	Calibration not valid

In the case of a yellow point color a yellow line is visible starting in the center of the point. It's lenght and direction is a measure for the absolute value and orientation of the error in relation to the position accuracy of point input in the world frame.

If there are big errors, potentially x- and y- coordinate are interchanged with one or multiple points, or some points are interchanged completely with others.

In the dialog: Calibration, Calibration parameter (Page 89) the **deviation values / errors:** "Mean", "Min"imum error and "Max"imum error are displayed. With these values the exact input positions of the existing points can be optimised.

This calibration method serves alongsid**e with the absolute coordinate values** as well as **the orientation** of the part to pick (if Contour or Pattern matching is used as detector).

The result coordinates of the target object are present in the reference system of the robot!

8.1.5.4 Advices on optimized use of the calibration plate / boundary conditions

- The calibration plate must be clean and plain.
- The plate must be illuminated homogeneously over the entire field of view and must not be overexposed. The bright regions should have a gray value of at least 100 and below 255. The contrast between bright and dark regions should be at least 100 gray values. That means, the image must not be under- or overexposed.
- The calibration pattern should cover the entire field of view of the SBS vision sensor. For a successful, precise calibration it's not necessary that the entire calibration plate is visible. To perform a calibration, at least one search pattern must be found.
- For small calibration patterns, it may be necessary to use two search patterns.
- Calibration works correctly only if the focus and position of the sensor does not change in relation to the measurement plane.

15 x 13, 50mm x 37.9mm
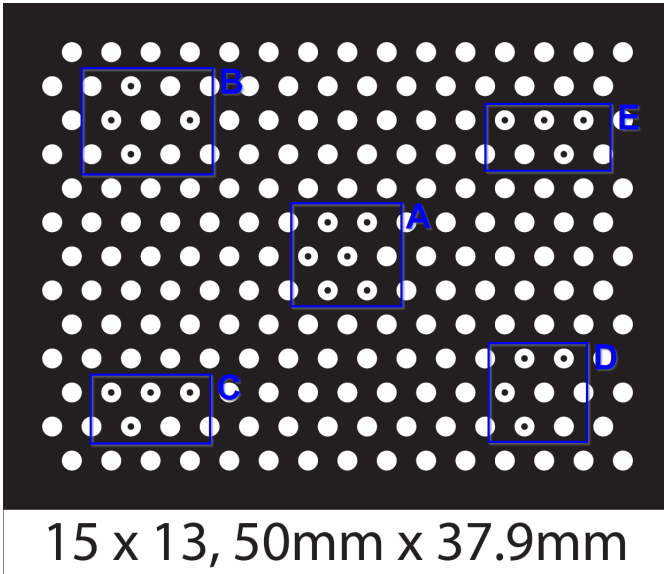
Fig. 55: Calibration plate, blue = search pattern.
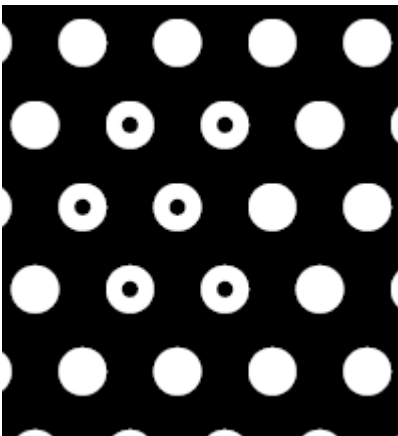
Fig. 56: Calibration plate, detail with smaller black points in the center (see above: blue regions).

8.1.5.5 Calibration, Calibration parameter

Here the calibration and the deviation parameters for optimization are displayed. In addition, the Z-Offset between calibration and measurement plane in Z-direction can be set and compensated.

This kind of calibration is suitable for standard lenses, integrated or C-mount. However it does not work for telecentric lenses.

Fig. 57: Calibration, Calibration parameter

Parameter	Function
Calibration model	
Calibration model: Standard lens, with distortion	Correction of: • Scaling, x and y separately • Tilt angle against perpendicular view to the measurement plane • Lens distortion
Offset calibration / measurement level in Z-direction [1] (Z-Offset)	For Z=0 the calibration and the measurement plane are identical. For Z≠0 the calibration plane is shifted against the measurement plane. The two planes are always parallel. The sign of the deviation results from the Z direction of the right hand calibration coordinate system (thumb = x, index finger = y, middle finger = z) **Please note:** The depth of focus of the sensor must cover the calibration and the measurement plane. Offset calibration / measurement level in Z-direction (Page 93)
Internal sensor parameters	
Focal length	Focus of the lens • With integrated lens: value of the built in lens [2] • With C-Mount lens: Take value written on the used lens and type in. Option: to check plausibility of e.g. z- value with below mentioned "External Sensor Parameters" no malfunction if not used. [1]
Kappa (x10E-6) [2]	Calculated kappa (distortion) value of the lens.
Pixel pitch [2]	Calculated pitch / axial distance from pixel to pixel on the sensor chip. Reduction of resolution in tab "Image acquisition" effects this value.
Principal point / pixel [2]	Point where the optical axis penetrates the measurement plane in the center of the sensor chip, compared with the ideal center point. This values refer to left , upper corner in pixel.
Image size [2]	Image size in pixel
External sensor parameter[S]	
X Y	All three calculated values for the translation of the measurement coordinate system in relation to the device coordinate system.

Parameter	Function
Z	Additional information: External sensor parameters (Page 91)
Rot. X Rot. Y Rot. Z	All three calculated values for the rotation of the measurement coordinate system in relation to the device coordinate system. Additional information: External sensor parameters (Page 91)
Deviation calibration *2	
Mean	Average error of calculated positions against input.
Min.	Minimum error of calculated positions against input.
Max.	Maximum error of calculated positions against input.

*1) Input parameter, *2) Read only parameter

Please note:
In case of large working distances, the estimated calibration parameters must be checked. This is only relevant when using the Z-Offset function.

Additional information:

Coordinate systems and transformations

Coordinate systems	Transformations
	External sensor parameters
	The "External sensor parameters" indicate the position and orientation of the measurement coordinate system in the device coordinate system.

Coordinate systems	Transformations
Device coordinate system Calibration coordinate system e.g. calibration plate Measurement Coordinate system object	
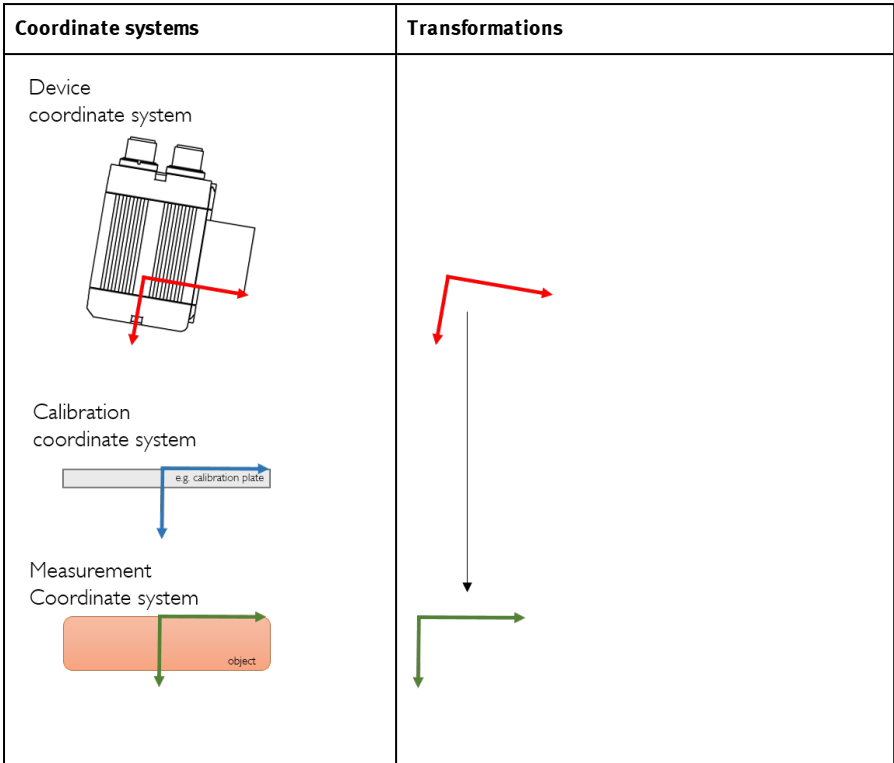
Offset calibration / measurement level in Z-direction

Negative Z-Offset	Positive Z-Offset
If the measurement plane (object) is above the calibration plane, a negative Z-Offset "-ΔZ" is created.	If the measurement plane (object) is below the calibration plane, a positive Z-Offset "+ ΔZ" is created.

Fig. 58: Negative Z-Offset
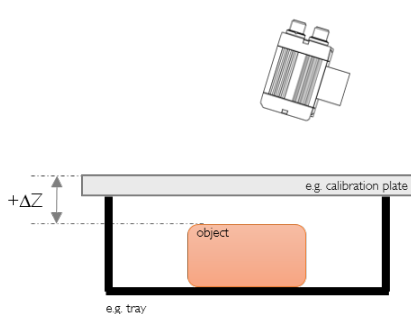
Fig. 59: Positive Z-Offset

8.1.5.6 Calibration via telegrams

Various interface telegrams are available for the calibration, see chapter: Overview telegram (Page 411).

The telegrams can be used for recalibration if a drift in the production process has occurred or if the mounting position of the sensor has changed. The calibration process can be executed automatically, e.g. from the robot controller.

8.1.5.6.1 Automated calibration: Point pair list (Robotics)

Fig. 60: Automated sequence for calibration via point pair list

8.1.6 Tab Cycle time

In tab Cycle time the timing conditions of the SBS vision sensor can be defined.

Next topic: Setup Alignment (Page 97)
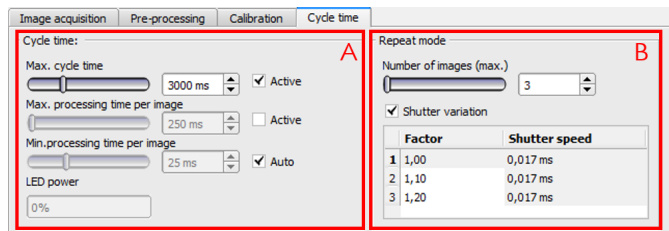
Fig. 61: Setup Job, tab Cycle time

(A) Cycle time	
Parameter	**Function**
Max. cycle time	Parameter to control the minimum and maximum time of a cycle. Inside a cycle some images can be evaluated (in case of "Number of images (max)" >1). Maximum processing time per image interrupts a job after a defined time. The result of a cycle after a timeout is always "not ok". Maximum processing time should be selected higher than the time demand for one execution. The processing time is the time elapsed from trigger till the setting of the digital outputs. If this cycle time should be limited (e.g. if the machine cycle should not be exceeded) this function can be used. The result of all detectors which are not processed / finished after this processing time has elapsed are set to "failed". As the currently processed detector will still be finished, please consider that the adjusted job time may not be met a 100% exactly, and it may last a few milliseconds longer till the job is interrupted. It's recommended to test the real cycle time and to choose a value for this parameter which is a bit smaller / shorter.
Max. processing time per image	Maximum duration of one evaluation inside a cycle including image capturing.
Min. processing time per image	Minimum duration of one evaluation inside cycle including image capturing. Minimum processing time blocks trigger signals which are coming before the minimum processing time is reached. In the case of "Number of images" = 1 (default), the minimum processing time per image corresponds to the minimum cycle time.

(A) Cycle time	
Parameter	**Function**
LED-Power	This value is calculated automatically. Standard Value is 100 %. LED-power may be reduced, if shutter time is quite long and minimum job time is quite short, because the recovery time for the LEDs may be to short in this case. To obtain 100 % LED power, minimum job time should be factor of 10 longer than shutter time.
Auto	If "Auto" is selected the minimum cycle time is automatically adjusted in a way that the LED-power is 100% (B) Repeat mode

Number of images (max.)	
Parameter	**Function**
Maximum number of image capturings, which are processed after one trigger, if the following stop criteria is not fulfilled:	"Overall job result"= positiv (access via Output/Digital output) • "Overall job result"= positiv (access via Output/Digital output) • "Max. cycle time" is not elapsed (if active) Option: • Assign detector to an image, see also: Repeat Mode: Assign the detector to an image (Page 97)
Shutter variation	When Shutter variation is "active", a variation from several different shutter speeds can be set up over a table. Per configured shutter speed an image is aquired, this means that first image is taken with shutter value 1, second image is taken with shutter value 2, third image is taken with shutter value 3, etc. Default setting for "Shutter variation" is off. In this case, the table is not displayed.
Factor and Shutter speed	Default value for "Factor" is: First value = 1.00 (the first factor is always identical to 1.00 and read-only). The user can modify the factor in the table, thereby the "Shutter speed" (second column, read-only) will automatically be updated and an image acquired. By a click into one row of the table, an image with the settings of these table row will be acquired. **Please note:** When changing the "Shutter speed" parameter in "Image acquisition" tab, the shutter speed in the "Shutter variation" listbox is recalculated.

Repeat Mode: Assign the detector to an image

In the setup "Detector" all selected detectors are listed. If the "Number of images (max)" parameter of the repeat mode is greater than 1, the option of assigning a detector to an image acquisition is obtained. In the "Repeat mode" column, this setting can be made for each detector.

- Always: Executed in all image acquisitions
- Recording n: Executed in the corresponding image acquisition

Open the selection table by double-clicking.

	Detector name		Detector	Alignment	Repeat mode
1	Brightness iO	●	Brightness	✓	Always
2	Test 1	●	Gray	✓	Image 1
3	Test 2	●	Gray	✓	Image 2

Fig. 62: Detector list, repeat mode

8.2 Setup Alignment

Alignment compensation can be necessary for objects or characteristics whose position varies in the image. The alignment determines the object / feature position in the image. Three different detection methods (alignment detectors) are available for this purpose.

Mode of function of an alignment detector

An alignment detector is a tracking coordinate system, which is anchored to one selected characteristic. All subsequently defined detectors are aligned in relation to this coordinate system. The aligned coordinate system is drawn in dark blue (for information on the meaning and adjustment of the different frames. See chapter:. Search and parameter zones (Page 271)).

Please note:

- Maximum of one alignment detector can be defined for each job.
- For each detector in the job, it can be selected whether the detector is to be tracked with the alignment or not.
- As alignment requires an extra calculation step, it should only be used if required by the application.

8.2.1 Selection and configuration of an Alignment

Select alignment detector:

1. Click on the setup button "Alignment".
2. Select a detection method in the configuration window **"Method"**.

Detection method	Description, Selection
None	Alignment deactivated
Pattern matching	Detection of any pattern Pattern matching can be used preferably if: • there are only marginal edges, parallel to axis or with strong contrast, but zones with gray pattern in the image. Pattern matching cannot be used if there is an angular deviation / rotation of the part. Rotation tolerance about +/- 5 % depending on the pattern.
Edge detection	The detection of edge should be used: • if an offset of the position occurs in X- and / or Y- direction. • at a maximum angle offset (rotational offset compared to the teach-in position) of approx. ± 20° (depending on object and application). • if there are edges with strong contrast, parallel to the axis. If above mentioned criteria are fulfilled, edge detection is a very quick method of alignment.
Contour detection	Detection of contours and edges at any angle Contour detection must always be used if: • there can be an angular offset (rotation against teach in position) occur up to 360°. It can be used preferably if there are edges of any shape but with good contrast. The relatively complex contour detection function usually results in a comparatively longer cycle time.

Configuration of alignment detector:

1. Adapt the position and size of the search and parameter zones displayed on the screen if necessary.
2. Configure the alignment detector in the Parameters tab .

Activation of alignment for detectors

In the "Detector" setup, all selected detectors are listed. In the "Alignment" column, it is possible to select for each detector whether it is to be aligned by the adjusted alignment or not. Default value is "Active".

	Detector name		Detector type	Alignment
1	Detector 1	●	Pattern matching	☐
2	Detector 2	●	BLOB	☑
3	Detector 3	●	Contrast	☑

Fig. 63: Detector list, alignment active / inactive

Reset

The "Reset" button can be used to restore the factory settings for the selected alignment detectors.

8.2.2 Alignment Pattern matching

This alignment detector is suitable for the detection of any patterns, even without clear edges and/or contours. The pattern is taught in and placed over the image during the subsequent check. A match is made at the largest similarity value.

8.2.2.1 Tab Color channel

In the color channel tab, a color image (3 channel) can be converted to a gray value image (1 channel). In contrast to the gray value image of a monochrome SBS vision sensor, contrasts can be significantly increased. The highlighting of a color can be set individually for each detector. Thus, the flexibility compared to the use of optical color filters is significantly higher.

The image displayed is dependent on the selected detector.

- Color detectors: Display always colored.
- Object detectors: Monochrome image, display dependent upon selected color model and color channels.

The following parameters can be configured in the Color channel tab:

Parameter	Function
Color model	Color models:

Parameter	Function
	RGB, Color model RGB (Page 274), HSV, Color model HSV (Page 275), LAB, Color model LAB (Page 275)
Selection color filter	Depending on the color space, all or part of the following color filters are available: Color channel (default) Color distance Binarization
▮▮▮	Switching the image between color and monochrome.

8.2.2.1.1 Selection color filter

The following color filters are available:

Color channel (default)

The selected color channel is used as a gray value image.
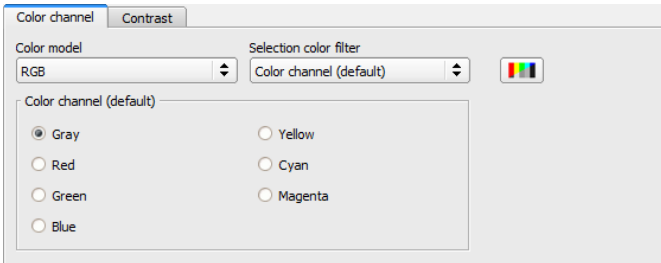
Fig. 64: Color filter, Color channel (default)

Color distance

A color is selected as reference color by specifying the color model values or by pipette. The gray value image indicates the distance of each pixel to this reference color. Typical application: Segmentation of characters for OCR.
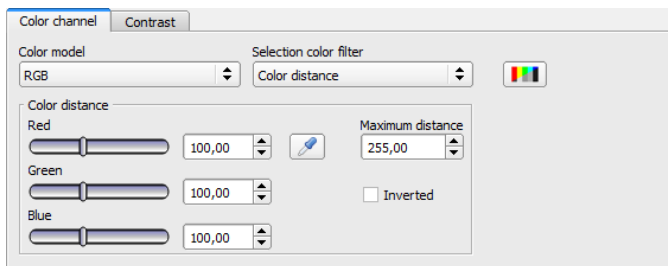
Fig. 65: Color filter, Color distance

Parameter		Function
Red Green Blue	Lightness A B	Color channels: The color channel can be set via the slider or by entering a value (default 0).
Pipette button		With the selection of the pipette button and a subsequent click into the image, the selected color channel is determined automatically.
Maximum distance		Distance of the current color versus the taught-in color. Colors that will exceed the maximum color distance will be black or white depending on the setting of "Inverted".
Inverted		Inversion of the color distance image.

Binarization

A color range is selected. All pixels within this color range become white. Pixels with deviating color values become black.
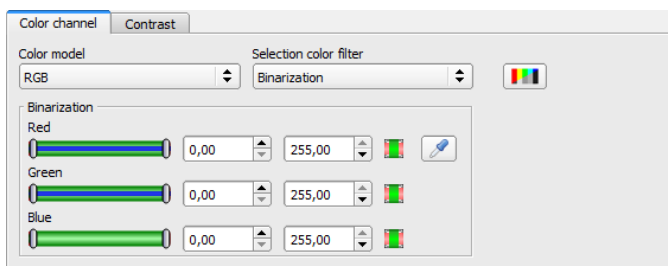
Fig. 66: Color filter, Binarization

Parameter			Function
Red Green Blue	Hue Saturation Value	Lightness A B	Determination of the color range. The color ranges can be set via the slider or by entering a value.
Inverting button			The current setting is inverted when selecting the button.
Pipette button			With the selection of the pipette button and a subsequent click into the image, the selected color channel is determined automatically.

8.2.2.2 Tab Parameters

The following parameters can be configured in the Parameters tab:

Parameter	Function
Threshold	Zone for the required concordance of the found sample with the taught sample
Accurate - fast	Number of search levels / coarsening levels High value: faster = riskier (candidates may be overlooked) Smaller value: slower = less risky (all candidates)
Pattern	Shows the taught sample = red frame
Edit pattern	By editing the ROI parts can be masked out of the search area. See chapter:: Function: Mask (Page 130)
Lock	Lock / Unlock Pattern: In locked status the taugth pattern is protected against (unintentional / accidental) changing, e.g. modification of the teach region. Unlock to modify taught pattern.
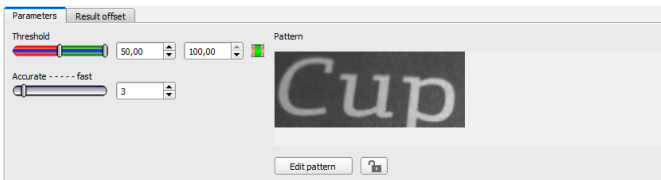
Fig. 67: Alignment Pattern matching, tab Parameters

8.2.2.3 Tab Result offset

With the Result offset, the final position of a found object can be modified. This can be useful when working with a robotic coordinate systems and needing to define a 'pick point' for example.

Settings in result offset tab:

Parameter	Function
None	Automatically determines the of the Region Of Interest or ROI.
Offset	Free selectable position (graphically or by value input). For example for robot gripper use. • X: Offset in X- direction (ref. ROI center) • Y: Offset in Y- direction (ref. ROI center) • Angle: angle offset (ref. ROI orientation)
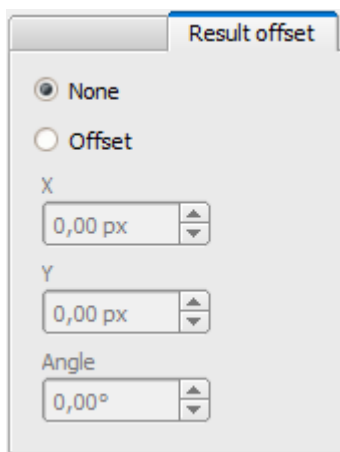
Fig. 68: Result offset

8.2.3 Alignment Edge detector

The alignment determines the object position and thus the tracked coordinate system based on the intersection point of edges in the image. Angle positions up to approx. ±20% deviation (depending on the object) can be compensated.

8.2.3.1 Structure of the edge detector

The alignment "Edge detector" is carried out via "Probes". Depending on the probe type, there are between one and three probe/s. The search region of a probe is indicated by the yellow frame (ROI). Within this ROI the object is searched and the edge of the object is scanned. The scanning is performed in the direction of the yellow arrow, the "search direction". This yellow arrow can also be used to turn the search region of the detector. From the starting point of the ROI, search stripes (number can be set as desired) are sent out in search direction. If the search stripe touches the edge of the object, the "touching point" of the search stripe is marked with a cross at this point. Depending on the number and the setting, there may be a "winner search stripe", the touching point of which is shown in bold. Which edge of an object is touched is indicated at the "scanning line" in the search direction. If an object is not scanned from both X and Y direction but only from one direction, the second scanning line is at the center of the search region. The arrows with the origin at the intersection of the scanning lines form the aligned coordinate system. In the following figure, the structure of the alignment Edge detector is visualized.

1	Object
2	Probe 1
3	Search region of probe 1
4	Scanning line
5	Tracked coordinate system
6	Touching point of winner search stripe
7	Touching point of a search stripe
8	Search direction of the probe
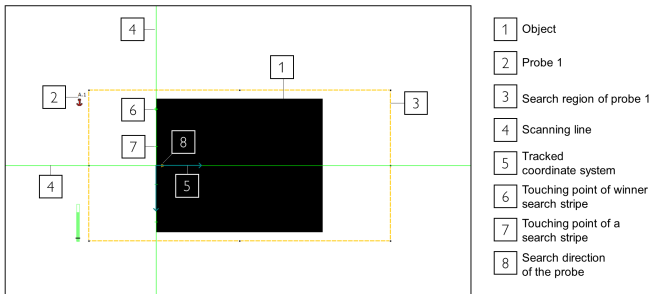
Fig. 69: Structure of Edge detector

8.2.3.2 Tab Color channel

See chapter: Tab Color channel (Page 99)

8.2.3.3 Tab Parameters

The probe type must be selected to perform the edge detection. The probe type determines which change in position of the object should be aligned: Shift in one or two directions, rotation. The following probe types are available:

Probe type		Function	Recommended use with varying object position		
			... in one direction	... in two directions	... with rotation
1		**One probe: Alignment by shift in one direction** Alignment of object by shift in one direction. The position of the scanning line is determined by the search direction of the detector. The other scanning line is in the middle of the search region (ROI). ○ **Please note:** ⓘ A rotation of the object position is not aligned.	✓		
2		**One probe: Alignment by shift in one direction and rotation** Alignment of object by shift in one direction and rotation. The position of the scanning line is determined by the search direction of the detector. The other scanning line is in the middle of the search region (ROI).	✓		✓
3		**Two probes: Alignment by shift in two directions** Alignment of object by shift in two directions. The position of the scanning line in X direction of the coordinate system is determined by probe 1. The position of the scanning line in Y direction of the coordinate system is determined by probe 2. The origin of the coordinate system lies at the intersection of the two scanning lines. ○ **Please note:** ⓘ A rotation of the object position is not aligned.		✓	

Probe type	Function	Recommended use with varying object position		
		... in one direction	... in two directions	... with rotation
4	**Two probes: Alignment by shift in two directions and rotation** Alignment of object by shift in two directions and rotation. The position of the scanning line in X direction of the coordinate system is determined by probe 1. The position of the scanning line in Y direction of the coordinate system is determined by probe 2. The origin of the coordinate system lies at the intersection of the two scanning lines. In addition, the orientation of the object is determined. Probe 2 is rotated and moved according to the object movement. The position of probe 2 is aligned relative to the position and orientation of the scanning line of probe 1.		✔	✔
5	**Three probes: Alignment by shift in two directions and rotation** Alignment of object by shift in two directions and rotation. A straight line is drawn through the touching points of the winner search stripes of probe 1 and 2. This scanning line (12) determines the position and orientation of the coordinate system. The origin of the coordinate system lies at the intersection of scanning line 12 and scanning line 3. Probe 3 is rotated and moved according to the object movement. The position of probe 3 is aligned relative to the position and orientation of the scanning line 12.		✔	✔

After selecting the probe type, the corresponding parameters must be determined.
The following parameters can set in the Parameters tab:

Parameter	Function
Edge strength	Edge strength / contrast at which an edge should be detected as an edge.
Smoothing	The edge contour is smoothed in search direction. With larger values, noisy edges, blurred edges or edges that are not perpendicular to the search direction are detected more reliably. In addition, light-dark-light or dark-light-dark transitions which are close together can be ignored with larger values. Thus, interfering edges, e.g. scratches, can be hidden. The effect of smoothing can be displayed graphically using the button "Results".
Transition	With the "Transition" parameter the edge transition can be determined.
• Both directions	Edge transition from light to dark and vice versa.
• Light → Dark	Edge transition from light to dark.
• Dark → Light	Edge transition from dark to light.
Search stripes	Number of parallel search stripes into which the width of the search region is divided. Edge detection is carried out in each search stripe and the first edge is decisive.
Edge position	The parameter "Edge position" determines which edge is to be detected from the search direction. It is determined how the winner search stripes and thus the edge position are determined.
• First	The first edge in search direction is detected. The distances from the beginning of the search region to the touching points of all search stripes in search direction are determined. The winner search stripe is the one with the shortest distance to the beginning of the search region.
• Last	The last edge in the search direction is detected. The distances from the beginning of the search region to the touching points of all search stripes in search direction are determined. The winner search stripe is the one with the longest distance to the beginning of the search region.

Parameter	Function
• Median	The distances in search direction from the beginning of the search region to the touching points of all search strips are determined. Then the median value of these distances is formed.
• Mean	The distances in search direction from the beginning of the search region to the touching points of all search strips are determined. Then the mean value of these distances is formed.
Orientation	The "Orientation" parameter defines the type of the scanning line determination.
• Best-fit line	In this setting, the scanning line is determined by placing a best-fit line through all search stripes.
• Edge guide	In this setting, a scanning line is determined which acts like a mechanical edge stop. This makes it possible to achieve more robust results for convex-shaped edges than with a simple best-fit line.
Search direction	This parameter determines the search direction of the probes. From this direction the object edge is aligned. All probes can be rotated with the small black arrow.
• ▭	The search direction takes place in only one direction, the direction of the yellow arrow (ROI). The touching points and thus the origin of the coordinates lie at an edge of the object.
• ▭	For each search stripe, a touching point is determined from both directions of the probe. Then the center between these touching points is determined. The origin of the coordinate system is at the center of the winner search stripe, i.e. in the object.
Results	Opens the results and histogram window. For more information, see Results / Histogram display (Page 180)
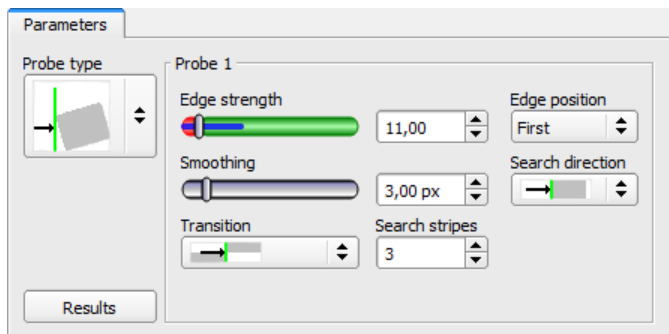
Fig. 70: Alignment Edge detector, tab Parameters

Optimization of execution speed:

- Search zone for position (yellow frame) only as large as required
- Reduce search stripes
- Reduce smoothing value
- Reduce resolution to QQVGA, QVGA or VGA instead of WVGA.

Attention:
The global parameter, affects all detectors!

Improve robust detection:

- If edges are blurred: increase smoothing value
- If interfering edges such as scratches are detected: increase switching threshold or / and smoothing value
- If edge is not vertical to search direction: increase search stripes

Effect of Number "search stripes"

"Search stripes" represent the how many search stripes the width of the search area is divided into. Edge detection is processed in each search stripe over the whole width. The first edge which is detected is the overall result of all search stripes. By increasing the number of search stripes it's assures that the first edge in the search area is found. By increasing search stripes it may happen that the found edge strength fluctuates, e.g. if only the half width of the search area is covered with an edge. This is because the first – not the strongest – edge which is above the threshold is detected.

Further information on edge detection see chapter: . Further explanations to Edge detector (alignment) (Page 110)

8.2.3.4 Further explanations to Edge detector (alignment)

8.2.3.4.1 Effect of Number "search stripes"

"Search stripes" represent the how many search stripes the width of the search area is divided into. The edge detection is performed separately in each search stripe. The first edge which is detected is the overall result of all search stripes. Increasing the value of "Search stripes", increases the chance to find the very first edge in the search area.

By increasing "Search stripes" it may happen, that the threshold value fluctuates strongly, e.g. if just the half of the search area is covered by the edge. The reason therefore is, that the first, not the strongest, edge is detected, which is above the threshold limit in search direction.

<table>
<tr>
<td colspan="2">Edge detector with search stripes = 1. The dominating edge, perpendicular to the search direction is found.</td>
</tr>
<tr>
<td>Settings in tab parameters: Search stripes = 1</td>
<td>
Fig. 71: Parameter "Suchstreifen" = 1</td>
</tr>
<tr>
<td>Image displayThe dominating edge, perpendicular to the search direction is found.</td>
<td>
Fig. 72: Dominating edge, perpendicular to the search direction</td>
</tr>
</table>

Edge detector with search stripes = 1. The first edge perpendicular to the search direction is found.	
Settings in tab parameters: Search stripes = 3	 Fig. 73: Parameter "Suchstreifen" = 3
Image display: The first edge perpendicular to the search direction is found.	 Fig. 74: First edge perpendicular to the search direction is found
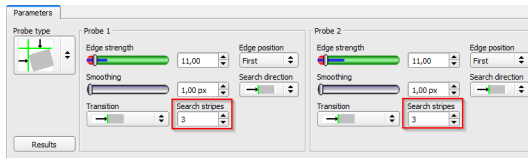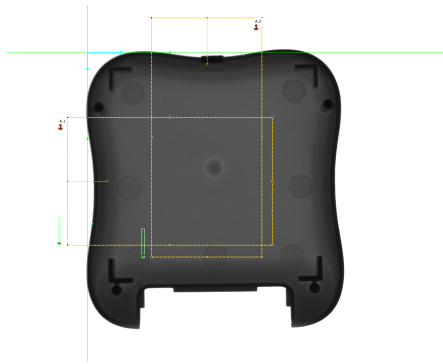
8.2.3.4.2 Function of Smoothing to sharp or blurred edges

The edge strength represents the assumption of edge steps over a certain area in search direction, which is quantified in "Smoothing".
With sharp edges the edge strength is not increased with increasing sigma.
But with blurred edges the edge strength is increased by increasing sigma value.

Edge detection of sharp and blurred edges with a low smoothing value	
Settings in tab parameters: Smoothing = 1	Fig. 75: Parameter Smoothing = 1
Image display: Edge detection of sharp edge. High edge strength with low smoothing.	Fig. 76: High edge strength with low smoothing.

Edge detection of sharp and blurred edges with a low smoothing value	
Image display: Edge detection of blurred edge. Low edge strength with low smoothing.	 Fig. 77: Low edge strength with low smoothing.
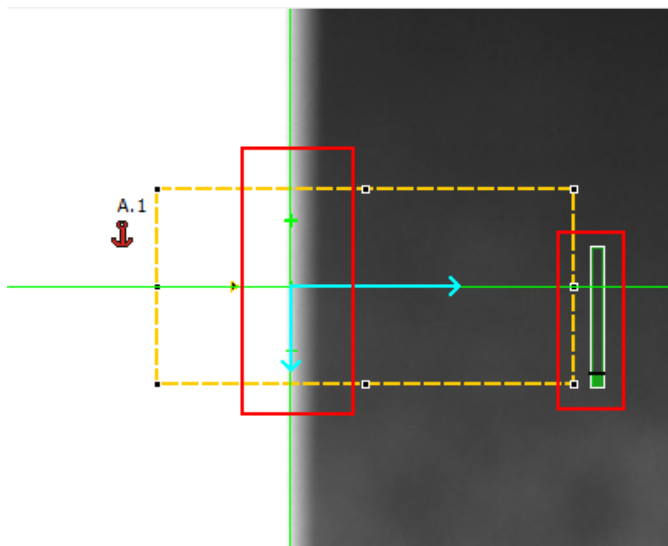
Edge detection of sharp and blurred edges with a low smoothing value	
Settings in tab parameters: Smoothing = 6	 Fig. 78: Parameter Smoothing › 1

Edge detection of sharp and blurred edges with a low smoothing value
Image display: Edge detection of blurred edge. High edge strength with high smoothing. Fig. 79: High edge strength with high smoothing
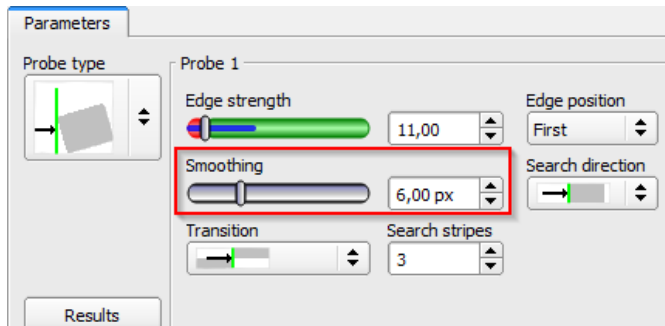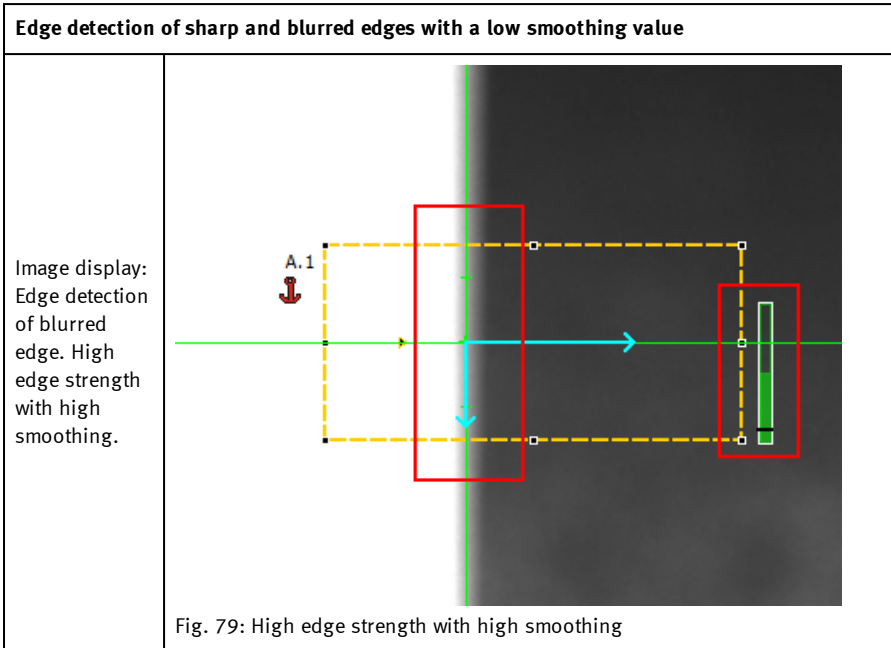
8.2.3.4.3 Function of Smoothing to residual edges

Like mentioned above, the edge strength represents the assumption of edge steps over a certain area in search direction, which is quantified in "Sigma" (smoothing). If in this area edges are found with different polarity (dark- bright: positive polarity, bright-dark: negative polarity) it's edges steps can neutralize each other. This can be used to eliminate residual edges, by choosing a sigma value which is high enough.

Edge detection with smoothing = 1. Residual edge is not eliminated.
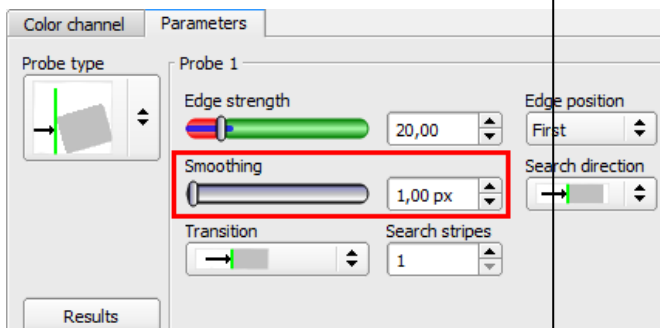
Settings in tab parameters: Smoothing = 1	 Fig. 80: Parameter Smoothing = 1
Image display: Residual edge is not eliminated.	 Fig. 81: Residual edge is not eliminated
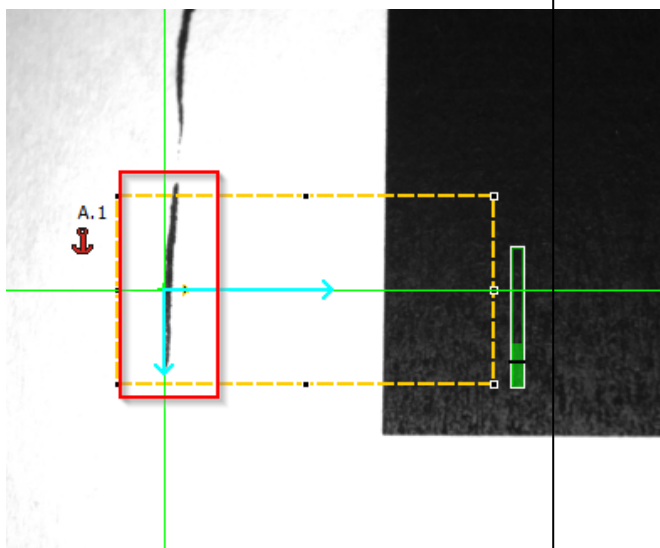
Edge detection with smoothing › 1 Residual edge is eliminated.	
Settings in tab parameters: Smoothing › 1	 Fig. 82: Parameter Smoothing › 1
Image display: Residual edge is eliminated.	 Fig. 83: Residual edge is eliminated

8.2.4 Alignment Contour detection

This detector is suitable for detecting contours by means of edges. The contours of an object in the search area are taught and stored in the sensor. In Run mode the sensor searches the position of the best fit with the taught contour. If the fit is higher than the selected threshold the

result is positive. The function contour detection can work incomplete 360° angular detection mode, i.e. the object can be rotated in any angle (the angular settings must be set accordingly).

8.2.4.1 Tab Color channel

See chapter: Tab Color channel (Page 99)

8.2.4.2 Tab Parameters

The most important parameters for contour detection can be set in the Parameters tab.
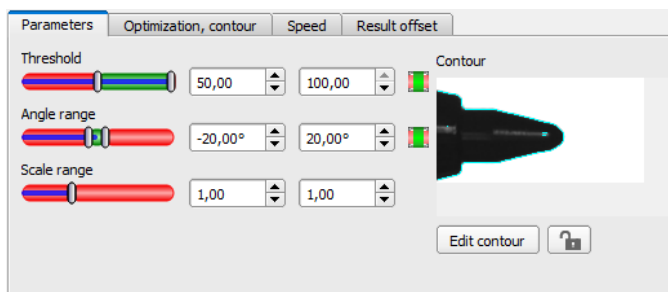
Fig. 84: Alignment Contour detection, tab Parameters

The pale blue edges in the lower right corner (high contrast changes in the image) have been identified and marked based on the parameter settings. The found edges / contour can be influenced by changing these parameters, or by the function "Edit contour". The SBS vision sensor now searches this contour in the search area (yellow frame).

The following parameters can set in the Parameters tab:

Parameter	Function
Threshold	Zone for required match of found contour with taught contour.
Angle range	Angle range in which search is carried out (large range means longer process time)
Scale range	Detection also of enlarged or reduced objects in a given scale range.
Contour	Shows the taught contour (red frame in the field of view)
Edit contour	By editing contour, parts of the search area can be masked out. The parts which are not relevant for an examination can removed like using an eraser. Masks can also be inverted. Next topic: Function: Mask (Page 130)

Parameter	Function
Lock	Lock / Unlock Contour: In locked status the taught contour is protected against (unintentional / accidental) changing, such as modification of the teach region. Unlock to modify taught contour.

Additional information:

Optimization of the execution speed:

- Search zone for position (yellow frame) only as large as necessary.
  Please note: The contour is found as long as the center point of the pattern is inside the search area!
- Please note: The contour is found as long as the center point of the pattern is inside the search area!
- Search zone for scale only as large as necessary
- Reduce resolution to QVGA instead of VGA

> **Attention:**
> The global parameter, affects all detectors!

- Set "accurate – fast" to fast
- Increase value "Min. contrast pattern". Take care that the relevant contours are still visible in the display.
- Increase value "Min. contrast image".
- Especially in the case of alignment: Use alternate reference pattern For example with higher contrast, so that "Min. contrast pattern" and "Min. contrast image" can be increased.

Robust detection:

- Search zone for position (yellow frame) sufficiently large?
- Search zone for angle sufficiently large?
- Search zone for scale sufficiently large?
- Contrasts for model and image suitably set?
- (for model visible in sample)
- Are there several overlapping objects in the image?
- Distinctive edges available? Re-teach if necessary.
- "Min. contrast pattern" set to a suitable value? If in the taught pattern the relevant contour lines are not shown completely: decrease "Min. contrast pattern". If there are too many contour lines shown: increase "Min. contrast pattern".
- "Min. contrast image" set to a suitable value for the current image? If the current image(s) do have a higher / lower contrast than the taught reference image /pattern please increase / decrease the value of "Min. contrast image" accordingly.

- If in the taught pattern the relevant contour lines are not shown completely: decrease "Min. If there are too many contour lines shown: increase "Min.
- Contour found at wrong position? If the taught pattern is not unique, teach in a new contour.
- If the result value is fluctuating strongly from image to image? Take care that there are no "false" edges taught (edges because of shadows, or fragments of contours, which are not desired in the contour model). Increase value "Min. contrast pattern". With the help of "Edit contour" search areas can be hidden.

Parameter Angle range: Rotational direction of angle

Fig. 85: Rotational direction of angle

8.2.4.3 Tab Optimization, contour

In the "Optimization, contour" tab further settings for the edge transition and the contrast can be made.
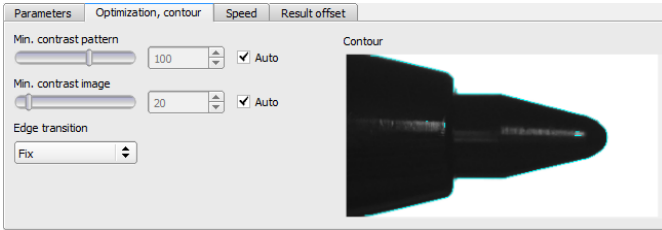
Fig. 86: Alignment Contour detection, tab Optimization, contour

The following parameters can be configured in the Optimization, contour tab:

Parameter	Function
Min. contrast pattern	Minimum contrast required with taught model for an edge to be detected as one.
Min. contrast image	Minimum contrast required in current image for an edge to be accepted as one.
Edge transition • Fix • Fix + inverted • Flexible	The parameter "edge transition" can be used to determine the transition between object/contour and background. Select whether the contour is to be detected only on the taught-in background ("Fix"), on the taught-in and inverted background ("Fix + inverted") or on any background ("Flexible"). See also "Additional information:"
Auto	Automatic selection

Edge transition

Example:

A gray object is taught-in in front of a brighter background, as shown in the following figure.

Fig. 87: Taught-in contour in front of a brighter background

The following table shows the results of the contour detector with the respective settings for the edge transition.

Settings for parameter "Edge transition"	Bright background	Dark background	Inconsistent background
Fix	 Contour detector: OK	 Contour detector: not OK	 Contour detector: not OK
Fix + inverted	 Contour detector: OK	 Contour detector: OK	 Contour detector: not OK
Flexible	 Contour detector: OK	 Contour detector: OK	 Contour detector: OK

8.2.4.4 Tab Speed

Using the adjustable parameters in the Speed tab, execution time of the sensor can be altered. Adjusting the Search levels alters the level of detail and corresponding time applied to a given search. The search is either performed less finely, i.e. the search is canceled sooner and is therefore faster, or even finer details are taken into account in the search, i.e. it is searched for longer and the search is slower.
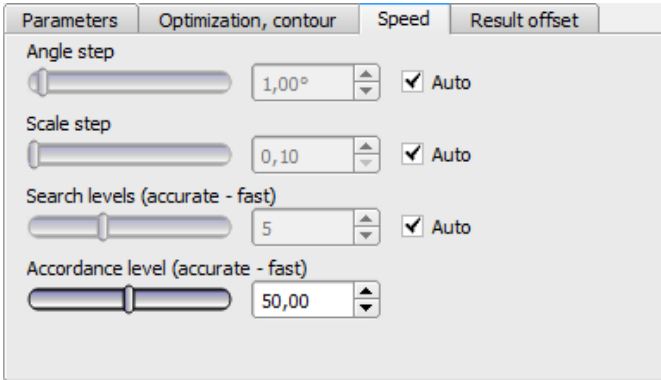
Fig. 88: Alignment Contour detection, tab Speed

The following parameters can be configured in the Speed tab:

Parameter	Function
Angle step	Sensitivity of search throughout the selected angle range in degrees [°]
Scale step	Sensitivity of search throughout the selected scale range
Search levels (accurate - fast)	Number of search levels • High value: faster = riskier (candidates may be overlooked) • Small value: slower = less risky (all candidates)
Accordance level (accurate - fast)	Candidates that score less than indicated will automatically be rejected during the search. • High value: early rejection = quicker = riskier • Small value: late rejection = slower = less risky In case of false results this value can be decreased (more accurate).
Auto	Automatic selection

8.2.4.5 Tab Result offset

See chapter: Tab Result offset (Page 103)

8.3 Setup Detectors

Each job contains one or several inspection steps (detectors), which you can define here. By clicking on the "Defector" button, or the "New" button under the Detector list, a window with a list of all available detectors opens. Drawings in the image (yellow, red frames etc.) can be activated or deactivated for any detector or category in the menu item "View/all drawings". With "View/drawings of current detector only", all drawings on the screen can be deactivated with the exception of the detector currently being processed.

For information to the meaning and adjustment of the different frames see chapter: Search and parameter zones.
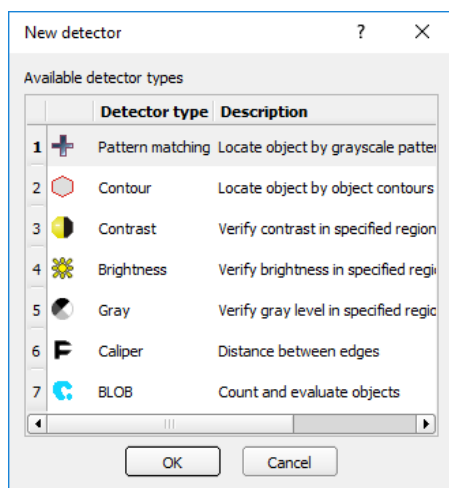
Fig. 89: Detector list for selection (here Object sensor)

8.3.1 Creating and adjusting detectors

Types of detector:

- Detector Pattern matching (Page 126)
- Detector Contour (Page 135)
- Detector Contrast (Page 143)
- Detector Brightness (Page 150)
- Detector Gray (Page 146)
- Detector BLOB (Page 153)
- Detector Caliper (Page 172)

- Detector Barcode (Page 181)
- Detector Datacode (Page 191)
- Detector OCR (Page 202)
- Detector Color area (Page 217)
- Detector Color list (Page 219)
- Detector Color value (Page 214)

Create new detector:

1. Click on "New" button under the selection list in the configuration window and select the type of detector required. A new detector entry appears in the selection list.

2. Edit the name of the detector by double clicking on "Name"

Configure detector:

1. Activate the detector in the selection list and assign a name for each detector.

2. Graphically define the appropriate Search and parameter zones (Page 271) within the image.

3. Configure the detector by entering / adjusting the parameters in the Parameters and if necessary Advanced tabs in the configuration window. Which tabs are shown depends on the type of detector selected.

Configure overlay:

In the menu "View / Overlay settings ...", the overlays in the image (ROIs in yellow, red, etc.) can be activated or deactivated for any detector or category. In "View / Overlay current detector only" or with the frame symbol button, all markings in the image can be switched off except for those of the currently processed detector.

Functions for administration of detectors:

Control panel	Function
New	Adds new detector › dialogue box with above-mentioned detector selection list appears
Copy	Copies all parameters from one detector to one or several others. The parameter zones are not copied. All detectors must be from the same type. Copy process: Create all desired destination detectors; they must be of the same type as the source detector. Mark source detector in the list Click to button "copy" A list will appear, mark all desired destination detectors (to select several press "Ctrl" key). Click "Copy" to confirm

Control panel	Function
Reset	Resets parameters, search and parameter zones of selected detector to standard values
Delete	Deletes the selected detector
Delete all	Deletes all of the detectors in the list

Please note:

"Flash x.x/yyyy.y kB" appears in the bottom corner of the screen, indicating first the memory used by the current configuration x.x), and the memory available on the sensor (yyyy.y) in kB. Should the memory used exceed the available memory, this indicator switches to red as there is not enough space for the current settings on the sensor. In this case you can delete other jobs from the sensor before transfer.

8.3.2 Selecting a suitable detector

Next topic: Detector Pattern matching (Page 126)

The following detectors are available in

Type of detectors	Description
Pattern matching	Part detection using pattern matching, X- and Y-translational
Contour	Part detection using object contour, up to 360° rotation
Contrast	Evaluation of contrast in selected search zone
Brightness	Evaluation of brightness in selected search zone
Gray level	Evaluation of gray values in selected search zone
BLOB	Count and evaluate objects
Caliper	Distance between edges
Color area	Barcode reading 1D Codes (Code reader)
Color list	Data code reading Datacodes (Code reader)

Type of detectors	Description
Color value	Optical character recognition (Code reader)
Barcode	Color verification inside area
Datacode	Color verification inside list
Optical Character Recognition OCR	Output of color values

8.3.3 Detector Pattern matching

This alignment detector is suitable for the detection of any patterns, even without clear edges and/or contours.
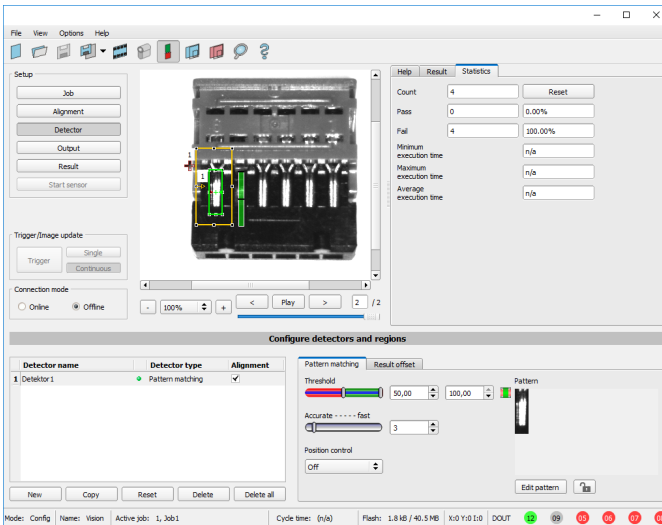
Fig. 90: Detector Pattern matching

8.3.3.1 Detector Pattern matching, tab pattern matching

Parameter	Function
Threshold	Zone for the required concordance of the pattern found with the pattern taught.
Accurate - fast	Number of search levels / coarsening levels (Possible settings 2 - 10) Higher value: faster = riskier (overlook candidates)

Parameter	Function
	Smaller value: slower = less risky (all candidates)
Position check	Checks whether the pattern found is in the right position. If position check is activated, the position frame is shown in blue (either rectangular or elliptic). The center of the pattern must be within the blue frame.
Pattern	Shows the taught pattern = contents of the red frame
Edit pattern	By editing the mask you can mask out regions of the search area. The regions which are not relevant for this examination can be painted out like using an eraser. Masks can also be inverted.
Lock	Lock / Unlock Pattern. In locked status the taught pattern is protected against (unintentional / accidental) changing by e.g. modification of the teach region. Unlock to modify taught pattern.

For newly generated detectors, all parameters are preset as standard values, suitable for many applications.

Optimization Pattern matching:

Execution speed:

- Search zone for position (yellow frame) is only as large as necessary.
  Attention: The search area marks the area where the center point of the pattern is searched!
- Reduce resolution to QVGA instead of VGA

  Attention:
  The global parameter, affects all detectors!

- Set "accurate – fast" to fast

Robust pattern detection:

- Select the search region for position (yellow frame) sufficiently large.
- Reduce search levels.
- Select a distinctive gray value pattern, re-teach if necessary.
- If found at wrong position: use distinct sample, re-teach if necessary.

If, directly after teach, the found position (green frame) is not identical with teach area (red frame) the slider "Accurate – fast" should be set to "Accurate".

8.3.3.2 Tab Color channel

See chapter:

8.3.3.3 Tab Result offset

See chapter:

8.3.3.4 Pattern matching application

In this example a metal contact (left side) in a black plastic part is taught as pattern and is detected with a high score value, as the metal contact is mounted (Threshold near 100 %).
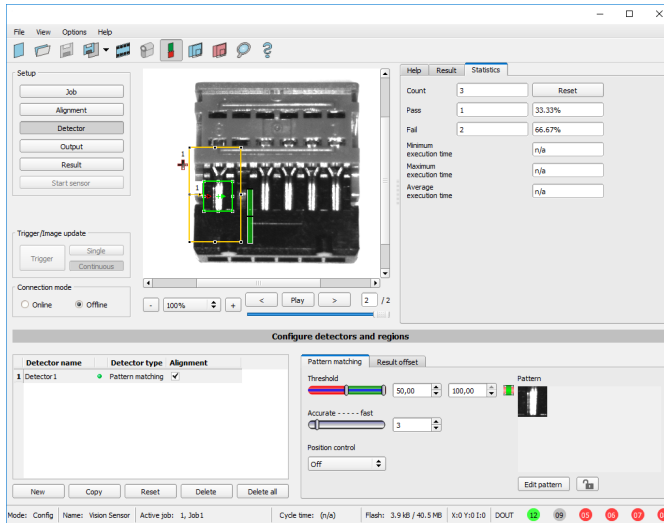
Fig. 91: Pattern matching, application example, positive result
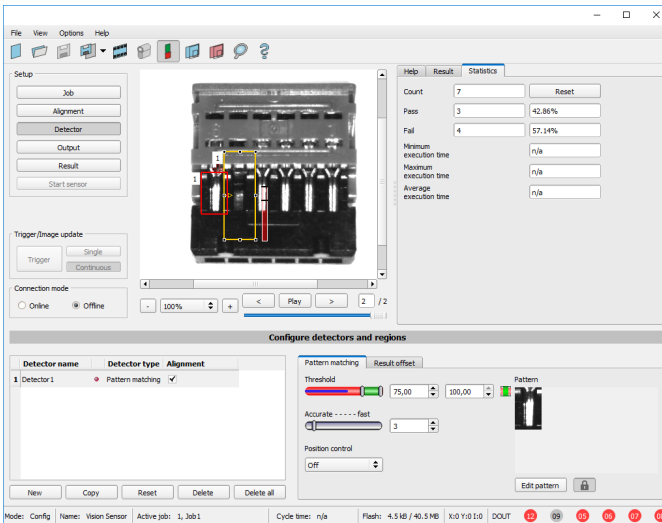
Fig. 92: Pattern matching, application example, negative result

If the same pattern matching is performed at a position, where the metal contact searched for is not mounted, the score value does not reach the threshold and a negative result is given. With the function "Pattern matching", the detection is made by the gray values of the pixels at the corresponding position in the image. As here the inner, shiny and therefore bright region does not exist, and instead of this the gray values of the pixels in the corresponding position do have lower (darker) values, the score value is significantly lower than with the contact mounted. But, as big regions of the search area are matching (the outer dark frame of the black plastic) the score value is not zero, but approx. 70 %.

The settings in these examples are just to illustrate the function of the detector pattern matching. In real operation, these settings should be optimized further (e.g. by smaller search and / or feature regions » relevant pattern gets more significant, etc.).

By Teaching the pattern inside the red frame, it gets stored in the sensor as reference pattern. Size and position of the reference pattern is defined by the red frame. In Run mode the SBS tries the find the best fit of the reference with any region in the image. Depending on the settings of the threshold, the object / feature is detected or not.

The function pattern matching does not work with rotated images; it´s tolerance is limited to an angle of approx. +/- 5°. Patterns with higher angular deviation are not detected. This behaviour can be used to detect if a part is in correct orientation in input process.

Example:

The following pattern was taught:

Fig. 93: Pattern, reference

With the following three examples, the object is detected with 100 % concordance, as the taught pattern is exactly the same, even though it is in another place on the image. Only offset in X or Y direction and not rotated.
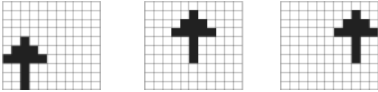
Fig. 94: Pattern, positive result

With the three now following examples in the second row, the object is also detected, but with less than 100 % concordance, as it deviates from the taught pattern in some pixels. Good or bad results are supplied according to the setting of the threshold value (degree of concordance).
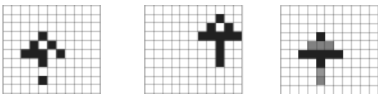
Fig. 95: Pattern, limit case

Pattern detection tolerates a ± 5 degree rotation. This means, the images in the bottom row were also detected, although the actual degree of concordance with the sample image is less than 100 %, despite 100 % pixel concordance. Patterns with a larger degree of rotation are not detected. This can be used as a function e.g. for detection of the correct alignment of parts on feeding units.
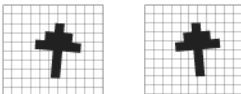
Fig. 96: Pattern, rotation

8.3.3.5 Function: Mask

With "Mask" function the search region can be modified. Inside the search and feature areas of the different detectors, regions can be included or excluded.

Application example:

Outer and inner contour lines as well as holes will not be considered, but all defects in the surface of the object are relevant.

In this example only the non-marked regions inside of the ROI of the detector are relevant. In this example only the non-marked regions inside of the ROI of the detector are relevant.
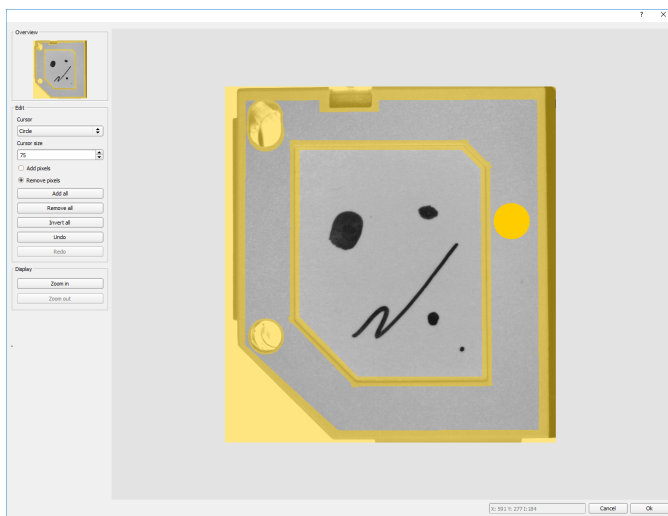
Fig. 97: Edit mask / search region

Operation:

Parameter	Function
Cursor (shape)	Changing shape (square, circle or line) of the cursor With the setting: "Cursor = Line", the angular position of the line jumps while the shift key is pressed in 15 ° increments.
Cursor size	Changing size of the cursor
Add pixels / Remove pixels	Select if the cursor adds or removes pixels
Add all	Adds all pixels
Remove all	Removes all pixels
Invert all	Inverts all pixels
Undo	Undo function – last action

Parameter	Function
Redo	Redo function – for last undo action
Display	Select a display mode (Zoom in / Zoom out)

By the flexible selection of cursor- shape and size, as well as if an action adds or removes pixels, complex geometric or free shaped search regions can be defined in a simple and quick manner. These regions are included = relevant, or excluded (yellow) in the search area.

To use the function "Mask" the following settings are necessary for the different detector types.

Detector type	Necessary setting to use the function "Mask"
Pattern matching, Contour	Generally possible with "Edit pattern"
Contrast, Brightness, Gray, BLOB, Color value, Color area, Color list	Search region "Free shape"

Function "Mask" of search regions, examples

For the above mentioned detectors three different shapes of search regions: Circle, Rectangle and Free shape are available.

The shapes: Circle and Rectangle can be rotated by picking and moving the tip of the arrow. If the shape of the search area cannot be fit in a satisfying manner to the shape of the object, the "Free shape" function can be used. With this feature, any geometry can be designed for a search area. To design the search area, the cursor can be set to a square, circle or line of any size. In the following examples the creation of a masked search region is shown.

Example 1

Logo with relevant zones.
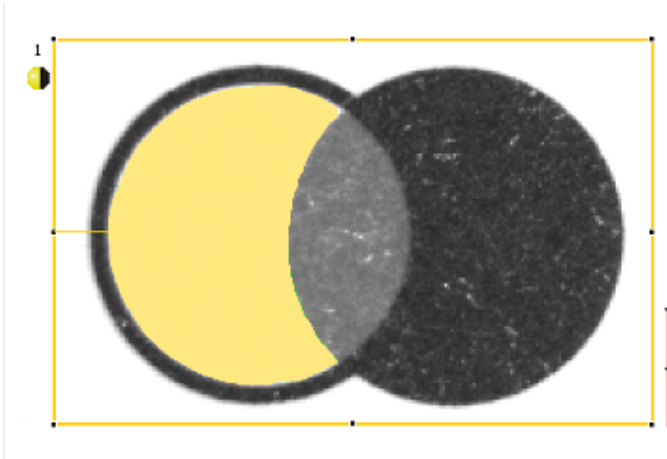
Fig. 98: Mask pattern 2

Created by one adding and one removing circle in front of the before reset mask.
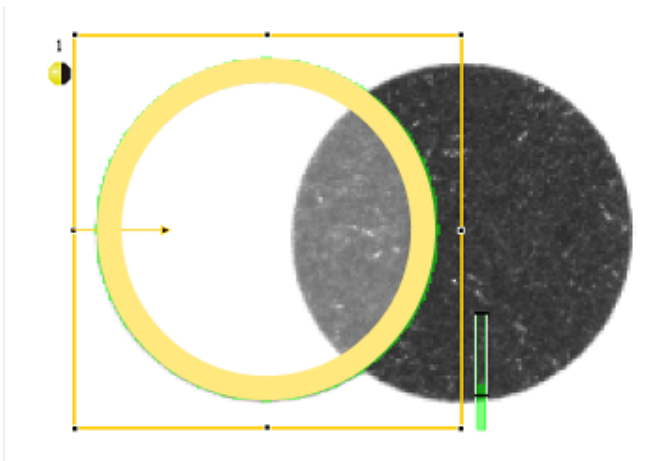
Fig. 99: Mask pattern 3

Created by one adding and one removing circle in front of the before reset mask.

Example 2

Only surface defects are relevant, object contour lines have to be masked.
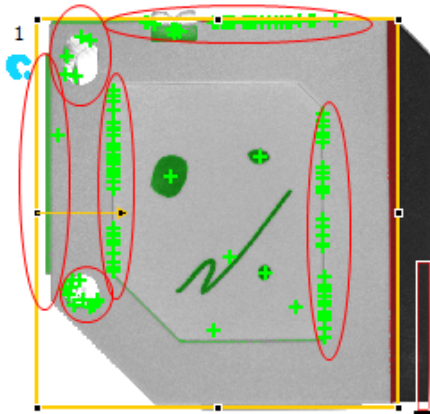
Fig. 100: BLOB without function Mask. With a BLOB detector the surface defects and the outer and inner contour lines are detected.
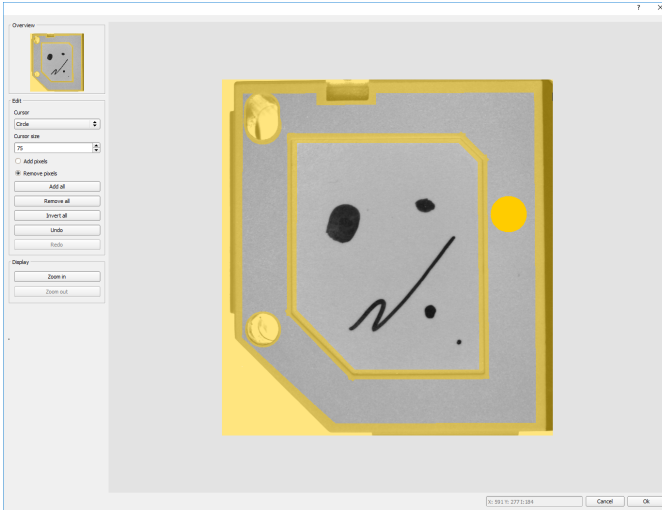
Fig. 101: Function Mask: masking contour lines shall not be considered.
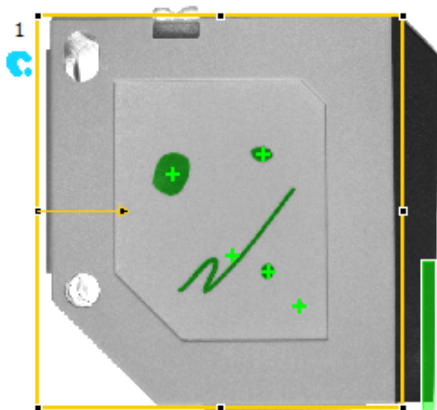
Fig. 102: BLOB with function Mask. Only surface defects are detected, all contour lines are not relevant as they are now masked.

8.3.4 Detector Contour

This detector is suitable for detecting contours by means of edges. The contours of an object in the search area are taught and stored in the sensor. In Run mode the sensor searches the position of the best fit with the taught contour. If the fit is higher than the selected threshold the result is positive. The function contour detection can work in complete 360° angular detection mode, i.e. the object can be rotated in any angle (The angular settings must be set accordingly!).

8.3.4.1 Tab Color channel

See chapter: Tab Color channel (Page 99)

8.3.4.2 Tab Contour

The most important parameters for contour detection can be set in the "Contour" tab.
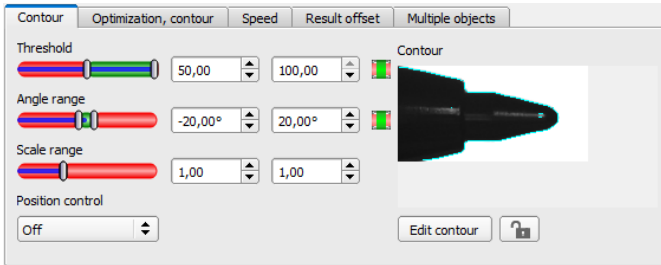
Fig. 103: Detector Contour, tab contour

The pale blue edges in the lower right corner (high contrast changes in the image) have been identified and marked based on the parameter settings. The found edges / contour can be influenced by changing these parameters, or by the function "Edit contour". The SBS vision sensor now searches this contour in the search area (yellow frame).

The following parameters can be configured in the "Contour" tab:

Parameter	Function
Threshold	Zone for required match of found contour with taught contour.
Angle range	Angle range in which search is carried out (large range means longer process time)
Scale range	Detection also of enlarged or reduced objects in a given scale range.
Contour	Shows the taught contour (red frame in the field of view)
Edit contour	By editing contour, parts of the search area can be masked out. The parts which are not relevant for an examination can removed like using an eraser. Masks can also be inverted. Next topic: Function: Mask (Page 130)
Lock	Lock / Unlock Contour: In locked status the taught contour is protected against (unintentional / accidental) changing, such as modification of the teach region. Unlock to modify taught contour.

Additional information:

Optimization of the execution speed:

- Search zone for position (yellow frame) only as large as necessary.
  Please note: The contour is found as long as the center point of the pattern is inside the search area!

- Please note: The contour is found as long as the center point of the pattern is inside the search area!
- Search zone for scale only as large as necessary
- Reduce resolution to QVGA instead of VGA

⚠️ **Attention:**
The global parameter, affects all detectors!

- Set "accurate – fast" to fast
- Increase value "Min. contrast pattern". Take care that the relevant contours are still visible in the display.
- Increase value "Min. contrast image".
- Especially in the case of alignment: Use alternate reference pattern For example with higher contrast, so that "Min. contrast pattern" and "Min. contrast image" can be increased.

Robust detection:

- Search zone for position (yellow frame) sufficiently large?
- Search zone for angle sufficiently large?
- Search zone for scale sufficiently large?
- Contrasts for model and image suitably set?
- (for model visible in sample)
- Are there several overlapping objects in the image?
- Distinctive edges available? Re-teach if necessary.
- "Min. contrast pattern" set to a suitable value? If in the taught pattern the relevant contour lines are not shown completely: decrease "Min. contrast pattern". If there are too many contour lines shown: increase "Min. contrast pattern".
- "Min. contrast image" set to a suitable value for the current image? If the current image(s) do have a higher / lower contrast than the taught reference image /pattern please increase / decrease the value of "Min. contrast image" accordingly.
- If in the taught pattern the relevant contour lines are not shown completely: decrease "Min. If there are too many contour lines shown: increase "Min.
- Contour found at wrong position? If the taught pattern is not unique, teach in a new contour.
- If the result value is fluctuating strongly from image to image? Take care that there are no "false" edges taught (edges because of shadows, or fragments of contours, which are not desired in the contour model). Increase value "Min. contrast pattern". With the help of "Edit contour" search areas can be hidden.

Parameter Angle range: Rotational direction of angle

Fig. 104: Rotational direction of angle

8.3.4.3 Tab Optimization, contour

In the "Optimization, contour" tab further settings for the edge transition and the contrast can be made.
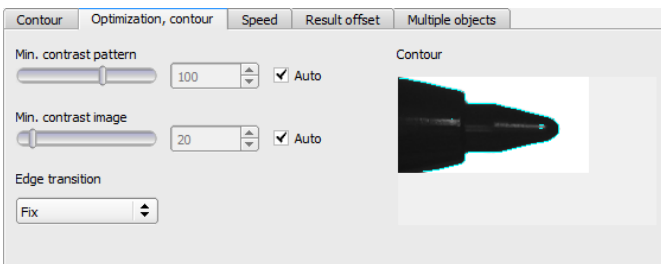
Fig. 105: Detector Contour, tab Optimization, contour

The following parameters can be configured in the "Optimization, contour" tab:

Parameter	Function
Min. contrast pattern	Minimum contrast required with taught model for an edge to be detected as one.
Min. contrast image	Minimum contrast required in current image for an edge to be accepted as one.
Edge transition • Fix • Fix + inverted • Flexible	The parameter "edge transition" can be used to determine the transition between object/contour and background. Select whether the contour is to be detected only on the taught-in background ("Fix"), on the taught-in and inverted background ("Fix + inverted") or on any background ("Flexible"). See also "Additional information:"
Auto	Automatic selection

Edge transition

Example:

A gray object is taught-in in front of a brighter background, as shown in the following figure.

Fig. 106: Taught-in contour in front of a brighter background

The following table shows the results of the contour detector with the respective settings for the edge transition.

Settings for parameter "Edge transition"	Bright background	Dark background	Inconsistent background
Fix			
	Contour detector: OK	Contour detector: not OK	Contour detector: not OK
Fix + inverted			
	Contour detector: OK	Contour detector: OK	Contour detector: not OK
Flexible			
	Contour detector: OK	Contour detector: OK	Contour detector: OK

8.3.4.4 Tab Speed

With these adjustable parameters the execution speed can be influenced. The search is processed either less detailed, that means it is stopped earlier and is thus quicker, or it's processed more detailed, that means search lasts longer and is thus slower.
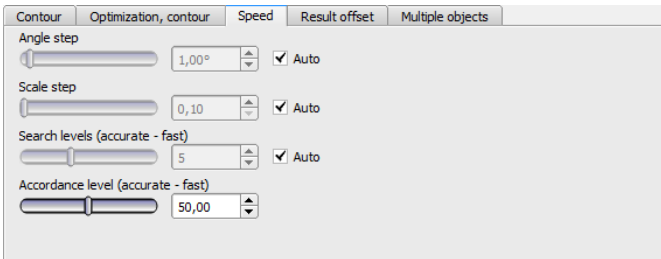
Fig. 107: Detector contour, tab speed

The following parameters can be configured in the "Speed" tab:

Parameter	Function
Angle step	Sensitivity of search throughout the selected angle range in degrees [°]
Scale step	Sensitivity of search throughout the selected scale range
Search levels (accurate - fast)	Number of search levels • High value: faster = riskier (candidates may be overlooked) • Small value: slower = less risky (all candidates)
Accordance level (accurate - fast)	Candidates that score less than indicated will automatically be rejected during the search. • High value: early rejection = quicker = riskier • Small value: late rejection = slower = less risky In case of false results this value can be decreased (more accurate).
Auto	Automatic selection

8.3.4.5 Tab Result offset

See chapter:

8.3.4.6 Tab Multiple objects

The "Multiple objects" function identifies objects whose contour matches the taught-in contour. Only as many objects as specified in the parameter "Max. no. objects" will be identified and output. The output of the object results is sorted according to the set criteria in ascending or descending order.
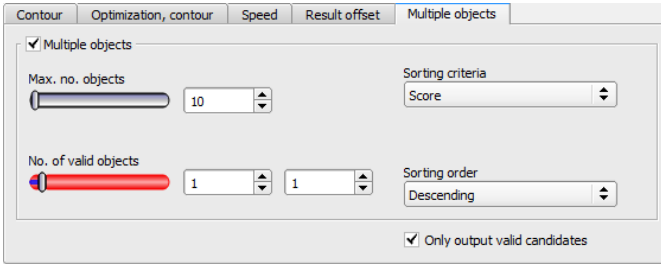
Fig. 108: Detector Contour, tab Multiple objects

It is also possible to use this function to count objects in the image. The number of objects found can be output as a telegram. The minimum and maximum number of tolerated objects can be specified with the "No. objects" parameter. If the number of objects found is outside this range, the detector result is not OK.

The following parameters can be configured in the "Multiple objects" tab:

Parameter	Function
Max. no. objects	With the parameter "Max. no. objects", the maximum number of target objects can be determined.
No. of valid objects	This parameter makes it possible to check whether the number of objects found is within a specified range. If it is within the range, the detector result is ok, otherwise not ok.
Sorting criteria	Sorting criteria according to which objects are "pre-sorted".
• Score	Score
• Position X	Position X
• Position Y	Position Y
• Angle	Angle
• Scale	Scale
Sorting order	Sorting order for the selected sorting criteria.
• Ascending	The values of the sorting criteria are sorted in ascending order.
• Descending	The values of the sorting criteria are sorted in descending

Parameter	Function
	order.
Only output valid candidates	If this checkbox is activated, only objects whose score value is above the set threshold (tab "Contour") are displayed and output. It can be used e.g. for parameter optimization.

8.3.5 Detector Contrast

This detector determines the contrast in the selected search area. Therefore all pixels inside the search area are evaluated with its gray value and the contrast value is calculated. If the contrast value is inside the limits set in parameter threshold the result is positive. The position of the single bright or dark pixels here is not relevant. The contrast is just depending on the bandwidth between darkest and brightest pixels and their quantity. Highest contrast value with 50% gray value "0" (= black) and 50% gray value "255" (=white).
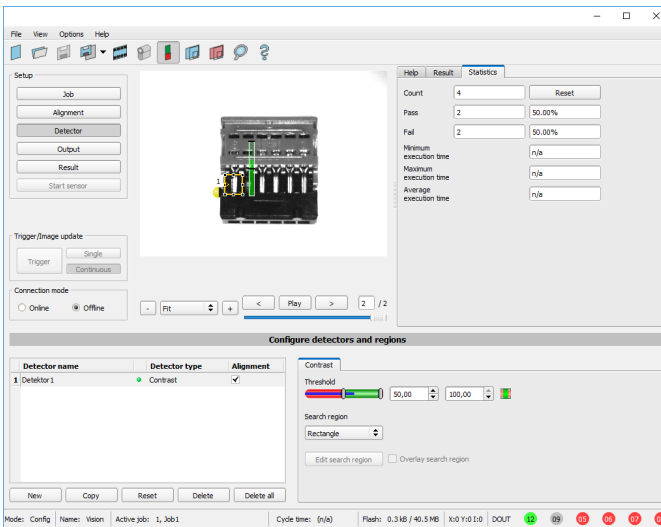
Fig. 109: Detector Contrast

8.3.5.1 Settings in tab Contrast:

Parameter	Function
Threshold	Range of contrast accepted.

Parameter	Function
Search region	Shape of search region can be set as Rectangle, Circle or Free shape. In mode Free shape "Edit search region" is active.
Edit search region	With Edit search region there can be masked out parts of the search area. The parts which are not relevant for this examination can be painted out like using an eraser. Masks can also be inverted, means that parts which are interesting can be marked. See chapter: Function: Mask
Overlay search region	On- / Off of display of edited search region.

For newly generated detectors, all parameters are preset as standard values, suitable for many applications.

8.3.5.2 Tab Color channel

See chapter: Tab Color channel (Page 99)

8.3.5.3 Contrast application

In the example the presence of a metal contact is checked with a contrast detector.
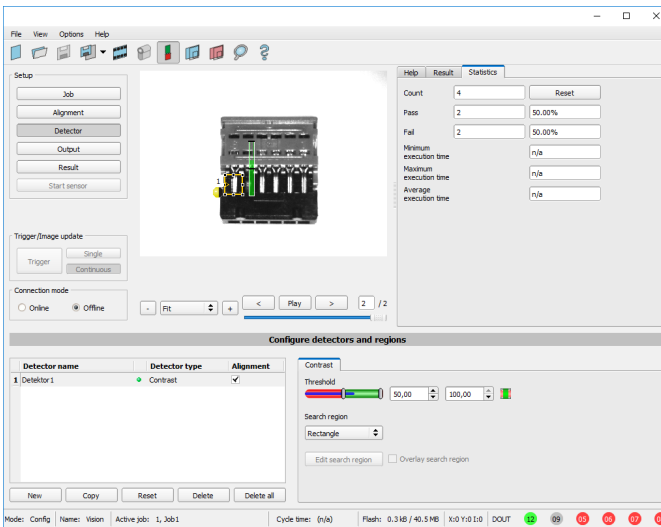
Fig. 110: Contrast, application example, positive result.

The presence of a shiny metal contact, in the middle of a surrounding black plastic housing, is checked with a contrast detector. As in this configuration contrast is pretty high, the contrast detector delivers a high score, and in combination with alignment the whole job works reliably.
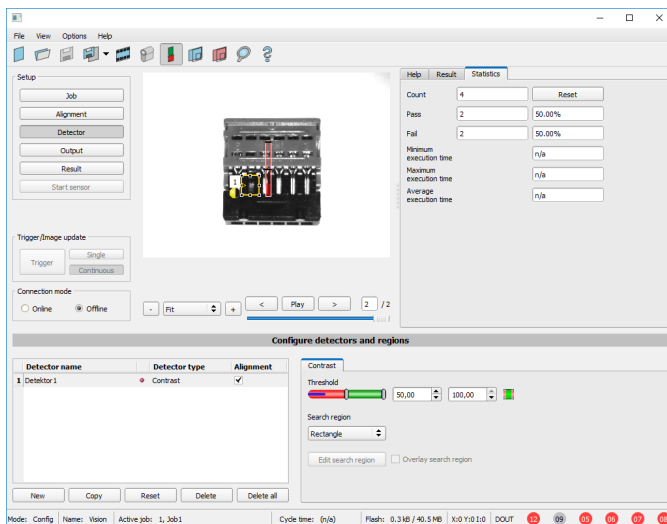
Fig. 111: Contrast, application example, negative result

If the same detector is placed now at a position where the metal contact is missing, it leads to a negative result. As, between the black surrounding and the now visible black background of the contact, the contrast value here is low.

Function detector Contrast

The dark and the bright pixels are evaluated according to the quantity and their intensity / brightness.

The position of the bright or dark pixels is not relevant.
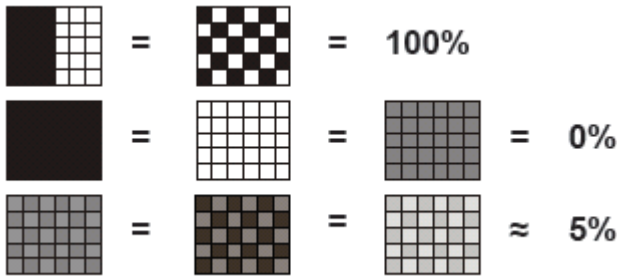
Fig. 112: Contrast examples

Fig. 113: Contrast explanation

8.3.6 Detector Gray

With this detector in the first step is the range of accepted gray values is defined by setting the two limit sliders of parameter "Grey level".

In the second step the share of the search area (in %) which must be covered by pixels with the gray value inside the definition made in step 1, is defined with the parameter "Threshold" to achieve a positive result.

By the respective invert function all possible combinations can be defined, also those where the relevant gray values are only at the upper or lower border of the range of values. The position of the respective brought or dark pixels is not relevant.

With the parameter "Overlay" pixels can be marked in a certain color as an aid to select pixels / regions, which have a gray value inside (valid pixels), or outside (invalid pixels) the range set in "Grey level". In this way pixels which are not covered with the settings / range of gray values can be detected very easily.

8.3.6.1 Settings in tab Gray:

Parameter	Function
Gray level min/max	Range of gray values that are to be accepted
Threshold min/max	Percentage of the area, which must be in the selected gray value range
Search region	Sets search region as rectangle, as circle or as free shape. In mode Free shape "Edit search region" is active.
Overlay	Selection of the pixels that have a gray value within (valid pixels) or outside (invalid pixels) of the grayscale definition under "graylevel". These are then highlighted in color from the selection guide. Thus, very easily e.g. noise pixels / areas that are not covered by the gray value range are detected.
Edit search region	By edit ROI there can be masked out parts of the search area. The parts which are not relevant for this examination can be painted out like using an eraser. Masks can also be inverted, means that parts which are interesting can be marked. See chapter: Function: Mask
Overlay search region	On- / Off of display of edited search region.

For newly generated detectors, all parameters are preset as standard values, suitable for many applications.

8.3.6.2 Tab Color channel

See chapter: Tab Color channel (Page 99)

8.3.6.3 Gray level application
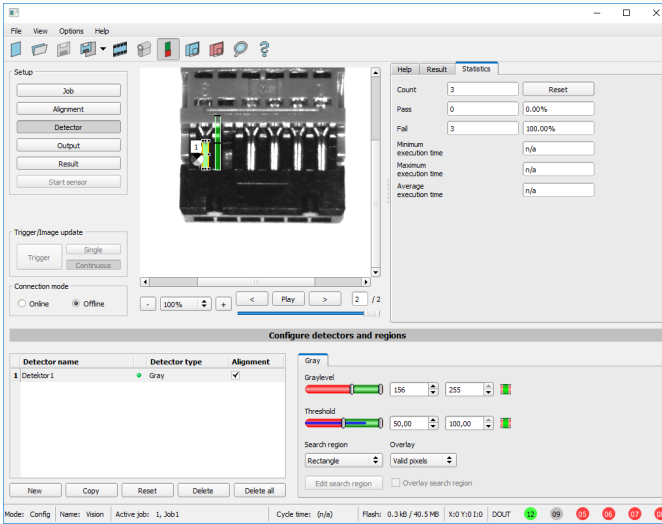
Fig. 114: Gray level, application example, positive result.

The contact is present in search area. Shiny metal contact shows gray values › 192, that means inside the limits of threshold = result positive.
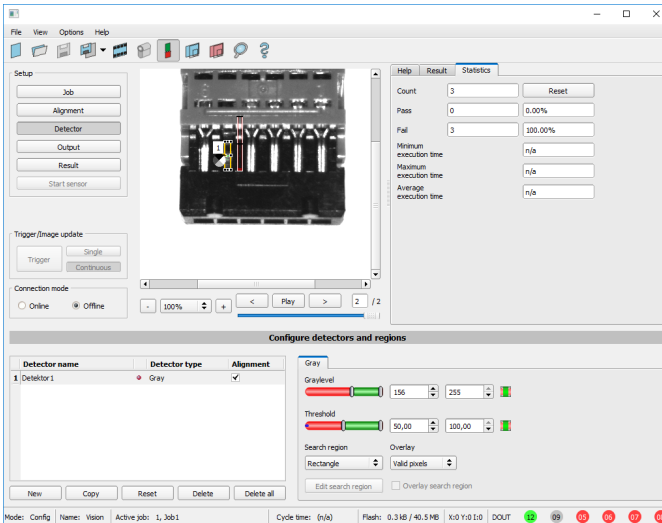
Fig. 115: Gray level, application example, negative result

Shiny metal contact is not present in the search area. That means average value of gray values in the search area is not inside the defined threshold limits (not inside gray value 192-255, but rather in range ‹ 50). Result: negative = contact not found.

Aid to determine gray values:

By placing the cursor somewhere in the image the according X- and Y- coordinate and the gray value ("I" = Intensity) are displayed in the status line on the screen below in the next to last field at the right.

Function detector Gray level.

The authorised gray value range is defined by the two limits on the gray level slider.

All pixels within this gray value range and within the defined working zone (yellow frame) are added together. The proportion of the number of all the pixels in the working zone (yellow frame) and of the number of pixels in the authorised gray value range represents the result of this detector.

If this result is within the limits set on the switching threshold slider, the result is positive.

The position of the gray value pixels on the screen is of no importance.

Example: (when the gray level slider is set to very dark values):

Both images produce exactly the same result with the gray level detector, as in each case 9 of the 25 pixels are detected as dark.
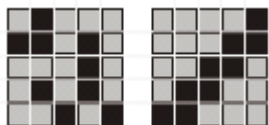
Fig. 116: Gray level, example 1

If the threshold value was set to 10 in this example, the following images would produce a positive result.
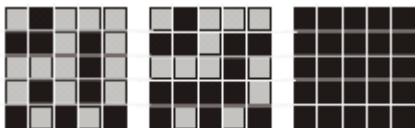
Fig. 117: Gray level, example 2

8.3.7 Detector Brightness

This detector determines the average value of the gray values in the search area. With the two limit sliders of the parameter "Threshold" the valid range of the brightness mean value is defined. As soon as the calculated average value is within these two limits the result is positive. The result value is standardized to %. The position of the bright or dark pixels is not relevant. If there are position deviations from check to check the alignment function must be used.

8.3.7.1 Settings in tab Brightness:

Parameter	Function
Brightness	min/max
Range of gray values that are to be accepted	Shape of search region can be set as Rectangle, Circle or Free shape. Shape of search region can be set as Rectangle, Circle or Free shape.
Edit search region	Edit search region With Edit search region there can be masked out parts of the search area. The parts which are not relevant for this examination can be painted out like using an eraser. Masks can also be inverted, meaning parts which are interesting can be marked. See chapter: Function: Mask
Overlay search region	On- / Off of display of edited search region.

For newly generated detectors, all parameters are preset as standard values, suitable for many applications.

8.3.7.2 Tab Color channel

See chapter: Tab Color channel (Page 99)

8.3.7.3 Brightness application

The detector Brightness calculates the average value of the gray values of all pixels within the search area.
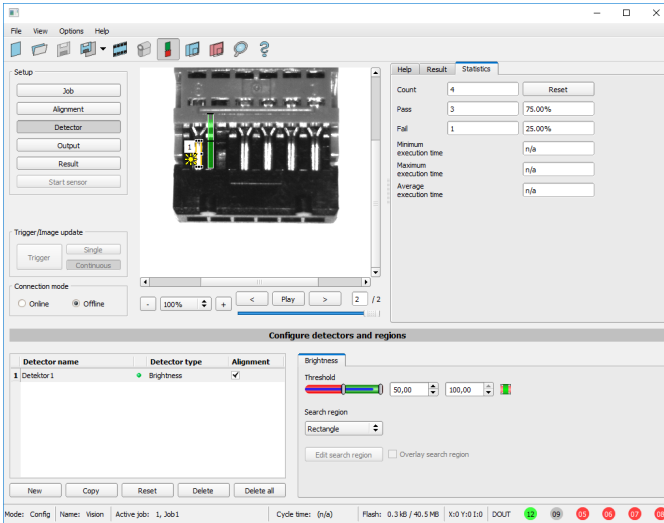
Fig. 118: Brightness, application example, positive result.

The contact is present within the position searched for; therefore the average value of the gray values in the search area has a high score (near 100%). This means the current value is within the requested threshold limits and the result is positive = contact present.
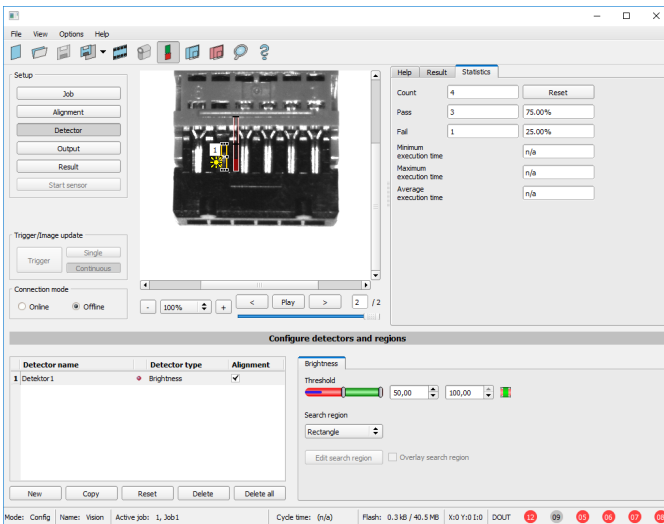
Fig. 119: Brightness, application example, negative result.

The contact is not present within the position searched for; therefore the average value of the gray values in the search area delivers a low score (near 0%). This means the current value is not within the requested threshold limits and the result is negative = contact not present.

Examples: Brightness value as average value of the gray values.
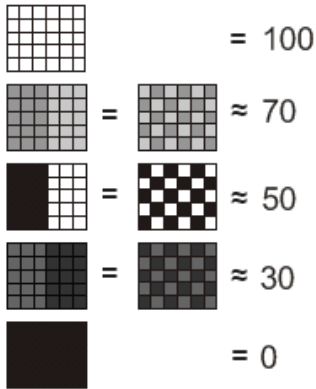
Fig. 120: Brightness, examples

8.3.8 Detector BLOB

The BLOB detector is used to identify and count one or more objects with some common features like same gray value range, same area, same circumference, etc.

BLOB, Introduction

"BLOB" abbreviation for "Binary Large Object" or "Binary Labeled Object".

Basic function of machine vision for evaluation of <u>connected</u> areas / objects in an image.

The single objects are distinguished by simple features like: area, width, height.

Fig. 121: Screws 1. Binarization, 2. detected as BLOB / object

Typical applications

- Count objects
- Differentiation / classification of objects in the image by:
- Size, area, contour
- Form, geometry
- Position, orientation
- Face up/ down
- Surface inspection
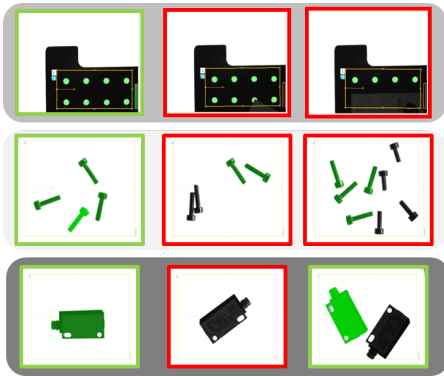
Fig. 122: Typical applications: count, classify / sort, orientation / face up / down

BLOB, simple configuration in 3 steps
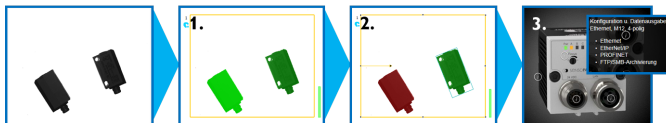
1. Binarization

Distinguish between relevant objects and background.

Tab Binarization, Absolute threshold (Page 155)

Tab binarization, dynamic threshold (Page 156)

2. Filtering of detected BLOBs

Filtering by different features like: area, circumference, orientation, position, ...

Tab Features (Page 161)

3. Data output

Definition of data output telegram and sorting of results.

Tab Sorting (Page 171)

Tab Telegram, Data output (Page 243)

8.3.8.1 Tab Color channel

See chapter: Tab Color channel (Page 99)

8.3.8.2 Tab Binarization, Absolute threshold

In this tab all parameters for binarization of a BLOB can be set.

Binarization is the first step of BLOB processing. It is used to distinguish relevant objects from the background of the image, by converting the gray image into a pure black and white / binary image.

Binarization can be done by two different binarization methods.
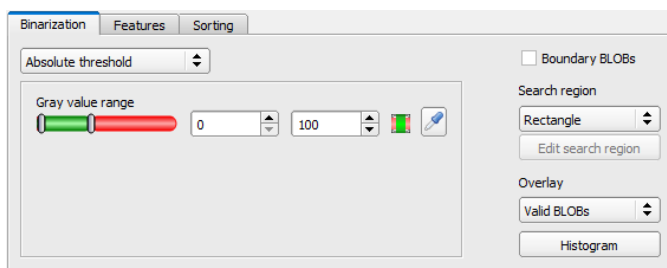
Fig. 123: Detector BLOB, tab Binarization

In the first combobox the threshold method for binarization is selected.

Parameter	Function
Absolute threshold	Binarization threshold is set to an absolute gray value in range of 0 .. 255.
Dynamic threshold	Threshold is automatically set to an statistically optimised position in order to distinguish between fore- and background. Tab binarization, dynamic threshold (Page 156)

Parameters with selection "Absolute Threshold"

Parameter	Function
Absolute threshold	Setting the upper and lower limit defines the range of valid gray values of pixels belonging to the BLOB.
Gray value range	Adjusting the upper and lower limit of gray values for binarization / valid for the BLOB.

Parameter	Function
Invert button	With the "Invert button" (default: red/green/red) the logic of detection can be inverted. This way the relevant range can be included or excluded.
Pipette button	With a click to the "Pipette button" the cursor changes into a pipette symbol. By moving the cursor and clicking to any position (pixel) inside the image the gray value of this pixel is taken and the limits of "Absolute threshold" are set to +/- 10 gray values of the gray value of this pixel (values clipped at 0 or 255).

Boundary BLOB´s, Overlay and Histogram

Parameter	Function
Boundary BLOBs	Selected BLOBs (objects) are considered, if they are fulfilling the BLOB- / filter- criteria, even if they are not completely positioned within the yellow search region. Please note: BLOBs are also considered as Boundary BLOBs if they are touching a zone masked with the "Edit search region / Function: Mask" (even masked zones inside the image / search region). Detector BLOB, Boundary BLOBs (Page 157)
Search region	Search region can be set to: "Rectangle", "Circle" or "Free shape". In mode "Free shape" the function "Edit search region" is active.
Edit search region	Using the "Edit search region" button the dialog window to edit the search region can be opened. Function: Mask (Page 130)
Overlay BLOBs	"Valid BLOBs": all valid BLOBs which fulfill the filter criteria are marked in green. With this selection invalid BLOBs are marked in red. "BLOB contour": all valid BLOBs (all BLOBs fulfilling the filter criteria) are marked with a green contour line. With this selection invalid BLOBs are not marked.
Histogram	The Histogram button opens the Histogram window for the BLOB. Detector BLOB, tab Binarization, Histogram (Page 160)

8.3.8.3 Tab binarization, dynamic threshold

In this tab all parameters for binarization with dynamic threshold can be set. The dynamic threshold can be used if BLOBs / objects and background do have clearly different gray value ranges, and illumination conditions are changing uniformly over the whole image.

If the brightness of the image changes uniformly, with the dynamic threshold limits are readjusted automatically. (With absolute threshold those limits must be readjusted manually.)

Please note:

- The Dynamic threshold is newly calculated with each new image / evaluation.
- Please consider that fluctuating illumination, surface- reflectivity, etc. may influence the result!
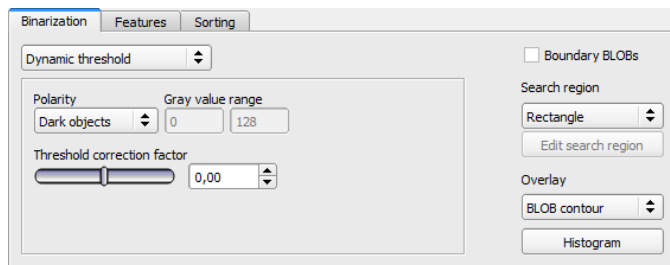
Fig. 124: Detector BLOB, tab Binarization, Dynamic threshold

Parameters with selection "Dynamic Threshold"

Parameter	Function
Dynamic threshold	Dynamic threshold is automatically set to an statistically optimised position in order to distinguish between fore- and background.
Polarity	Definition if BLOB is brighter or darker compared to the background.
Gray value range	Adjusted limits of gray values for binarization.
Threshold correction factor	With the Threshold correction factor the above automatically calculated binarization threshold can be moved / manipulated either towards the foreground- or background- brightness.

For illustration of the dynamic threshold see also: Detector BLOB, tab Binarization, Histogram (Page 160).

8.3.8.3.1 Detector BLOB, Boundary BLOBs

Selected BLOBs (objects) are considered, if they are fulfilling the BLOB- / filter- criteria, even if they are not completely positioned within the yellow search region. (Of course they have to fulfill the BLOB- / filter- criteria anyway).

Please note:

BLOBs are also considered as Boundary BLOBs if they are touching a zone masked with the **"Edit search region / Function: Mask"** (even if masked zones are inside the image / search region).

Example 1: Boundary BLOBs, touching outer search region.
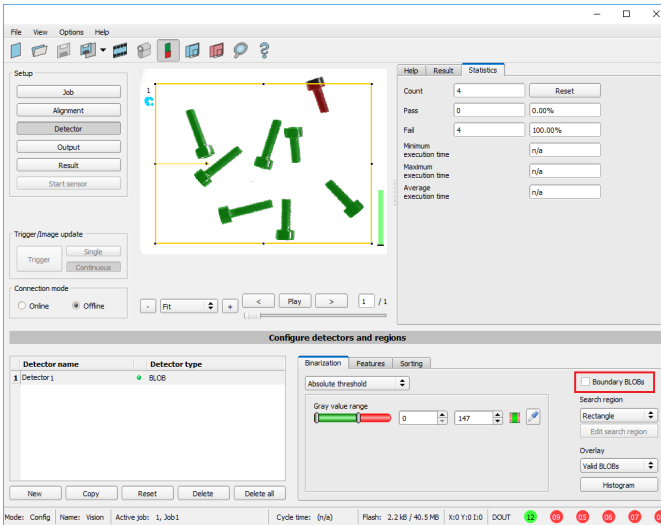
Fig. 125: Boundary BLOB example 1/1: BLOB is touching outer yellow search region. It is not considered as valid BLOB as setting **"Boundary BLOBs"** is NOT active.
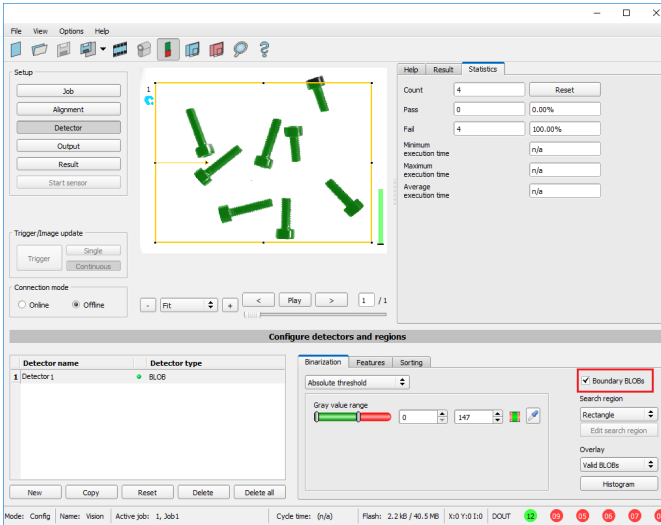
Fig. 126: Boundary BLOB example 1/2: BLOB is touching outer yellow search region. It is considered as valid BLOB, as setting "Boundary BLOBs" is ACTIVE now!

Example 2, Boundary BLOBs, touching inner "Mask" region.
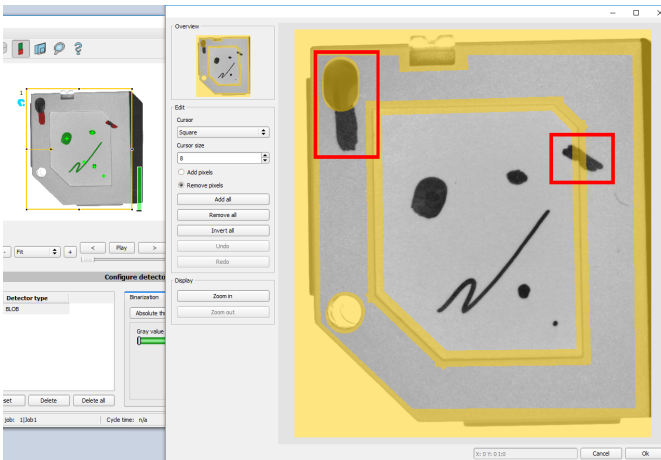
Fig. 127: Boundary BLOB example 2/1: BLOBs are touching inner yellow "Mask" regions. They are not considered as valid BLOBs, as setting "Boundary BLOBs" is NOT active.

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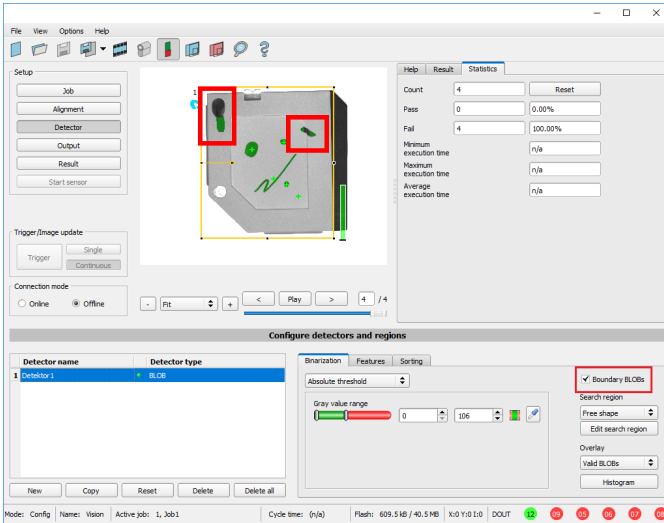
Fig. 128: Boundary BLOB example 2/2: BLOBs are touching inner yellow "Mask" regions, but they are considered as valid BLOBs yet, as setting "Boundary BLOBs" is ACTIVE now!

8.3.8.3.2 Detector BLOB, tab Binarization, Histogram

In this window the Histogram of the gray values inside the yellow ROI, and the chosen thresholds are shown.

In the here shown example there are clear maxima for fore- and background. The binarization threshold is adjusted to approx. the center in between.
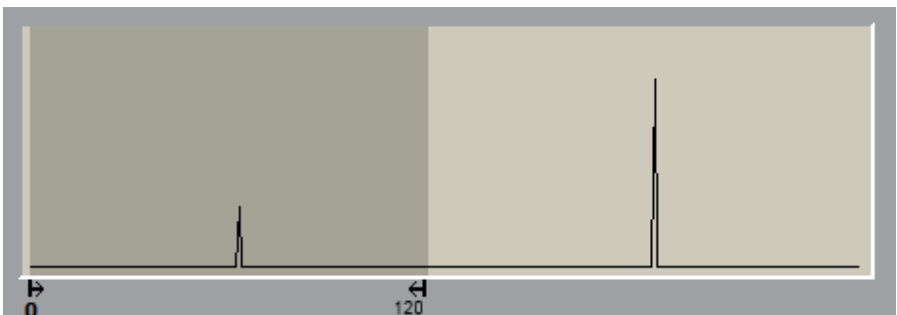
Fig. 129: Detector BLOB, tab Binarization, Histogram

8.3.8.4 Tab Features

In this tab, the features / filter criteria to distinguish between valid and invalid BLOBs/objects can be defined. Only the valid BLOBs are processed further, e.g. for data output.

Example: If the feature "Area" is set to a range of 100 ... 150 (pixel), only BLOBs with an area within this range are considered as valid (green).
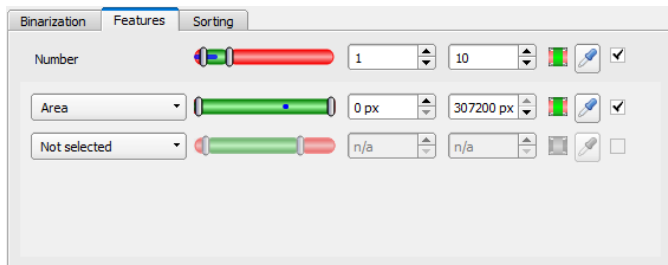
Fig. 130: Detector BLOB, tab Features

The following parameters can be configured in the "Features" tab:

Parameter	Function
Number	Additionally to the features used for filtering the BLOBs, the number of existing and valid BLOBs can be checked. For this purpose the lower and upper limit of accepted BLOBs (max. 10.000) is determined. • Detector result positive: Number of valid (filtered) BLOBs is within the range of "Number". • Detector result negative: Number of valid (filtered) BLOBs is outside the range of "Number". If the number of BLOBs is outside the defined limits, the detector result is negative, although valid BLOBs are marked in green. If the detector counts more than 10.000 BLOBs (maximum), the detector result is negative and no further calculations are performed. **Please note:** Defect detection via number = 0.
Invert button	With the "Invert button" (default: red/green/red) the logic of detection can be inverted. This way the relevant range can be included or excluded.

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Parameter	Function
Pipette- button (Number)	By clicking this symbol, the lower and upper limit of "Number" are set to exactly the found number of BLOBs in the image.
Pipette- button (Feature)	By clicking on the "Pipette button", the cursor changes into a pipette symbol. By moving the cursor and clicking to any position (pixel) inside a valid (green) BLOB, the limits of the selected feature are adjusted automatically to +/-10% of the value of the selected BLOB. Example: With selected feature "Area" and clicking with Pipette active on any pixel inside the BLOB , the lower and upper limit of area is set to +/-10% of the found number of pixels of the selected BLOB.
Checkbox (Default: Active)	• Active: Feature is calculated, filtered (limits adjustable), and available for data output. • Inactive: Feature is calculated, but NOT filtered, but is available for data output.

List of features / first level: BLOB type / Geometric Model

The features of the first level (Area, Area incl. holes, Contour length, ...) are calculated directly from the BLOB data, i.e. the pixels belonging to the BLOB. For further features, a geometric model is first fitted to the data via a best-fit line. Then the features are based on this model and not directly on the pixels belonging to the BLOB.

Feature	Function
Area	Area of the BLOB, without holes, in pixels. Corresponds to the number of pixels belonging to the BLOB.
Area (incl. holes)	Area of the BLOB, including holes, in pixels. Corresponds to the number of pixels within the outer contour.
Contour length	Number of pixels of outer contour of the BLOB.
Compactness	Compactness of BLOB (Circle = 1, all other ›1) The stronger the shape of the BLOB deviates from an ideal circle the larger the value of compactness will be. Range of slider: 1 -100 (clipped at 100, BLOBs with

Feature	Function
	higher values are marked as invalid)
Center of gravity X	X- coordinate of center of gravity of BLOB If in the setup "Job" the calibration is activated, the value can also be output in world coordinates, e.g. millimeters.
Center of gravity Y	Y- coordinate of center of gravity of BLOB If in the setup "Job" the calibration is activated, the value can also be output in world coordinates, e.g. millimeters.

BLOB type / Geometric Model	Function
Some features are calculated based on a given geometric model. For example eccentricity is based on an ellipse fit to the object	
Rectangle, paraxial (R1)	Enclosing rectangle parallel to Y- axis and X- axis. Outliers are not eliminated.
Rectangle, min. area (R2)	Enclosing rectangle with smallest area. Outliers are not eliminated.
Circle, fit (C1)	Circle-fit, not enclosing, outlier correction (robust against outliers)
Ellipse, equivalent (E1)	Equivalent ellipse, based on moments of area.

List of features / second level: BLOB type parameter

Feature	Relevant for	Function	Possibility of value output in world coordinates [mm] when calibration is activated
Center X	R1, R2, C1, E1	X- coordinate of the center of the fitted, geometric element (rectangle, ellipse)	✔
Center Y	R1, R2, C1, E1	Y- coordinate of the center of the fitted, geometric element (rectangle, ellipse)	✔
Width	R1, R2, E1	Width of geometric element. Width ≥ 0, width ≥ height. The orientation is choosen in a way that width is always bigger than height. (Exception: R1, Rectangle, paraxial: Width always in horizontal orientation = parallel to X- axis)	✔
Height	R1, R2, E1	Height of geometric element. Height ≥ 0, height ≤ width. The orientation is choosen in a way that width is always bigger than height. (Exception: R1, Rectangle, paraxial: Height always in vertical orientation = parallel to Y- axis)	✔
Angle (180)	R2, E1	Orientation of width (long axis) of object in degrees (range: -90 ... +90°, 0° = east, counterclockwise). See also: Feature Angle (Page 165)	
Angle (360)	R2, E1	Orientation of width of object in degrees (range: -180 ... +180°, 0° = east, counterclockwise). See also: Feature Angle (Page 165)	
Axial ratio	E1	Ratio long / short axis (a/b)	
Face up / down, area	E1	Face up/down discrimination, based on area, indicated by sign. See also: Feature Face up / Face down (Page 171)	
Radius	C1	Specifies the radius of the fitted circle.	✔

Feature	Relevant for	Function	Possibility of value output in world coordinates [mm] when calibration is activated
Deviation, in	C1	Indicates the largest deviation between the BLOB contour and the contour of the geometric element (deviation into the fitted circle). See also: Feature Deviation (Page 167)	✓
Deviation, out	C1	Indicates the largest deviation between the BLOB contour and the contour of the geometric element (deviation out of the fitted circle). See also: Feature Deviation (Page 167)	✓
Deviation, mean	C1	Indicates the mean of the absolute "in" and "out" deviation values between the BLOB contour and the contour of the geometric element. See also: Feature Deviation (Page 167)	✓

Feature Angle

With the feature "Angle (180)" and "Angle (360)", the orientation of the object can be determined. The angle always indicates the orientation of the width axis (width is the longest side of an object). The angles are specified in [degrees °].

The "Angle (180)" feature has a rotational range of -90° to +90°, as shown in the following figure.
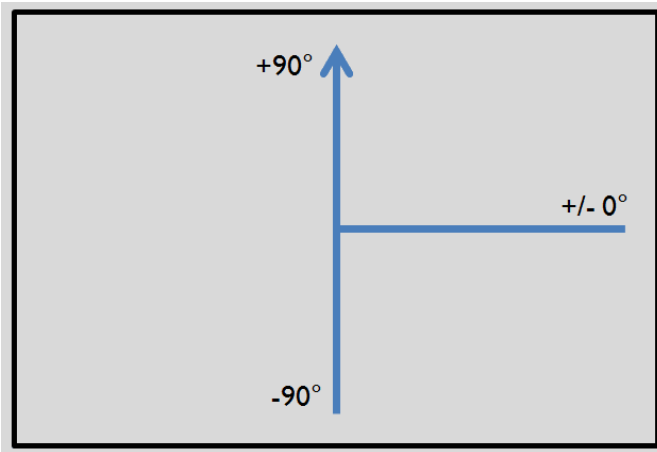
Fig. 131: Rotational direction of "Angle 180"

The "Angle (360)" feature depends on the selected geometric model (e.g. E1 Ellipse, R2 Rectangle minimal area, etc). It has a rotational range of -180° to +180°, as shown in the following figure.
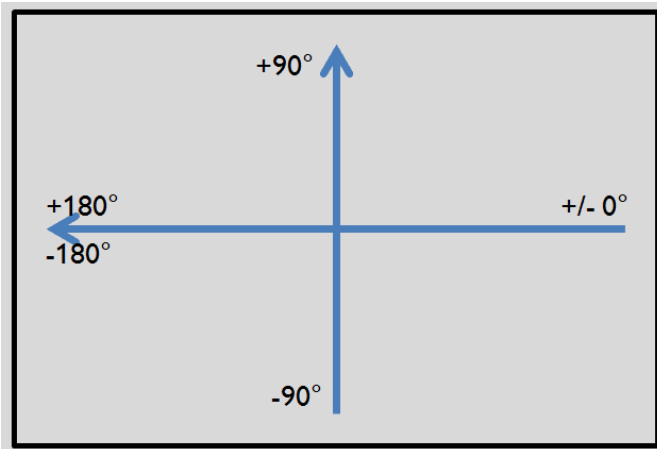
Fig. 132: Rotational direction of "Angle 360"

In contrast to the "Angle (180)" feature, in the "Angle (360)" feature the orientation of the width axis is set depending on a vector. This vector indicates the direction to the contour point with the longest distance to the center and the orientation (180°) of the vector point to the same side. Whether an object lies in half plane (-90° ... +90°) or in half plane (-180° ...-90°; 90°...180°) is

determined by the half plane in which the vector lies. The following figures show two examples of the angle determination of the feature "Angle (360)".
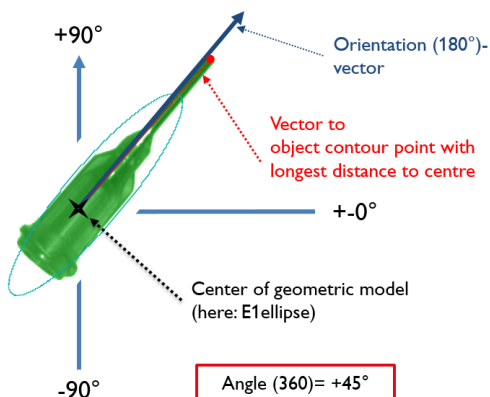
Fig. 133: Example 1: Angle (360) = +45°
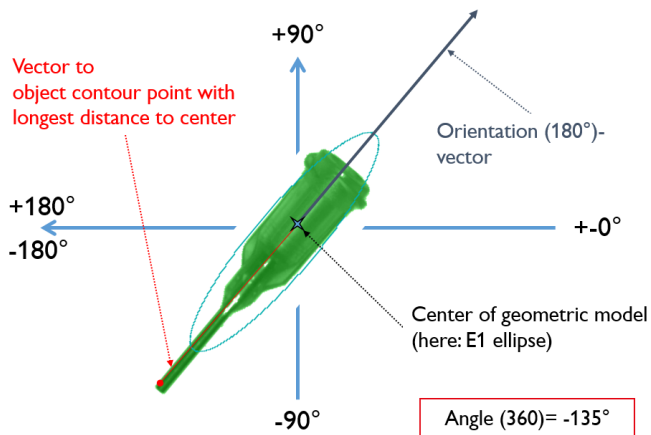
Fig. 134: Example 2: Angle (360) = -135°

Feature Deviation

The deviation feature calculates measures that quantitatively describe the deviation of the actual object from the fitted model. The features "Deviation, in", "Deviation, out" and "Deviation, mean" assess indentations and protruding elements of the BLOB/object contour. The deviation values

always refer to the fitted circle. All indentations into the fitted circle are "Deviation, in". All elements which protrude out of the fitted circle are determined by the feature "Deviation, out". The orientation directions of the features are shown in the following figure.
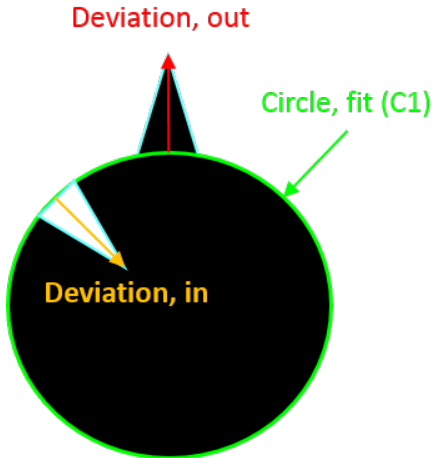
Fig. 135: Orientation direction "Deviation, in" and "Deviation, out"

In the "Result" tab of the SBS Software, the value of the largest "Deviation, in" and "Deviation, out" is displayed for each fitted circle (if active).

The "Deviation, mean" feature indicates the mean of the absolute deviation values to all positions, i.e. to all pixels, of the fitted circle.

Example: Deviation, mean

Jagged elements are checked by the feature "Deviation, mean", see figure "Deviation, mean".
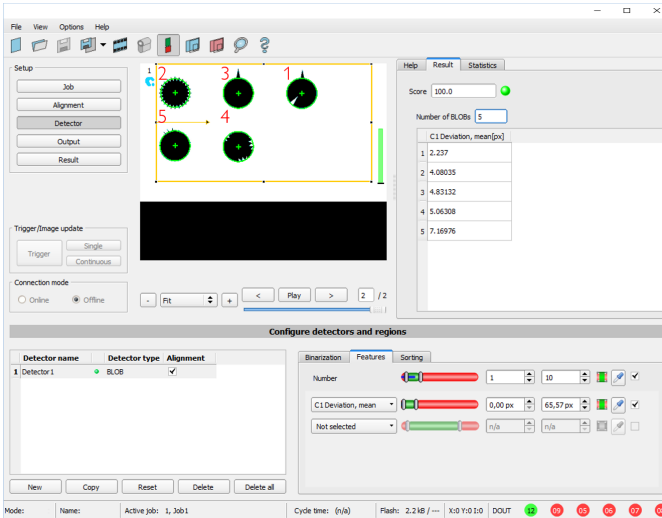
Fig. 136: Deviation, mean

The "Deviation, mean" feature calculates all deviations from the circle-fit (green) to the contour of the object/BLOB (cyan) per pixel of the fitted circle inwards and outwards. The following figure shows a zoomed-out section of the circle number "2" from the previous figure. The red arrows indicate the deviations per pixel of the fitted circle to the BLOB contour. The amounts of all determined values are averaged and form the result of the "Deviation, mean" feature.
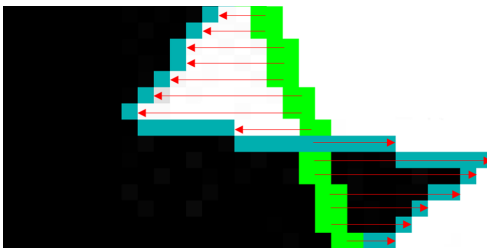
Fig. 137: Deviation, mean: Circle 2 zoomed

Example: Deviation, in and Deviation, out

Six circles with different indentations and protruding elements are to be examined for the features "Deviation, in" and "Deviation, out".

In order to improve the presentation, "BLOB contour" is selected in the "Binarization" tab of the "BLOB" detector. Now the detector marks the contours of all circles in the search field in cyan.

In the "Features" tab, the features:

- "C1 Circle, fit" (first-level feature), "Deviation, in" (second-level feature)
- "C1 Circle, fit" (first-level feature), "Deviation, out" (second-level feature)
- "C1 Circle, fit" (first-level feature), "Deviation, mean" (second-level feature)

are selected.

Now the results of the features per circle can be read in the "Result" tab, see also the following figure. (Please note: The results can be assigned to the circles by moving the mouse over the circles in the field of view.)
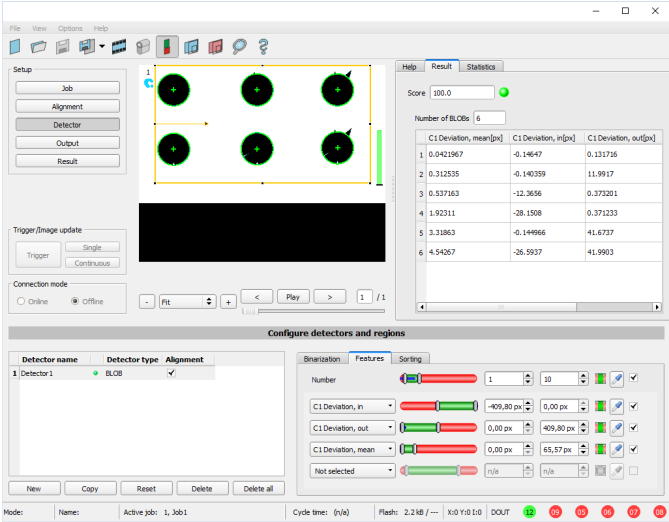
Fig. 138: "Deviation, in", "Deviation, out" and "Deviation, mean" results

The figure below serves to allocate and interpret the results from the screenshot above.
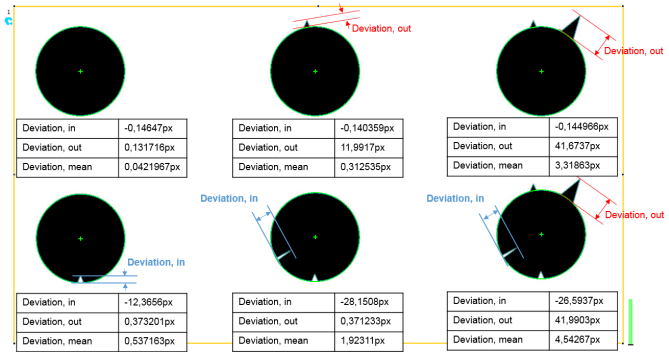
Fig. 139: Interpretation of results: "Deviation, in", "Deviation, out" and "Deviation, mean"

Feature Face up / Face down

"Face up/down, area" and "Face up/down, contour" assess the symmetry of the BLOB with respect to an axis determined by the center and the orientation of the BLOB. If a BLOB is fully symmetric with respect to this line the result value will be 0 otherwise it will deviate from 0. The sign of the value indicates whether the side to the left or right is "stronger".

"Face up/down, area"and "Face up/down, contour" can be used e.g. for distinguishing between face up and face down position of an object as necessary in pick-and-place applications or with vibratory feeders. Face up / Face down, area or contour
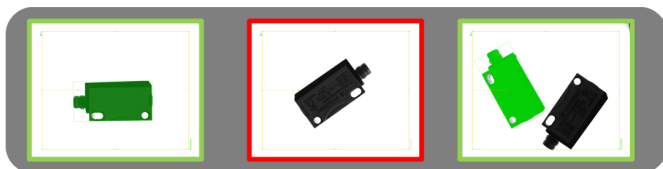
Fig. 140: The left image displays the target object face down.

The thresholds are chosen in a way that this position is considered OK. The image in the middle shows the same object face up and is considered not OK.
The right image displays both objects in the image and only the one with face up is considered OK.
"Face up / down, area" takes each pixel belonging to the BLOB into account for the calculation.

- "Face up/down, contour" only takes the pixels belonging to the BLOB's contour into account.
- This method can be used, if e.g. the object inside the contour varies or is subject to changes due to reflections or other environmental influences. The axis used for the calculation is determined by the center and the rotation angle (360°) of the BLOB.

Thus these values are dependent of the geometric model for the BLOB that has been chosen (e.g. smallest enclosing rectangle (rectangle 2) or equivalent ellipse (ellipse 1)).

The geometric model has to be chosen in a way that its orientation (360°) returns a stable and unambiguous value. Thus highly symmetric objects (e.g. perfect rectangles, circles, squares or point-symmetric objects) cannot be reliably evaluated with this method. For objects where the smallest enclosing rectangle (rectangle 2) returns an unambiguous orientation angle, e.g. "L"-shaped geometries or right-angled triangles, the ellipse model might return better results.

8.3.8.5 Tab Sorting

The features that have been defined in the tab features Tab Features (Page 161) are calculated for each individual BLOB. For each BLOB the results of these calculations will be sent to the PLC or

computer, if this feature is defined as a telegram Tab Telegram, Data output (Page 243). The sequence of these results is defined in the tab "Sorting".

If e.g. the feature "Center of gravity Y" is calculated and there are 5 BLOBs in the image, the telegram comprises the results of all 5 BLOBs.

If sorting criterium "Area" and order "Descending" are selected, the result (here: Center of gravity Y) of the BLOB with the largest area will be transmitted first.
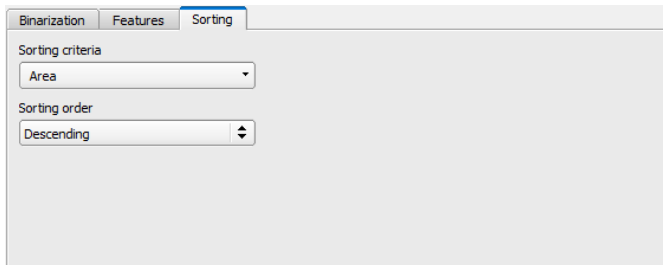
Fig. 141: Detector BLOB, tab Sorting

Settings in tab Sorting

Parameter	Function
Sorting criteria	As a sorting criteria any feature explained in tab "Features" can be selected.
Sorting order	Sorting order for the selected sorting criteria. It can be sorted "Ascending" or "Descending".

8.3.9 Detector Caliper

With this detector you can control the dimensional accuracy of an object.

8.3.9.1 Tab Color channel

See chapter: Tab Color channel (Page 99)

8.3.9.2 Tab Probe

In this tab all parameters of the probe(s) can be set and the result / histogram display can be accessed.
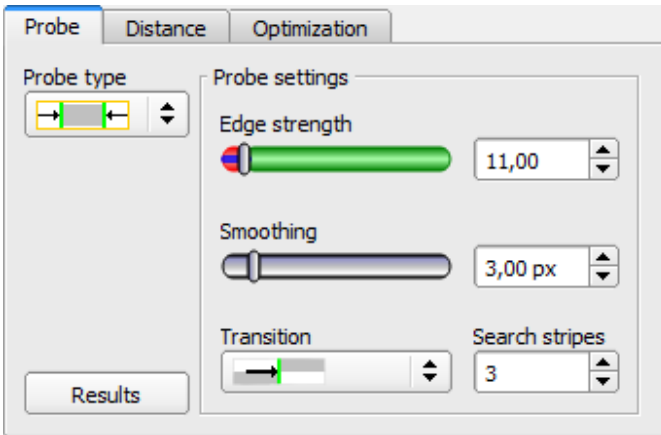
Fig. 142: Detector Caliper, tab Probe

Parameter	Function
Probe type	Selection of Probe type: • One probe, both sides • One probe, one side • Two probes, antiparallel (opposite direction) • Two probes, same direction
Edge strength	Edge strength / contrast above which an edge should be detected as an edge
Smoothing	The edge contour is smoothed in search direction. With larger values, noisy edges, blurred edges or edges that are not perpendicular to the search direction are detected more reliably. In addition, light-dark-light or dark-light-dark transitions which are close together can be ignored with larger values. Thus, interfering edges, e.g. scratches, can be hidden. The effect of smoothing can be displayed graphically using the button "Results".
Transition	Selection between:

Parameter	Function
	• Light → dark
	• Dark → light
	• Both directions (light-dark and dark-light transition)
Search stripes	Number of parallel search stripes into which the width of the search region is divided. Edge detection is processed in each search stripe over the whole width. The bigger the number of search stripes, the more probable the very first edge will be found. (Finer detection - longer execution time).
Results	Opens result and histogram display

8.3.9.3 Tab Distance

In this tab all parameters to identify the distance can be set.
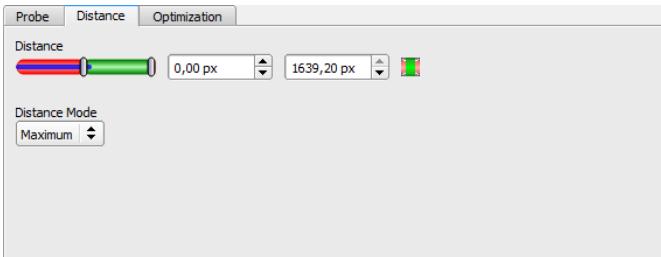
Fig. 143: Detector caliper, tab distance

Parameter	Function
Distance	Distance in pixels, with two limits for tolerance band Blue bar: current distance value
Distance mode	For each search stripe one touching point is calculated. If the number of search stripes ›1 there a different options to calculate the final result. • Maximum: The touching point which represents the longest distance is selected. • Minimum: The touching point which represents the smallest distance is

Parameter	Function
	selected.
	• Mean (Average): All touching points are arithmetically averaged. If there are outliers these are also used for the calculation, and do influence the result.
	• Median: The values of the touching point are sorted ascending and the middle (central) distance in the list is chosen. Outliers do not influence the result.
	Only available for the both-side probe type "▢":
	• Maximum by search stripe: The touching points of the search stripe with the largest distance are selected.
	• Minimum by search stripe: The touching points of the search stripe with the smallest distance are selected.

Additional information:

Distance mode

Information about the structure of the edge detector can be found at:Structure of the edge detector (Page 104)

To determine a distance, different distance modes can be select in the "Distance" tab. In the following examples, the difference between "Minimum" and "Minimum by search stripe" as well as the difference between "Maximum" and "Maximum by search stripe" is explained.

The following object is detected:

Fig. 144: Demonstration object

For the demonstration, in the tab "Probe" the both-side probe type "▢" is selected and the number of search stripes is increased to 20.

Difference between "Minimum" and "Minimum per search stripe"

With the "Minimum per search stripe" distance mode, unlike the "Minimum" distance mode, the touching points of only one search stripe are evaluated. In this case, the stripe with the smallest distance between the touching points (see figure: Results histogram, distance mode "Minimum per search stripe").

With the distance mode "Minimum", the smallest distance is determined by selecting the scanning lines with the smallest distance to each other. The touching points of the scanning lines can also originate from two different search stripes, in contrast to the distance mode "Minimum per search stripe" (see figure: Result histogram, distance mode "Minimum").

Distance mode "Minimum per search stripe"	
Smallest opposite distance determined at the touching points of one search stripe.	
  Fig. 145: Result histogram, distance mode "Minimum per search stripe"	 Fig. 146: Image with overlay, distance mode "Minimum per search stripe"

Distance mode "Minimum"
Minimum distance determined at the scanning lines with the smallest distance to each other. The touching points of the scanning lines can but do not have to come from just one search stripe.

Distance mode "Minimum"

Fig. 147: Result histogram, distance mode "Minimum"

Fig. 148: Image with overlay, distance mode "Minimum"
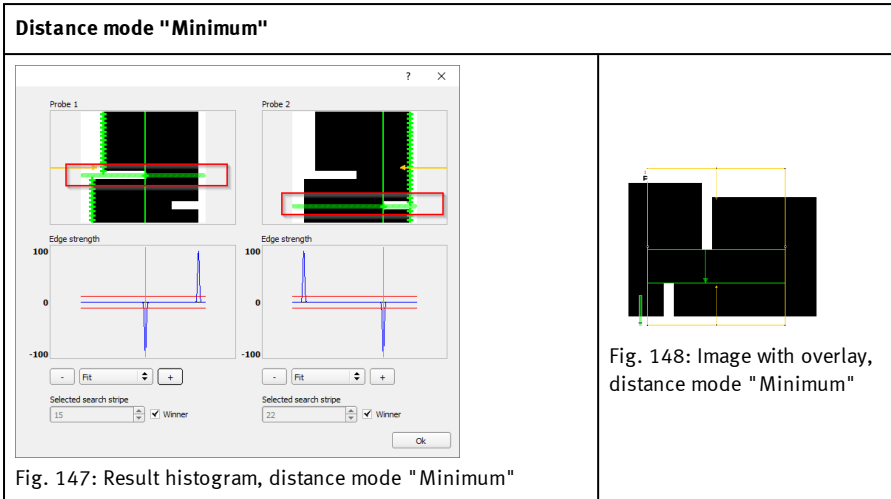
Difference between "Maximum" and "Maximum per search stripe"

The selected demonstration object displays identical images when determining the distance with the distance mode "Maximum" and the distance mode "Maximum per search stripe" (see figures, right columns in the tables below). The distances are not determined identically.

With the distance mode "Maximum per search stripe" the touching points are evaluated by only one search stripe. The search stripe with the largest distance between the touching points is selected (see figure: Results histogram, distance mode "Maximum per search stripe")

With the "Maximum" distance mode, the maximum distance is determined by selecting the scanning lines with the largest distance to each other. However, the touching points of the scanning lines can come from two different search strips (see Figure: Results histogram, distance mode "Maximum").

Distance mode "Maximum per search stripe"

Largest opposite distance determined at the touching points of one search stripe.

Distance mode "Maximum per search stripe"
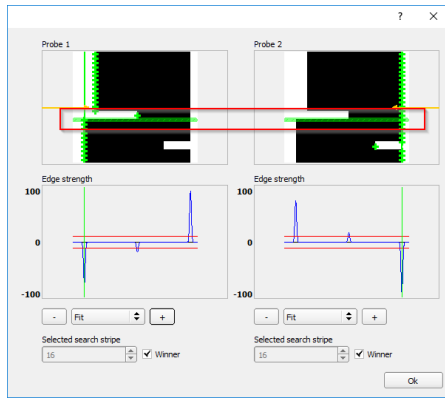
Fig. 149: Result histogram, distance mode "Maximum per search stripe"
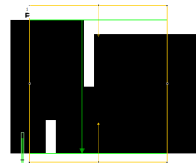
Fig. 150: Image with overlay, distance mode "Maximum per search stripe"

Distance mode "Maximum"

Maximum distance determined at the scanning lines with the largest distance to each other. The touching points of the scanning lines can but do not have to come from just one search stripe.
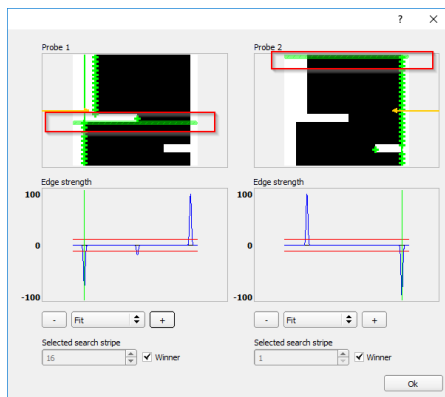
Fig. 151: Result histogram, distance mode "Maximum"
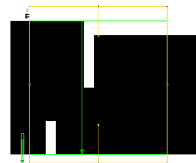
Fig. 152: Image with overlay, distance mode "Maximum"

8.3.9.4 Tab Optimization

In the "Optimization" tab, further settings for optimizing the edge detection can be made. The following figure shows the "Optimization" tab.
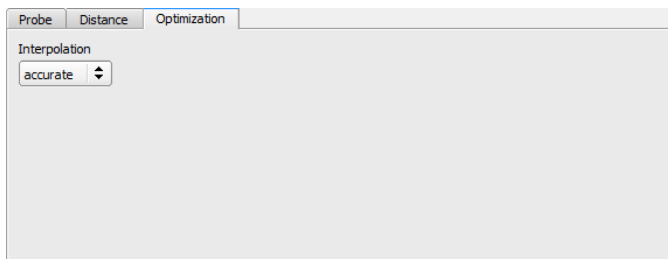
Fig. 153: Detector caliper, "Optimization" tab

The following parameters can be configured in the "Optimization" tab:

Parameter	Function
Interpolation	The calculation of the edge position can be performed either with subpixel accuracy (up to 1/10 pixels) or with simple accuracy.
• Accurate	Subpixel accuracy
• Fast	Simple accuracy: This setting partly provides calculations which are over 50% faster.

8.3.9.5 Results / Histogram display
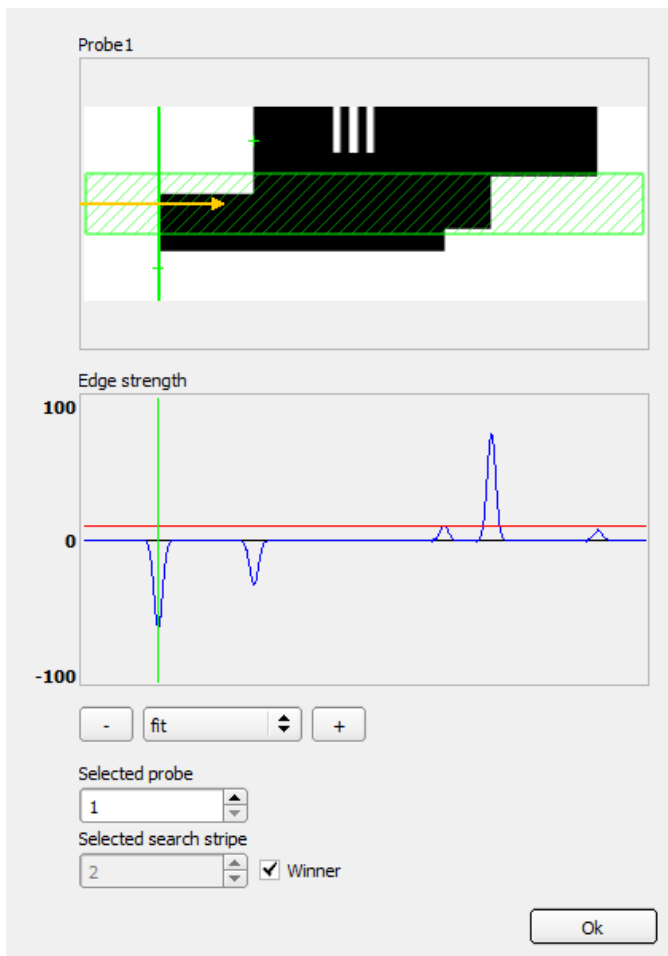
Fig. 154: Results / Histogram display

Parameter	Function
Probe (x)	Image of probe (x) with: • Green line: detected overall result edge

Parameter	Function
	• Green crosses: detected edge transition per search ray • Light blue zone: display of "Selected search ray"
Edge strength	Histogram with: • Blue line: contrast gradient in image, depending on "Selected search ray" • Red line: required contrast for edge detection (Threshold) • Light blue line: detected edge transition, depending on "Selected search ray"
Fit, "+", "-"	Fit or zoom of "edge strength" histogram
Selected probe	Display of the selected probe
Selected search stripe	Selection of search stripe to be displayed in "Probe (x)" image • Winner: winner search stripe (depending on settings in "Distance/Distance mode") • "1, 2, .." Number of search stripe

8.3.10 Detector Barcode

8.3.10.1 Tab Code

Fig. 155: Detector Barcode, tab Code

Settings in tab Code

Parameter	Function
Bar code type	Select here the type of barcode to be read with the Code reader.
Decoded string length	Max. Length of a barcode. If contents of code are longer than this value, the rest will be cut off. If more than one code is read by this detector, this value has to be set for the longest code.
Check character	This setting activates the processing for a check character in case it is part of the code. Barcodes with check characters are e.g. Code 39, Codabar, 25 Industrial or 25 Interleaved. If this setting is not activated, the check character will be given out with the normal result string.
Min. number of codes	Minimum number of codes to be read inside the search area.
Max. number of codes	Maximum number of codes to be read inside the search area. If this value is set higher than necessary, the reading time may increase slightly.
Number of characters	Number of expected characters in the barcode. Codes with a different number of characters are ignored. If the number of characters of the code is known, this check increases the detection. If codes with a certain number of characters are to be found under several codes, then the parameter "Max. number of codes" is to be set to a higher value than the number of searched codes.
No-read string	Specifies the text, which is given out over the interfaces in case of non successful reading. The text does not appear in the result display.
Polarity	Specifies printing of code "black on white" or "white on black".

For newly generated detectors, all parameters are preset as standard values, suitable for many applications.

Optimization:

Execution speed:

- Search zone for position (yellow frame) only as large as necessary

Robust detection:

- Search zone for position (yellow frame) sufficiently large?
- Contrasts for model and image suitably set?

• Are thresholds set correctly?

8.3.10.2 Tab Reference string
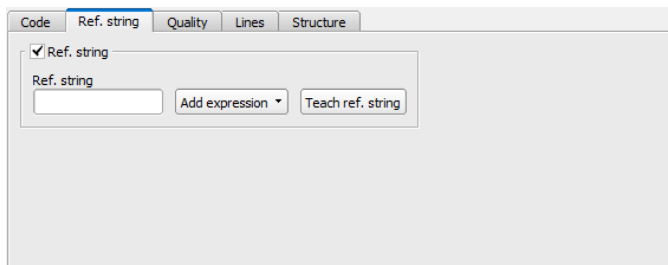
Fig. 156: Detector Barcode, tab Reference string

Settings in tab Reference String

Parameter	Function
Compare string	Activates verification of contents of the result information. The verification is done by using of regular expressions.
Reference string	This text or regular expression is taken for verification. Here can be entered characters or regular expressions. If codes with a certain reference string are to be found under several codes, then the parameter "Max. number of codes" in the "Code" tab is to be set to a higher value than the number of searched codes.
Add expression	Opens a list with examples for regular expressions.
Teach ref. string	Reads the code under the code reader and takes the contents of this code as a reference string. This text can be changed later.

For newly generated detectors, all parameters are preset as standard values, suitable for many applications.

Examples for reference strings specified by regular expressions:

Reference string	Hit	Example for hit
123	String containing 123	01234
\A123	String beginning with 123	1234

Reference string	Hit	Example for hit
123\Z	String ending by 123	0123
\A123\Z	String matching exactly 123	123
[123]	String containing one of the characters	33
[123]{2}	String containing sequence of the characters of length 2	23
[12][34]	String containing a character of one of both groups	4

Most important elements of regular expressions:

^ or \A Matches start of string

$ or \Z Matches end of string (a trailing newline is allowed)

. Matches any character except newline

[...] Matches any character listed in the brackets. If the first character is a '^', this matches any character except those in the list. You can use the '-' character as in '[A-Z0-9]' to select character ranges. Other characters lose their special meaning in brackets, except '\'.

* Allows 0 or more repetitions of preceding literal or group

+ Allows 1 or more repetitions

? Allows 0 or 1 repetitions

{n,m} Allows n to m repetitions

{n} Allows exactly 'n' repetitions

| Separates alternative search expressions

8.3.10.3 Tab Quality

Fig. 157: Detector Barcode, tab Quality

Settings in tab Quality

Parameter	Function
Quality type	Evaluation of printing quality according to international standard ISO/IEC 15416. In order to achieve an evaluation according to the norm, there are defined minimum requirements for the size of the code inside the camera image (resolution) and mounting of camera and illumination. These requirements are specified inside the norm. For simple 1D Barcodes, the rating of printing quality is combined in a total of eight elements: Q1 Overall Q2 Not used Q3 Not used Q4 Decode Q5 Symbol Contrast Q6 Minimal Reflectance Q7 Minimal Edge contrast Q8 Modulation Q9 Defects Q10 Decodability Q11 Additional Requirements "Overall" is rating the total quality, the further elements give information about possible reasons for a reduced quality. Inside ISO/IEC15416 there is a list with common defects and their influence to the single grades. The single quality grades are defined as follows: "Overall" is the minimum value of all other grades. "Decode" has value 4 when the code was read and value 0 when the code was not read. "Symbol contrast" is the difference between minimum and maximum reflexion value of grayscale, better contrast gives better grading. "Minimal reflectance" is set to 4 if the lowest reflectance value in the scan reflectance profile is lower or equal to 0.5 of the maximal reflectance value. Otherwise a value of 0 is assigned. "Edge contrast" is the contrast between any two adjacent elements, either bar-to-space or space-to-bar. The "minimal edge contrast" grades the minimum of the edge contrast values measured in the reflectance profile. "Modulation" indicates how strong the amplitudes of the bar code elements are. Big amplitudes make the assignment of the elements to bars or spaces more certain, resulting in a high modulation grade. "Defects" is a grading of reflectance irregularities found within elements and quiet zones. "Decodability" grade reflects deviations of the element widths from the nominal widths defined for the corresponding symbology. "Additional requirements" are bar code symbology specific requirements: mostly regarding the required quiet zones, but sometimes it can be also related to wide/narrow ratio, inter character gaps, guarding patterns or further symbology specific characteristics. For composite codes, the rating has 24 grades:

Parameter	Function
	OVERALL: Q1 Overall Q2 Overall Linear Q3 Overall Composite LINEAR: Q4 Decode Q5 Symbol Contrast Q6 Minimal Reflectance Q7 Minimal Edge contrast Q8 Modulation Q9 Defects Q10 Decodability Q11 Additional Requirements COMPOSITE: Q12 Decode Q13 Rap Overall COMPOSITE RAP: Q14 Contrast Q15 Minimal Reflectance Q16 Minimal Edge Contrast Q17 Modulation Q18 Defects Q19 Decodability Q20 Codeword Yield Q21 Unused Error Correction Q22 Modulation Q23 Decodability Q24 Defects The "overall" grade in the group OVERALL is the final symbol grade to be reported. It is just the lower from the other two in the group: "overall linear" and "overall composite", which are the overall grades of the linear and the composite sub symbols, respectively. The other two groups, "LINEAR" and "COMPOSITE", contain the corresponding individual grades for both sub symbols, and give information for possible causes for poor quality of the symbol. The grades in the "LINEAR" group correspond to those for the simple 1D bar code case, described above. The grades in the "COMPOSITE" group correspond to the grades for a PDF 417 data code symbol, where "rap overall" is called after the specific, so-called RAP, start/stop pattern of Composite symbols. Additionally, the sub group "COMPOSITE RAP" expands the individual grades for the reflectance profile of the RAP patterns. The RAP grades are consistent with the grades for the simple 1D bar

Parameter	Function
	code case explained above.
Quality result type	There are existing two possibilities, to display quality parameters. Both are according to the norm. The grades can be given in values from A to F or from 4 to 0. A and 4 are the best possible grades. The setting made here affects both the display of the quality parameters on the screen and the output of the quality parameters via the interfaces. The assignment is the following: ABCDF 43210

For newly generated detectors, all parameters are preset as standard values, suitable for many applications.

8.3.10.4 Tab Lines
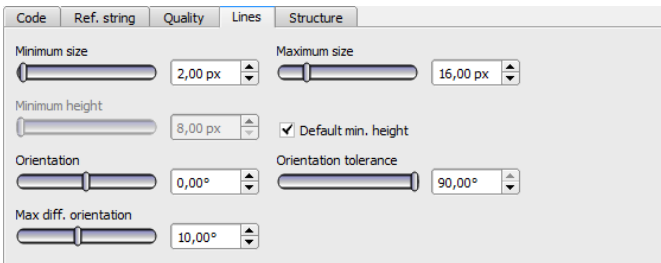
Fig. 158: Detector Barcode, tab Lines

Settings in tab Lines

Parameter	Function
Minimum size	Minimal size of bar code elements, i.e. the minimal width of bars and spaces. For small bar codes the value should be reduced to 1.5. In the case of huge bar codes the value should be increased, which results in a shorter execution time.
Maximum size	Maximal size of bar code elements, i.e. the maximal width of bars and spaces. This value should be adequate low such that two neighbouring bar codes are not fused into a single one. On this other hand the value should be sufficiently high in order to find the complete bar code region.
Minimum height	Minimal bar code height. In the case of a bar code with a height of less than 16 pixels the respective height should be set by the user. Note, that the minimal

Parameter	Function
	value is 8 pixels. If the bar code is very high, i.e. 70 pixels and more, manually adjusting to the respective height can lead to a speed-up of the subsequent finding and reading operation.
Orientation	With the parameter Orientation the range of angel for code reading can be restricted. Barcodes with rotated positions outside the specified angle range are not read. For example, the parameter can be used if a barcode can be located in different rotated positions in front of the code reader and not all rotated positions should be read. If codes with a certain rotated position are to be found under several codes, then the parameter Max. number of codes in the Code tab is to be set to a higher value than the number of searched codes. If the bar codes are expected to appear only in certain orientations in the processed images, one can reduce the orientation range adequately. This will detect wrong candidates sooner. This enables an early identification of false candidates and hence shorter execution times. This adjustment can be used for images with a lot of texture, which includes fragments tending to result in false bar code candidates.
Orientation tolerance	Tolerance of orientation. See the explanation of 'orientation' parameter.
Max. diff orientation	A potential barcode region contains bars, and hence edges, with a similar orientation. This value indicates how strongly the difference in the orientation of adjacent edges may be. The maximum orientation deviation is a differential angle in degrees. If a barcode is of bad quality with jagged edges this parameter should be set to bigger values. If the bar code is of good it can be set to smaller values, thus reducing the number of potential but false bar code candidates.

For newly generated detectors, all parameters are preset as standard values, suitable for many applications.

Parameter Orientation

The following figure illustrates the orientation.

Please note:
The orientation indication refers to the image and not to the rotational position of the search range.
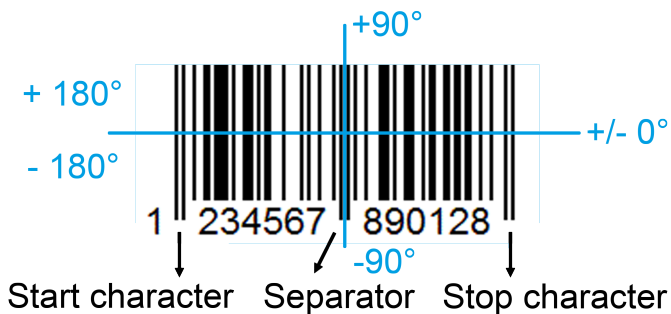
Fig. 159: Parameter Orientation

Optimization:

Execution speed:

- Search zone for position (yellow frame) only as large as necessary

Robust detection:

- Search zone for position (yellow frame) sufficiently large?
- Contrasts for model and image suitably set?
- Are thresholds set correctly?
- Code size sufficient in the field of view?
- Width of barcode line sufficient?

8.3.10.5 Tab Structure
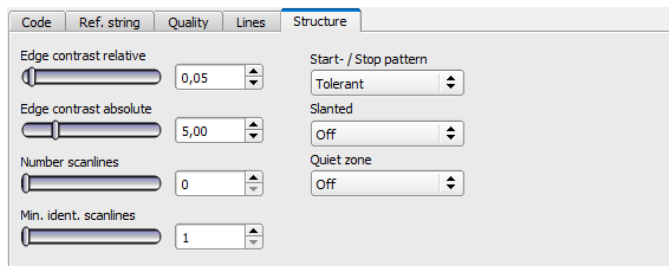
Fig. 160: Detector Barcode, tab Structure

Settings in tab Structure

Parameter	Function
Edge contrast relative	Edges inside barcode are found by setting of a threshold. Parameter "Edge contrast relative" defines how this threshold in respect to the dynamic range of the scan line pixels is calculated. In the case of disturbances in the bar code region or a high noise level, the value of ´Edge contrast relative´ should be increased. Typical values: [0.05 ... 0.2]; Default: 0.05
Edge contrast absolute	Edge contrast absolute prevents misdetections of edges. For images with high noise levels this value should be higher. In noise-free images with very weak contrast, this parameter might disturb the detection of real edges. So it might be necessary to reduce it or even completely disable it by setting it to 0.0. Typical values: [0.0 ... 10.0]; Default: 5.0
Number scanlines	Number of scanlines used during the scanning of a code. Reducing the number of scanlines improves speed. Images with higher quality need less scanlines than images of lower quality. For an average image, a value between 2 and 5 should be good. If a code can not be detected any more after reducing the number of scanlines, the number has to be increased again. Typical values: [0, 5, 10, 20 ...]; Default: 0
Min. ident. scanlines	Minimal number of identical scanlines for a decoding of a code symbol to be accepted. If this parameter is not set (has a value of 0) a bar code is considered decoded with the first scanline, which was successfully decoded. Increasing this parameter to 2 or more is useful to avoid wrong readings. Typical values: [0, 2, 3, ...]; Default: 0
Start- / Stop pattern	Set searching criteria for a start or stop pattern to 'tolerant' or 'accurate'. 'Tolerant' will increase the detection chances of a bar code especially in images with low contrast. 'Accurate' increases the robustness against false detections. List of values: 'Tolerant', 'Accurate'; Default: 'Tolerant'
Slanted	If 'slanted' = 'On' improves readability of codes if single lines are orientated different from the others like when the code is not on a plain surface. If 'slanted' = 'Off' default setting when all lines of the barcode are parallel in image. If 'slanted = 'Auto' the sensor tries first 'On' and then 'Auto', this setting can increase reading time.

Parameter	Function
	List of values: 'Off', 'Auto', 'On'; Default: 'Off'
Quiet zone	Enforces the detection of the quiet zones of a bar code. With 'Quiet zone' ='on' the Quiet zones must be at least as wide as specified by the corresponding bar code standard. With 'Quiet zone' set to an integer value greater than or equal 1, the quiet zones must be at least as wide as 'Quiet zone' x X pixels. With 'Quiet zone' = 'tolerant' a limited number of edges are allowed in the quiet zone, but at most 1 per 4 module widths. The intent of this is to prevent detecting only part of a bar code, while still allowing to read bar codes with simple quiet zone violations. With 'Quiet zone' = 'off', the quiet zones detection is disabled. Detection of quiet zone prevents that simple bar code types are detected inside of a longer bar sequence. Usually, values between 2 and 4 achieve optimal results by effectively suppressing false bar codes, but still tolerating small disturbances, textures, label edges, etc. next to the symbol. Typical values: 'Off' 'On', 1, 2, 3, 4, 5; Default: 'Off'

For newly generated detectors, all parameters are preset as standard values, suitable for many applications.

8.3.11 Detector Datacode

8.3.11.1 Tab Code
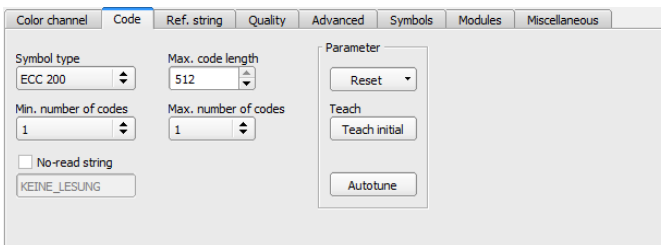
Fig. 161: Detector Datacode, tab Code

Parameter	Function
Symbol type	Select here the type of code to be read with the Code reader.

Parameter	Function
Code length	Max. Length of a barcode. If the contents of code are longer, the rest will be cut off. If more than one code is read by this detector, this value has to be set for the longest code.
Min. number of codes	Minimum number of codes to be read inside the search area.
Max. number of codes	Maximum number of codes to be read inside the search area. If this value is set higher than necessary, the reading time may increase slightly.
Reset	Reset parameters are for setting the code reading parameters back to the default state before teaching. There can be selected "standard", "enhanced" and "maximum". "Standard" is setting the default parameters in a way that most of the codes can be read. If your code can not be read, please use setting "Enhanced". If the code still cannot be read, use setting "Maximum". Settings "Enhanced" and "Maximum" may increase the reading time. This reset function is only for resetting the detector parameters, not for resetting of other settings outside the detector (i.e. general settings like illumination, in-outputs, serial settings etc.). After resetting the parameters, there can be made an initial teach, again.
Initial teach / Additive teach	Teach: the region of interest is searched for codes. If a code was found the parameters are set for this code. After successful teaching, the code will be marked with a green frame. After teaching a code the code reader will search in "run"-mode only for this type of code. Once teaching was done at least one time successful, this button is named "Teach additive". "Teach additive" is for extending the parameters either in order to read several different codes in one detector or in order to cover differences in printing quality. "Additiv teach" extends the already taught-in parameter set.
Autotune	Automatic setting (pre-processing filter and image acquisition) for the optimization of code reading.
No-read string	Specifies the text, sent out over the interfaces in case of non successful reading.

For newly generated detectors, all parameters are preset as standard values, suitable for many applications.

Optimization

Execution speed:

- Search zone for position (yellow frame) only as large as necessary

Robust detection:

- Search zone for position (yellow frame) sufficiently large?
- Contrasts for model and image suitably set?
- Are thresholds set correctly?

8.3.11.1.1 Autotune

When selecting the Autotune function, the SBS vision sensor automatically detects all the settings to optimize code reading.

The function always starts with the parameters already set by the user. So, if parameters are set roughly before the start of the "Autotune" function, Autotune makes the fine adjustment to optimize the result.

After the optimization run of "Autotune", "OK" or "Cancel" can be selected. In case of "OK", the altered parameters are used. When "Cancel" is selected, the old parameters are restored to the values from before the "Autotune" execution.

Fig. 162: "Autotune" Window

The "Autotune" function consists of the following elements:

(A) Progress	
Start	Start "Autotune" function. After pressing start, the progress is displayed.
Stop after reaching expected quality	The "Autotune" function stops the automatic settings when the minimum required quality is reached.

(B) Image acquisition	
Shutter Speed	**Active:** An activated Checkbox defines those parameters, that should be determined automatically by the SBS vision sensor. Not activated parameters remain unchanged. **Best Value:** The "Best Value" field shows the last setting, which was determined by the Autotune function.
Gain	
Internal illumination	
Polarization filters	
External illumination	

(C) Pre-processing	
Mean	**Active:** An activated Checkbox defines those parameters, that should be determined automatically by the SBS vision sensor. Not activated parameters remain unchanged. **Best Value:** The "Best Value" field shows the last setting, which was determined by the Autotune function.
Erosion	
Dilation	
Swap erosion/ dilation	

(D) Datacode parameters	
Module robustness	The best settings found by the Autotune function are displayed.
Find pattern tolerance	
Contrast tolerance	

(E) Quality of best parameter set	
number of codes	Number of codes in the field of view tested by the Autotune function.
Correction	Decode error, which is achieved with selected parameters.

8.3.11.2 Tab Ref. String
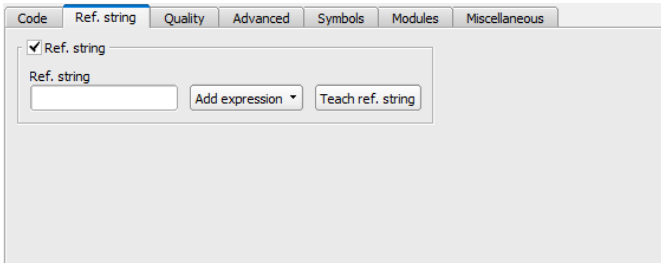
Fig. 163: Detector Datacode, tab Ref. String

Settings in tab Reference String

Parameter	Function
Compare string	Activates verification of contents of the result information. The verification is done by using of regular expressions.
Reference string	This text or regular expression is taken for verification. Here can be entered characters or regular expressions. If codes with a certain reference string are to be found under several codes, then the parameter "Max. number of codes" in the "Code" tab is to be set to a higher value than the number of searched codes.
Add expression	Opens a list with examples for regular expressions.
Teach ref. string	Reads the code under the code reader and takes the contents of this code as a reference string.

For newly generated detectors, all parameters are preset as standard values, suitable for many applications.

This text can be changed later.

Reference string	Hit	Example for hit
123	String containing 123	01234
\A123	String beginning with 123	1234
123\Z	String ending by 123	0123
\A123\Z	String matching exactly 123	123
[123]	String containing one of the characters	33
[123]{2}	String containing sequence of the characters of length 2	23
[12][34]	String containing a character of one of both groups	4

Most important elements of regular expressions:

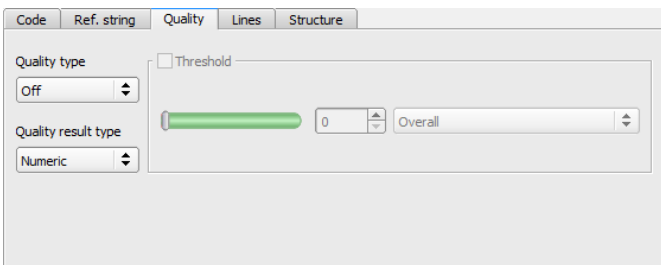| ^ or \A	Matches start of string
$ or \Z	Matches end of string (a trailing newline is allowed)
.	Matches any character except newline
[...]	Matches any character listed in the brackets. If the first character is a '^', this matches any character except those in the list. You can use the '-' character as in '[A-Z0-9]' to select character ranges. Other characters lose their special meaning in brackets, except '\'.
*	Allows 0 or more repetitions of preceding literal or group
+	Allows 1 or more repetitions
?	Allows 0 or 1 repetitions
{n,m}	Allows n to m repetitions
{n}	Allows exactly n repetitions
|	Separates alternative search expressions

8.3.11.3 Tab Quality
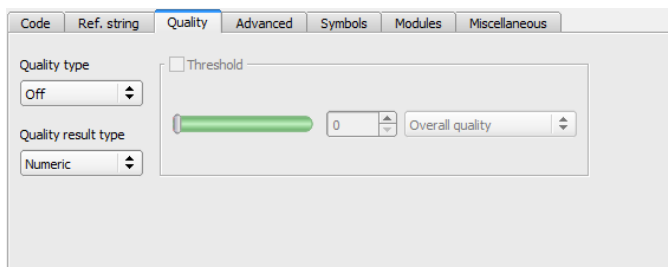
Fig. 164: Detector datacode, tab quality

Settings in tab quality

Parameter	Function
Quality type	Quality parameters are additional information for rating the printing quality of the code. There are two different standards: AIM DPM-1-2006 and ISO/IEC 15415. Quality parameters are eight single parameters, the definition of the respective elements is as follows: Q1 Overall quality Q2 Contrast Q3 Modulation Q4 Fixed pattern damage Q5 Decode Q6 Axial non-uniformity Q7 Grid non-uniformity Q8 Unused error correction Q9 Mean light The overall quality is the minimum of all individual grades. The contrast is the range between the minimum and the maximum pixel intensity. A strong contrast results in a good grading. The modulation indicates how strong the amplitudes of the data code modules are. Big black parts as well as small black parts leads to a reduction of the value. A balanced ratio of black and white simplifies the assignment of the individual modules. The fixed pattern of both ECC200 and QR Code is of high importance for detecting and decoding the codes. Degradation or damage of the fixed pattern, or the respective quiet zones, is assessed with the fixed pattern damage quality. The decode quality always takes the grade 4, meaning that the code could be decoded. Naturally, codes which cannot be decoded cannot be assessed

8.3.11.4 Tab Advanced

Fig. 165: Detector datacode, tab advanced

Settings in tab Advanced

Parameter	Function
Min. Contrast	Minimum contrast in gray values between bright and dark parts of the code, range (1...100).
Polarity	Possible restrictions concerning the polarity of the modules: If they are printed dark on a light background or vice versa.
Slant max.	Slant of the angle in the L-shaped finder pattern from the (ideally) right angle. The indication is in radians and corresponds to perspective distortions that can occur when printing the symbol or when taking images.
Mirrored	Setting option, whether the code was applied mirrored or not. Due to the symmetry of the code, this is not visible to the eye. The function helps, if codes should be read through transparent parts like glass.

For newly generated detectors, all parameters are preset as standard values, suitable for many applications.

8.3.11.5 Tab Symbols
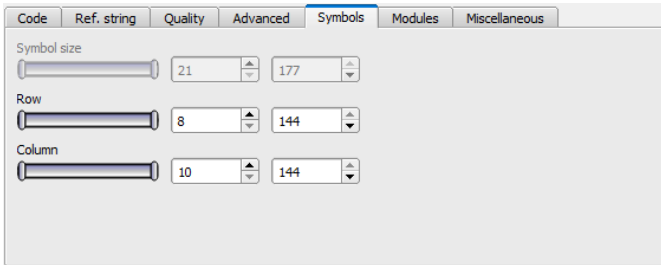
Fig. 166: Detector Datacode, tab Symbols

Settings in tab Symbols

Parameter	Function
Symbol size min. / max.	Only QR-Code: Size of symbol inside picture in pixel.
Column min. / max.	Only ECC200 and PDF 417: Number of columns including finder pattern.
Row min. / max.	Only ECC200 and PDF 417: Number of rows including finder pattern.

8.3.11.6 Tab Modules
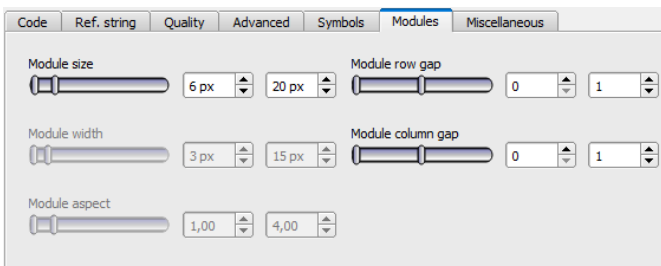
Fig. 167: Detector datacode, tab modules

Settings in tab Modules

Parameter	Function
Module size min. / max.	Size of modules in pixels.
Module width min. / max.	Only PDF 417: width of modules inside picture in pixels.
Module aspect min. / max.	Only PDF 417: minimum aspect of modules (rows compared to columns).
Module row gap	Only ECC200 and QR-Code: allowed gap between rows, i.e. at dot peened codes which have no full size modules.
Module column gap	Only ECC200 and QR-Code: allowed gap between columns.

8.3.11.7 Tab Miscellaneous
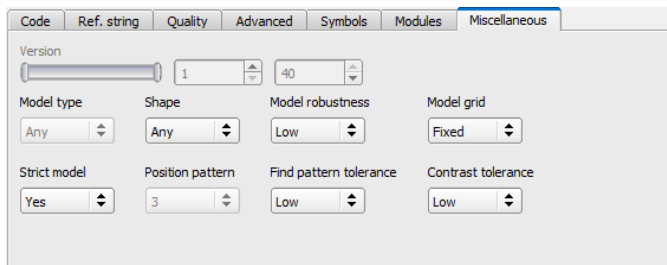
Fig. 168: Detector datacode, tab miscellaneous

Settings in tab Miscellaneous

Parameter	Function
Version	Only QR code: version of the code, with model 1 range of values 1 ... 14, with model 2 range of values 1 ... 40. Version indicates the size of the code. Version 1 means 21 x 21 modules, version 2 means 25 x 25 modules. , . (Per version 4 modules more)
Model type	Only QR-Code: Model 1 or Model 2. Model 2 is the newer version, supporting larger codes.
Shape	Only ECC200 and QR-Code: Possible restrictions concerning the module shape

Parameter	Function
	(rectangle and / or square).
Model robustness	Robustness of the decoding of data codes with very small module sizes. Setting the parameter to 'high' increases the likelihood of being able to decode data codes with very small module sizes. Additionally, in that case the minimum module size should also be adapted accordingly, thus should be set to the expected minimum module size and width, respectively.
Model grid	Only ECC200: Describes whether the size of the modules may vary (in a specific range) or not. Dependent on the parameter different algorithms are used for the calculation of the module's center positions. If it is set to 'fixed', an equidistant grid is used. Allowing a variable module size ('variable'), the grid is aligned only to the alternating side of the finder pattern. With 'any' both approaches are tested one after the other. Please note that the value of 'module_grid' is ignored if 'finder_pattern_tolerance' is set to 'high'. In this case an equidistant grid is assumed. List of values: 'fixed', 'variable', 'any' Default: 'fixed' (enhanced: 'any').
Strict model	Specifies, if the code parameters have to be meet completely or not. If this parameter is set to "Yes", all codes outside the parameter range will be ignored.
Position pattern	Only QR-Code: Number of position detection patterns that have to be visible for reading a code (2 or 3).
Find pattern tolerance	Only ECC200: Tolerance of the search with respect to a disturbed or missing finder pattern. The finder pattern includes the L-shaped side as well as the opposite alternating side. In one case ('low'), it is assumed that the finder pattern is present to a high degree and shows almost no disturbances. In the other case ('high'), the finder pattern may be heavily disturbed or missing completely without influencing the recognition and the reading of the symbol. Note, however, that in this mode the run-time may significantly increase.
Contrast tolerance	Tolerance during Code search in regards to strong local contrast variations.

8.3.12 Detector OCR

8.3.12.1 Detector OCR, Procedure

To set up an OCR Detector please follow these steps. As some steps base on the results of the one which was processed before, for a correct processing the sequence of the steps must be as described.
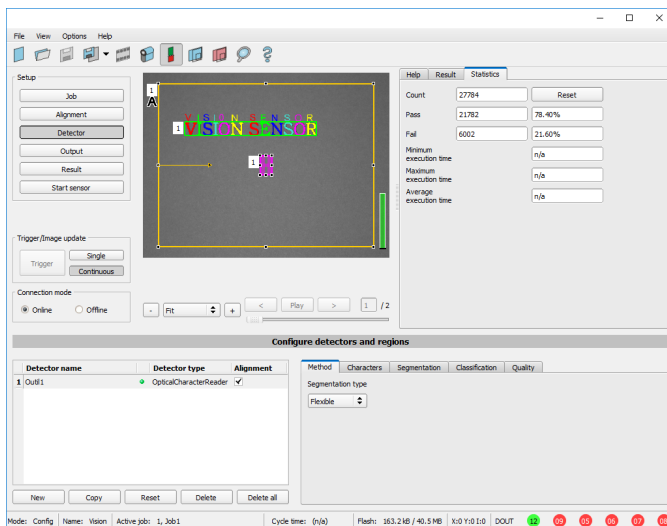
Fig. 169: Detector OCR

8.3.12.1.1 Basic sequence of setting parameters

- Segmentation by use of the tabs "Characters" and "Segmentation" as well as tab "Pre-Processing" in step "Job".

- Classification by use of tab "Classification" by selection of a font and definition of a reference string.

- Removing of characters which not have been classified with sufficient quality in tab "Quality".

- Using the OCR-Detector it is not sufficient to set the parameters with only one image. Stable reading results can only be achieved by using a large number of images. We recommend saving typically 20 to 30 images to cover all variations of the process, and optimizing parameters in offline mode. Stable reading results can only be achieved by using a large number of images.

8.3.12.1.2 Segmentation

- Optimizing of segmentation by use of the tabs "Characters" and "Segmentation". Goal is to get a stable segmentation for all single characters. The result of classification "reading result" is not important in this step, this will be optimized later.

- Segmentation can be improved by use of image pre-processing in tab "Job" – "Pre-Processing", e.g. by use of "Gauss", "Mean" or "Dilatation"/"Erosion" or a combination of

them. To achieve a stable segmentation it is recommended to use smoothing filters like "Gauss" or "Mean".

- Parameter "Groups of characters" may support segmentation by specification of the number of characters per group.
- Parameter "Max. deviation from base line" specifies, how much the vertical character position may be different from the base line of the font. Value is in percent of character height.
- Verify proper segmentation of all characters before going to step "Classification". Classification has no influence to segmentation. Faulty segmented characters will be classified wrong.

8.3.12.1.3 Segmentation Examples:
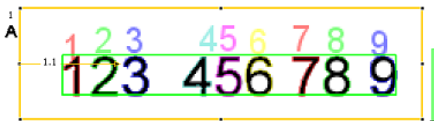
Fig. 170: Segmentation without any preset for parameter "Groups of characters": All characters are found
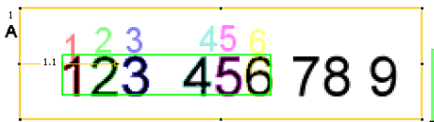
Fig. 171: Segmentation with value "3 3" for parameter "Groups of characters": Only the both groups of 3 characters are found.
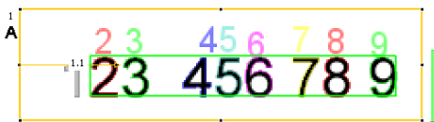
Fig. 172: Segmentation without preset for parameter "Groups of characters": The segmentation for the first character "1" failed, as it´s contrast to background is much lower than all others.
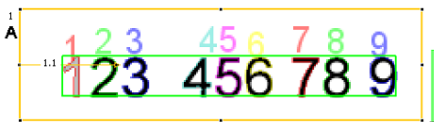
Fig. 173: Segmentation with value "3 3 2 1" for parameter "Groups of characters": Also the "lower contrast character" get´s segmented.
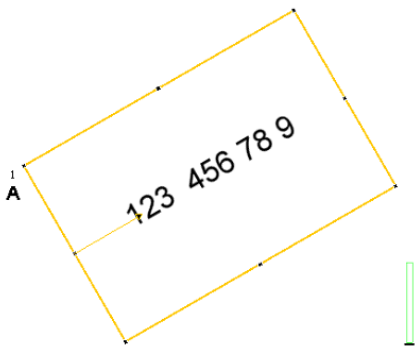
Fig. 174: Segmentation with parameter "Text orientation" = "Font horizontal in image": No characters are segmented as there are no characters with horizontal orientation in the image.
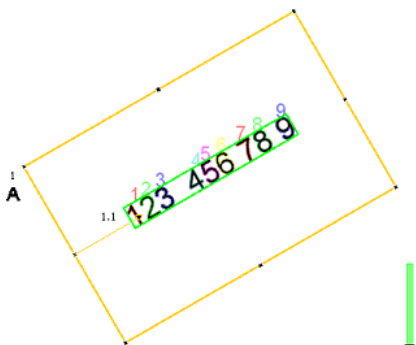
Fig. 175: Segmentation with parameter "Text orientation" = "Font horizontal in ROI": Segmentation works as characters are horizontal relative to ROI (**search area**).
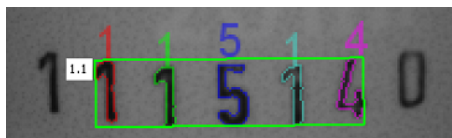
Fig. 176: Segmentation with value 15% for parameter: "Max deviation from base line": Only the inner five characters are segmented.
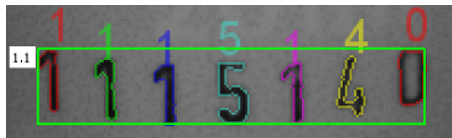
Fig. 177: Segmentation with value 25% for parameter "Max deviation from base line": All characters are segmented.

8.3.12.1.4 Classification

- In this step a suitable character set "font" is selected. Each font is available with different character sets. Goal is to choose the font with the most stable results for the application.
- Naming of fonts by the example of group "Industrial":
    - "Industrial_0-9": all numbers
    - "Industrial_0-9+": all numbers and special characters
    - "Industrial_A-Z+": all capital letters and special characters
    - "Industrial_0-9A-Z": all numbers and capital letters
    - "Industrial.omc": all characters
- Reference string has two functions:

    1. Manipulation of classification (of the recognized characters): For each segmented character a rating value (confidence), in relation to each in the whole set of characters (font) available character is calculated.
    If reference string is not used, the character with the highest rating value (confidence) is the winner.
    By use of reference string the "N" best alternatives will be considered (No. of alternatives). Maximum number of allowed character changes which did not have the maximum rating value (confidence) is specified in: "No. of corrections".
    2. Manipulation of detector result:
    A minimum quality for complete string is specified (Threshold). If quality is below the threshold, detector result will be "false".

8.3.12.1.5 Quality

- If quality of one of the classified characters is below "Minimum confidence", the detector result will be "false".
- Low confidence shows, that a character was not classified reliably. High confidence value however, is not a guarantee for reliable classification!

8.3.12.2 Tab Characters (flexible)

Definition of basic settings of characters to read.
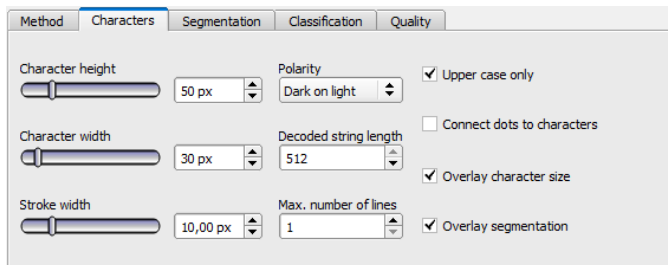
Fig. 178: Detector OCR, tab Characters

Parameter	Function
Character height	Max. height of character in pixels.
Character width	Max. width of character in pixels.
Stroke width	Average width of lines of characters in pixels.
Polarity	Possibility to select between dark characters on bright background or vice versa.
Text orientation	"Font horizontal in Image": text has to be horizontal in camera image. Rotated text will be not read or wrong read. "Font horizontal in ROI": by rotation of ROI a rotation angle for reading of rotated text can be specified.
Max. number of lines	Max. number of lines to read.
Upper case only	Limitation to capital letters only.
Connect dots to characters	Connects single dots, e.g. of a dotted font or of a bad printed font for complete characters.
Overlay character size	Switch on and off overlay rectangle for size of letters.
Overlay segmentation	Switch on and off colored overlay for segmentation of characters.

For newly generated detectors, all parameters are preset as standard values, suitable for many applications.

Optimization:

Execution speed:

- Search zone for character (yellow frame) only as large as necessary

8.3.12.3 Tab Segmentation

Definition of basic settings of characters to read.
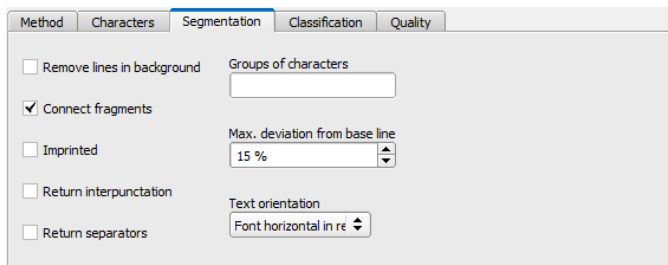
Fig. 179: Detector OCR, tab segmentation

Parameter	Function
Remove lines in background	This parameter can be used to remove disturbing lines in the background.
Connect fragments	Connects characters which may be divided e.g. by bad printing in two parts to one segment.
Imprinted	Enables reading of imprinted fonts e.g. if characters appear due to the illumination as white text with black outline (shadow) or vice versa.
Return Punctuation	Activates output of special characters such as full stops or comma.
Return separators	Activates output of special characters like dash.
Groups of characters	Enables possibility to specify the spacing of characters to read. E.G. if characters are always printed in two groups of four characters this can be specified by input of "4 4". This function should be used, if in several reading attempts in one and the same image, a different string length is read.
Max. deviation from base line	Maximum allowed difference of horizontal position characters on a straight line between first and last character. This function may be used if characters are not printed on a horizontal line.

8.3.12.4 Tab Classification

Definition of basic settings of characters to read.
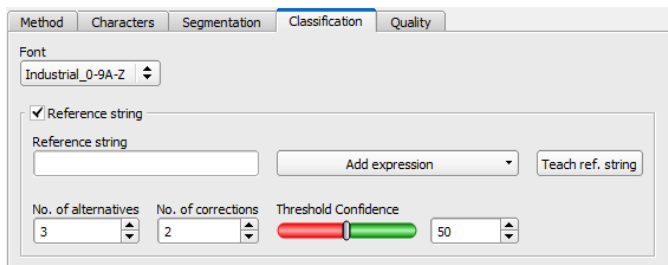
Fig. 180: Detector OCR, tab Classification

Parameter	Function
Font	For available fonts see chapter: Detector OCR, available fonts. 0-9 =› numbers only 0-9+ =› numbers and special characters A-Z =› only capital letters A-Z+ =› capital letters and special characters No extension =› all characters
Ref. String (Checkbox)	Activates verification of contents of the information read. Verification is done on base of regular expressions.
Ref. string	This text or regular expression is taken for verification. Here can be entered definite characters, which are compared directly, or with regular expressions to verify the structure of the result read. Characters which look very similar as number or as letter like "8" and "B" can be corrected automatically by use of regular expressions.
Add expression	Opens a list with examples for regular expressions.
Teach ref. string	Reads the code below the Code Reader and copies the contents into Ref. string. Text can be edited afterwards.
No. of alternatives	This command controls how many possible alternatives can be searched to find and automatically replace a character according to the regular expression in the reference string.
No. of corrections	This command controls how many characters with in the string can be changed when using a regular expression in the reference string. Example: Day 3 letter

Parameter	Function
	(MON / TUE / WED / etc) is the segmentation. Decode gives the letters W6O rather than WED. With a setting of '2' in this field the camera software will automatically 'correct' the (number) 6 and (letter) O to become a (letter) E and D - If the setting in the field was 1 then the detector would fail.
Threshold	Threshold for good-bad decision: if number of corrections is higher than this threshold, the text will be marked as "not read" (detector result false).

Most important elements of regular expressions

Reference string	Hit	Example for hit
123	String containing 123	01234
\A123	String beginning with 123	1234
123\Z	String ending by 123	0123
\A123\Z	String matching exactly 123	123
[123]	String containing one of the characters	33
[123]{2}	String containing sequence of the characters of length 2	23
[12][34]	String containing a character of one of both groups	4

Most important elements of regular expressions:

^ or \A	Matches start of string
$ or \Z	Matches end of string (a trailing newline is allowed)
.	Matches any character except newline
[...]	Matches any character listed in the brackets. If the first character is a '^', this matches any character except those in the list. You can use the '-' character as in '[A-Z0-9]' to select character ranges. Other characters lose their special meaning in brackets, except '\'.
*	Allows 0 or more repetitions of preceding literal or group
+	Allows 1 or more repetitions
?	Allows 0 or 1 repetitions

{n,m}	Allows n to m repetitions
{n}	Allows exactly n repetitions
|	Separates alternative search expressions

8.3.12.4.1 Detector OCR, available fonts

Overview of fonts:

Semi

Dot print

Handwritten

Industrial

MICR
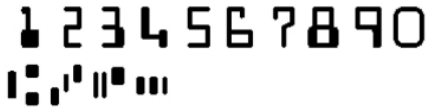
OCRA

OCRB

Pharma
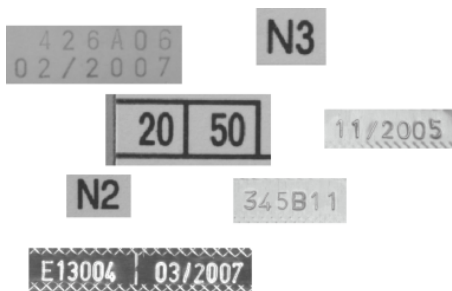
8.3.12.5 Tab Quality

Definition of basic settings of characters to read.
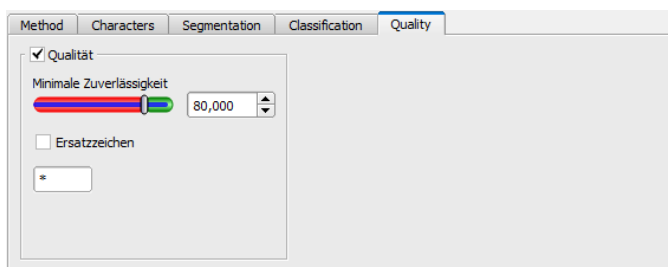
Fig. 181: Detector OCR, tab quality

Parameter	Function
Quality	Quality of each character gets a value of 0 – 100 %. As higher the value, as higher is the confidence to the result. Small values are a sign for a bad reading quality.
Minimum confidence	If minimum confidence was not reached the character is considered to be not read and will be replaced by the replacement character.
Replacement character	Output character for the case that minimum confidence was not reached.

8.3.12.6 Result OCR

This function executes the job defined on the PC and the Result statistics window is displayed with Detector list and Evaluation results. Execution times are not updated in this mode, as they are not available from the sensor.

Detailed inspection results from the detector marked in the selection list are displayed in run mode.

In the image window the search- and feature areas and the result bar graphs are displayed – if set up.
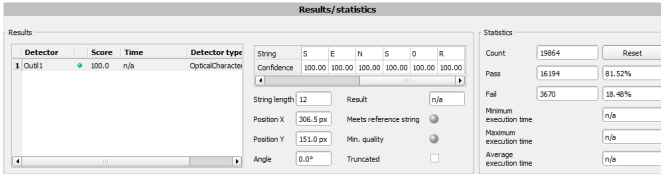
Fig. 182: Detector OCR, Result display

The parameters displayed vary according to the type of detector selected:

Parameter	Function
String	Characters read
Confidence	Value from 0-100%, shows how reliably a character has been read
String length	Length of string
Position X	Position X in pixels
Position Y	Position Y in pixels
Angle	Angle compared to horizontal line
Compare result	Is an indication for the quality of a result. If no characters had to be replaced according the reference string, this value is at 100%. The value decreases with rising number of corrections
Meets reference string	Indicates if string meets the reference string.
Compare result	Indicates if minimum quality was reached.
Truncated	Indicates if a part of the string was truncated.

8.3.13 Detector Color value

Output of average color values RGB / HSV / LAB over one of the interfaces.

8.3.13.1 Tab Color channel

Selection of Color models (Page 273) or color channel on which the detector should work.

An image, taken with a color chip contains more information by the color component than a monochrome image. This feature can be used with the color channel selection. By selection of single color channels specific zones can be intensified or weakend. The display of the image depends on the image chip and the selected detector.

- Monochrome chip: Display always black/ white
- Color chip + Color detector: Display always colored
- Color chip + Object detector: Monochrome image, display depending on selected color model and color channel
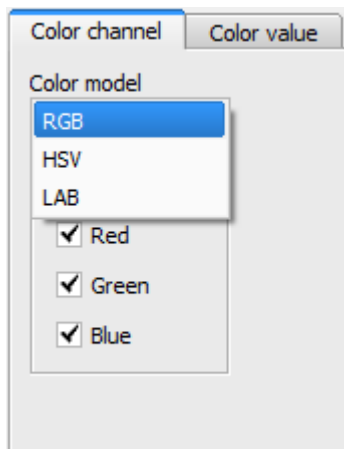
Fig. 183: Color channel

Parameter	Function
Color model	Color model: RGB, Color model RGB (Page 274), HSV,Color model HSV (Page 275) , LAB, Color model LAB (Page 275)
Color channel	One ore more channels can be selected.

8.3.13.2 Tab Color value

Output of average color values RGB / HSV / LAB over one of the interfaces.
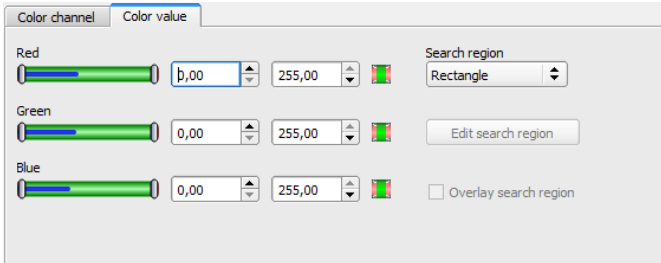
Fig. 184: Color value

Parameter (Color channel dependent from setting of color model)detector	Function
Red (Hue / Lightness)1	Threshold for selected channel min. / max.
Green (Saturation / A)	Threshold for selected channel min. / max.
Blue (Value/ B)	Threshold for selected channel min. / max.
Search region	Sets search region as rectangle, as circle or as free shape. If free shape was selected, "Edit search region" gets active.
Edit search region	By edit ROI there can be masked out parts of the search area. The parts which are not relevant for this examination can be painted out like using an eraser. Masks can also be inverted, means that parts which are interesting can be marked.
Overlay search region	Activate overlays for free shape search regions.

Predestined applications:

- Output of calculated color parameters via one of the data interfaces for further processing.

For newly generated detectors, all parameters are preset as standard values, suitable for many applications.

8.3.14 Detector Color area

Determines percentage of area covered by a color or a range of colors. Depending from area there can be created a good / bad decision.

8.3.14.1 Tab Color channel

See chapter: Tab Color channel (Page 215)

8.3.14.2 Tab Color area

Determines percentage of area covered by a color or a range of colors. Depending from area there can be created a good / bad decision.
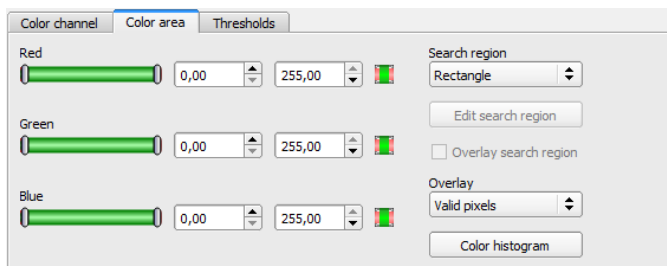
Fig. 185: Color area

Parameter (Color channel dependent from setting of color model) detector	Function
Red (Hue / Lightness)1	Threshold for selected channel min. / max.
Green (Saturation / A)	Threshold for selected channel min. / max.
Blue (Value/ B)	Threshold for selected channel min. / max.
Search region	Sets search region as rectangle, as circle or as free shape. If free shape was selected, "Edit search region" gets active.
Edit search region	By edit ROI there can be masked out parts of the search area. The parts which are not relevant for this examination can be painted out like using an eraser. Masks can also be inverted, means that parts which are interesting can be marked.
Overlay search region	Activate overlays for free shape search regions.

Parameter (Color channel dependent from setting of color model) detector	Function
Overlay	Color marking of pixels inside or outside of specified color range. This is a help during setup to vizualise detector results and to set thresholds more accurate.
Color histogram	Offers possibility to enter the thresholds inside a color histogram.

Predestined applications:

- Colored object with certain size and variable position in the ROI

For newly generated detectors, all parameters are preset as standard values, suitable for many applications.
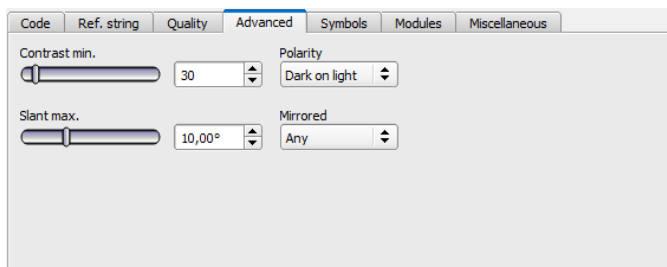
8.3.14.2.1 Color histogram

Depending from selected color model there are displayed histograms for RGB, HSV or LAB. The histogram shows the distribution of colors in region of interest. By the buttons there can be switched on and off single channels. Limits for color detection can by set by moving small markings below the histogram. The selected range of colors is shown by colored areas. Crossing the limits results in invertion of the selection. If a color can be detected reliable by using only one channel, the other channels have to be set to minimum or maximum limits to avoid disturbing influence to detection.
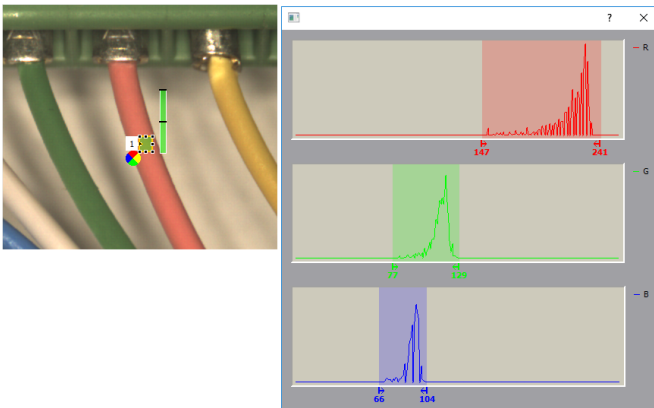
Fig. 186: Color histogram

8.3.14.3 Tab Thresholds

Determines percentage of area covered by a color or a range of colors. Setting of thresholds.
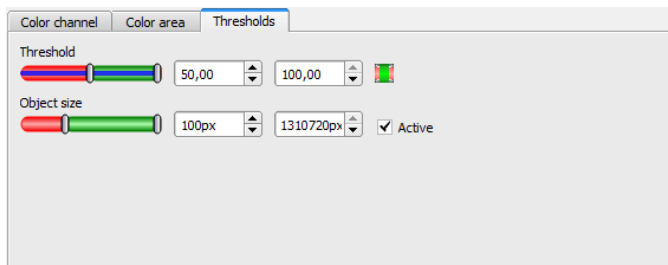
Fig. 187: color area, tab thresholds

Parameter	Function
Threshold	Threshold for percentage of the area min. / max.
Object size	Min. / Max. object size (connected area)

For newly generated detectors, all parameters are preset as standard values, suitable for many applications.

8.3.15 Detector Color list

Compares a color with a list of known colors. Result: number or name of the color closest to a color in the list. This enables sorting of parts by color.

Tab Color channel (Page 215)

Tab Color list (Page 219)

8.3.15.1 Tab Color channel

See chapter: Tab Color channel (Page 215)

8.3.15.2 Tab Color list

Compares a color with a list of known colors. Result: number or name of the color closest to a color in the list. This enables sorting of parts by color.
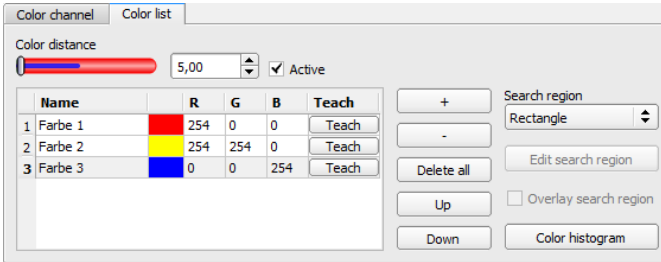
Fig. 188: Color list

Parameter	Function
Color distance	Distance of the current color versus the taught-in color. The metric of the color distance depends on the Color models (Page 273) used, only the selected color channels are considered. *1)
Name	Name of color, can be changed by doubleclick, e.g. red, green, blue...der Farbe, kann per Doppelklick auf den Namen geändert werden, z.B. Rot, Gelb, Blau
Sample color	Ouput of taught color as colored area and in numbers (RGB / HSV / LAB)
Teach	Teach color in active line, if more than one color has to be taught in one and the same image, a small ROI has to be moved to every color.
+	Add new line at end of list.
-	Delete active line.
Delete all	Delete complete list.
Up	Move marked line one line up.
Down	Move marked line one line down.
Search region	Sets search region as rectangle, as circle or as free shape. If free shape was selected, "Edit search region" gets active.
Edit search region	By edit ROI there can be masked out parts of the search area. The parts which are not relevant for this examination can be painted out like using an eraser. Masks can also be inverted, means that parts which are interesting can be

Parameter	Function
	marked.
Overlay search region	Activate overlays for free shape search regions.
Color histogram	Offers possibility to enter the thresholds inside a color histogram.

1*) In the RGB- and LAB- color model the color distance is the euklidean distance.
In the color model LAB the distribution of colors is nearly homogeneous over the entire model, that means that color distances of the same value lead to the very equal cognition of color difference over the entire model. That is why we can state that a distance of a value of ›= 5 leads to a cognition of a different color in this color model.

Predestinated applications:

- Sorting of colored object via the list index
- Simple control of homogenious colored areas (average of color value over ROI, teach, adjust small color distance (tolerance band) .. that´s it)

For newly generated detectors, all parameters are preset as standard values, suitable for many applications.

8.3.15.2.1 Color histogram

Depending from selected color model there are displayed histograms for RGB, HSV or LAB.
The histogram shows the distribution of colors in region of interest. By the buttons there can be switched on and off single channels. Limits for color detection can by set by moving small markings below the histogram. The selected range of colors is shown by colored areas. Crossing the limits results in invertion of the selection. If a color can be detected reliable by using only one channel, the other channels have to be set to minimum or maximum limits to avoid disturbing influence to detection.
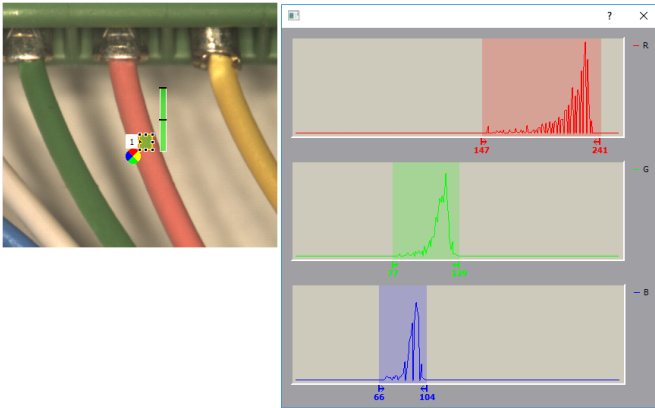
Fig. 189: Color histogram

8.4 Setup Output

Here you define the assignment and logical connection of the digital signal outputs as well as the interfaces and output data of your SBS.

8.4.1 Tab I/O mapping

Here the following settings can be made:

1. Definition, if I/O is used as an input or output
   Pin 05 - 08, can be used as input or output.
2. Assignment of functionality to inputs and outputs.
   In the list-box there can be seen and selected all available functions for this input or output. The functions listed under "Unique function" are only available via this pin / line.
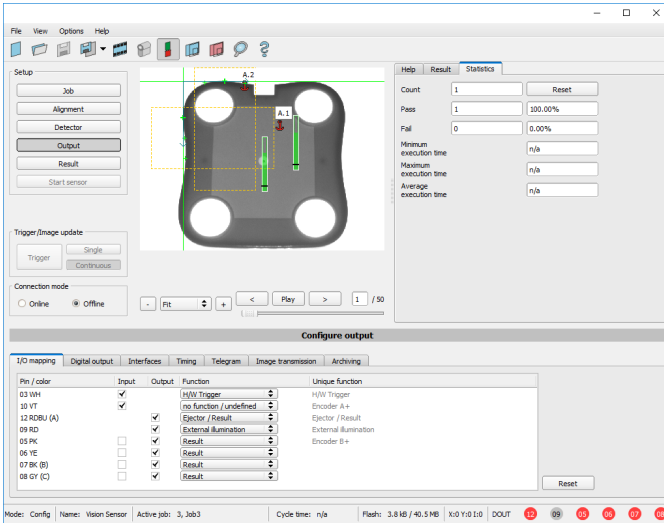
Fig. 190: Output, I/O Mapping

8.4.1.1 Functions of inputs

Function	Description
H/W Trigger	Hardware Trigger (only on pin 03 WH available)
Encoder A+	Input for encoder, Track A+ (only on pin 10 VT available)
Encoder B+	Input for encoder, Track B+ (only on pin 05 PK available)
Enable Trigger	Function for enabling or suppressing trigger signals. Reading this function takes about 1 ms. This creates a pause in which a trigger signal is ignored, even though the Enable Trigger signal is present.
Job 1 or 2	Job change between Job 1 and Job 2, depending on status of this input. Low = Job 1, High = Job 2.
Job 1 ... N	Job change by pulses on one input. If possible, the job change should take place via the binary signals (binary coded).
Teach temporary / Teach permanent	Teaching of all detectors. Rising edge on this input and trigger start teaching.

Function	Description
	Temporary: storage in RAM, void after reset. Permanent: storage in flash, still valid after reset.
Job switch (BitX), binary coded	Job switching via binary bit pattern to up to 5 inputs that can be defined for this purpose, i.e. switch between 1 to 32 jobs. ranking of the bits according to assigned ascending input designation 1 - 5. Bit 1 = LSB. See chapter: Job 1... 31 via binary bit pattern
Repeat mode enable	Images are captured and evaluated as long as: this input is on high level and none of the following stop criteria is fulfilled: - "Overall job result" = positive (access via Output/Digital output) - "Max. cycle time" is not elapsed (if active) If "Repeat mode enable" is used, this implicitly causes function "Trigger enable" at the same time. That means only if a high signal is at this input, triggers are accepted and executed, see below: Input: Repeat Mode Enable, with Trigger (Page 229)
No function, undefined	no function, not used

Functions which are used already are displayed in gray, because they cannot be used any more. All inputs need a minimum signal length of 2 ms.
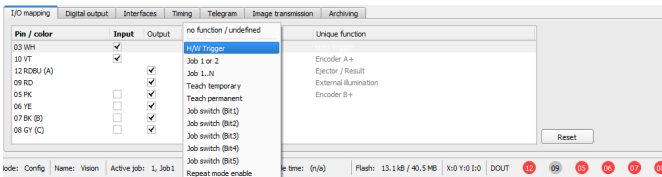
Fig. 191: Output, Inputs

8.4.1.1.1 Encoder Connection

If both tracks A+ and B+ are used increasing or decreasing counting can be done / forward or backward movement. The encoder inputs can work with a frequency of maximum 18 kHz.
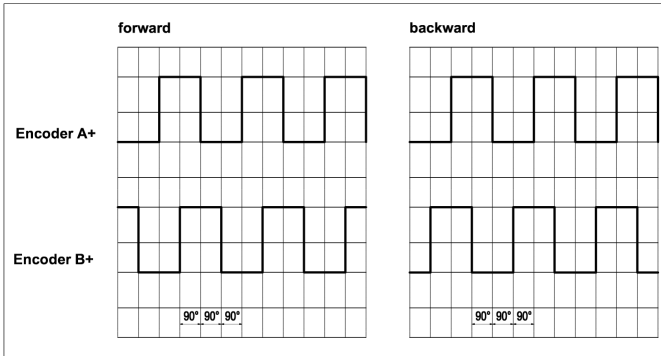
Fig. 192: Encoder connection A+ / B+

8.4.1.2 Functions of outputs

Function	Description
Ejector	Dedicated ejector output, maximum load 100 mA (all other outputs 50 mA), only on pin 12 RDBU available (corresponds LED "A").
Result	Result output, every result output can be covered with a detector result or a logical expression.
Acknowledge job change	When changing jobs via digital I/O ("Job 1..N" or "Job PinX, binary coded"), a low / high edge can be set here to confirm the success case. The high edge is set after the new job content is loaded and active, i.e. at the same time as the high edge of the ready signal after switching (see timing ...). The high level stops for 20 ms and is then deleted. If job switch was not successful, signals remain low.
External illumination	If this setting is selected (via pin 09 RD available only), a external illumination can be connected / triggered
No function, undefined	no function, not used

Fig. 193: Outputs

There are two predefined outputs:

- Ready: indicates, that Sensor is ready to receive a trigger.
- Valid: indicates, that data on outputs are valid.

8.4.1.3 Functions of the programmable, digital inputs:

During operation with process control, the following cases can be carried out via the inputs:

- inactive
- enable / disable
- load Job (binary coded)
- load Job 1 ... n
- teach temporarily
- Teach permanent

Description of different cases with a signal diagram.

All following signal diagrams are based on the setting "PNP".

8.4.1.3.1 Input: "Trigger enable"

For enable (high) or disable (low) of trigger input.
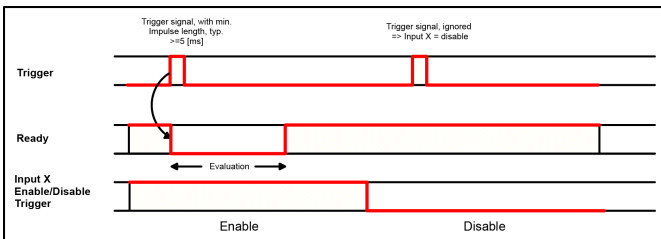
Fig. 194: Input timing, Trigger enable

8.4.1.3.2 Input: Job change binary or by function Job 1 or 2:

Job change binary over up to 5 inputs (Job 1- max. 31):

As soon as the binary input signal change Ready is set to low. Ready remains low until switchover to the new job is done. If the option "Job change confirm" is used, this signal occurs after the job change, and hereafter "Ready" is set high again. During Job Change via binary inputs there must not be sent any trigger signal. The change of the logic levels of the according inputs must happen at the same time (during maximum 10 ms all inputs must have a stable logic level).

Job change by function: Job 1 or 2:

At the level change of the according input Ready is set low. Ready remains low until switch-over to the new job is done. If the option "Job change confirm" is used, this signal occurs after the job change, and hereafter "Ready" is set high again. During Job Change over binary inputs there must not be sent any trigger signal. A high level causes evaluation according to job 2; a low level produces evaluation according to job 1.

Differences between binary switching and Job 1 or 2:

By usage of binary job switch the desired job number must be represented binary coded via the selected inputs. Therefore in this mode to switch between 2 jobs minimum 2 inputs are necessary.

In case of Job change Job 1 or 2 a high level cause's evaluation according to job 2, a low level produces evaluation according to job 1. In this way with only one input two the switching between two jobs can be done.
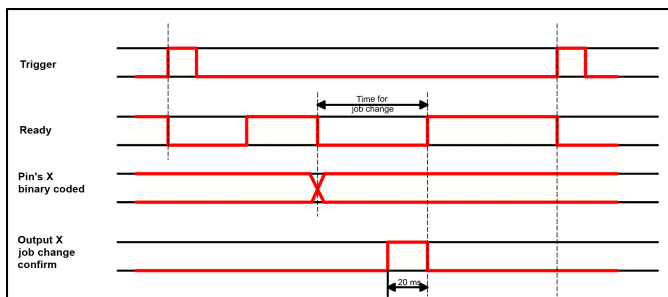
Fig. 195: Input timing, Job change via Binary / Job 1 or 2

8.4.1.3.3 Input: Job 1 … n

For switching between jobs via impulses.

Impulses are counted until the first delay of ≥= 50 ms and then switches to the appropriate job. Ready remains low until switch-over to the new job occurs. If the option "Job change confirm" is used, this signal occurs after the job change, and hereafter "Ready" is set high again. Pulse length for job change should be 5 ms pulse and 5 ms delay. During Job Change over binary inputs there must not be sent any trigger signal. If possible job change should be made by binary coded signals, this is the faster way.
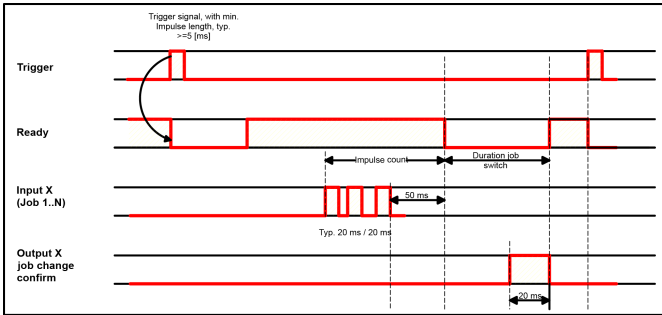
Fig. 196: Input timing, Job 1 ... n

Attention:

At Job switch please take care of the following:

- All Jobs must have the same setting for job change
- All Jobs must be in triggered mode
- Ready signal must be high when trigger sequence starts

8.4.1.3.4 Input: Teach temp. / perm.

For re-teaching samples of all detectors of the current job. A rising edge initiates teaching, during which a high level must exist at least until the next trigger, so that an image of an inspection part can be recorded in the correct position. Ready is set to low and remains low until teaching has been completed. Storage is either temporary (only in RAM), or permanent (in flash) according to the setting.
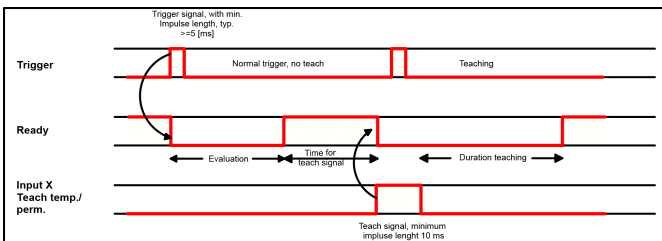
Fig. 197: Input timing, Teach

Please note:
The functions Job 1 or 2, Job 1 ... n or teach temp. / perm. can only be used in trigger mode

8.4.1.3.5 Input: Repeat Mode Enable, with Trigger

Images are captured and evaluated as long as, this input is on high level and none of the following stop criteria is fulfilled:

- "Overall job result" = positive (access via Output / Digital output)
- "Max. cycle time" is not elapsed (if active)

If "Repeat mode enable" is used, this implicitly causes function "Trigger enable" at the same time. That means only if a high signal is at this input, triggers are accepted and executed
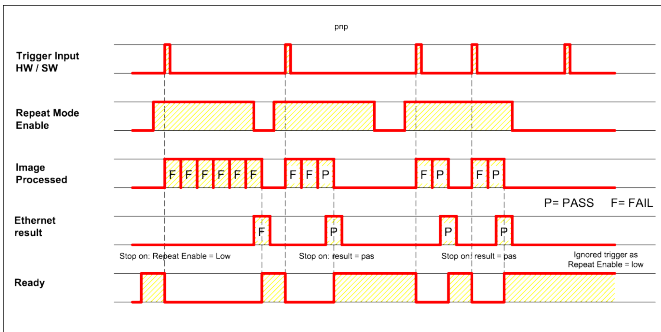
Fig. 198: Input, Repeat Mode Enable, with Trigger

8.4.1.3.6 Input, Repeat Mode Enable, in Freerun

Fig. 199: Input, Repeat Mode Enable, with Trigger

8.4.2 Tab Output signals (Digital outputs / Logic)

In this tab, you define the switching behavior and logical connection of the digital outputs. Number of outputs depends from settings in tab IO mapping. Additionally an IO-extension can be connected over the serial interface.
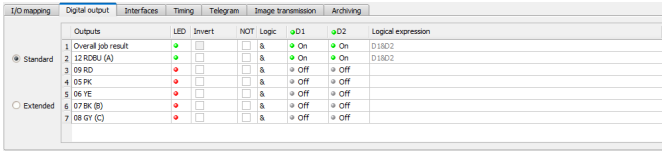
Fig. 200: Output, tab digital output

Description of different cases with a signal diagram.

For each pin (output) there are the following possibilities:

Parameter	Function
Overall job result	No physical output. Effects recorder, statistics and archiving functions
Invert	Invert total result for this pin (output)
Mode	Standard: combine several detectors by logical expressions like AND (&) / OR (I) / NOT (!) to one logical expression. Advanced: Free edit of logical expression.
NOT	Select: operator NOT (!)
Logic	Select: operator AND (&) / OR (I)
D1 - D...	All active detectors are shown in this list depending from number of detectors. These can be assigned to the listed output. Each detector can be set to on, off and invert.
Logical Expression	Here is shown either the logical expression that was build automatically by using of standard mode or the logical expression can be entered free by using the advanced mode.

Defining logical connection:

Define the logical connection between the inspection results of the individual detectors and the status of the selected output. You have two input possibilities:

- Standard mode (checkboxes and operators)
- Extended mode (formula)

8.4.2.1 Logical connection – Standard mode

In standard mode, connection of detector inspection results with the selected output must be carried out using the option buttons operator and the checkboxes in the detector selection list.

The result is displayed in the logical formulas window (cannot be edited).

Connecting results:

Select the logical operator to be used for connecting the detectors in the selection list, from the operator window.

Activate the detector in the selection list which is to contribute to the result (tick in the Active column).

By activation the "Inverted" column, you can individually invert the respective detector result.

The entry in the "Result" column alters accordingly.

Examples:

The detector results can only be connected by one logical operation, e.g.:

- (D1&D2&D3) or
- !((!D1)|D2|D3) etc.

> **Please note:**
> If a detector is assigned to an image acquisition (see "Repeat mode", chapter Tab Cycle time (Page 95)), its result in the remaining image acquisitions does not affect the logic result.

8.4.2.2 Logical connection – Formula mode

In formula mode, connection of detector inspection results with the selected output is defined by the direct input of a logical formula. The operators AND, OR and NOT and round brackets are available for this purpose.

Please use the following characters for the logical operators when editing the formula:

- "&" for AND
- "|" for OR ("AltCtrl" key and "◊" key)
- "!" for NOT

Examples:

Logical expressions of any complexity can be created, e.g.:

- (D1&D2)|(D3&D4)
- !((D1|D2)&(D3|D4))
- (D1|D2)&(D3|D4)&(D5|D6)

etc.

Please note:

If a detector is assigned to an image acquisition (see "Repeat mode", chapter Tab Cycle time (Page 95)), its result in the remaining image acquisitions is set to logic "0". The logic result must be adjusted accordingly.

8.4.3 Tab Interfaces

In this tab you select and activate the digital inputs / outputs used and the interfaces for data output. The outputs and interfaces can be separately activated or deactivated in the Active column.

	Name	Setting 1	Setting 2	Setting 3	Logical outputs	Enable
1	Internal I/O	PNP				✓
2	Serial	RS422	19200 Bd	8N1	0	
4	Ethernet	(IN)2006	(Out)2005		0	
5	EtherNet/IP				0	
6	PROFINET					
7	Vision Sensor Visualisation Studio	Image and overlay				✓
8	SBSWebViewer					
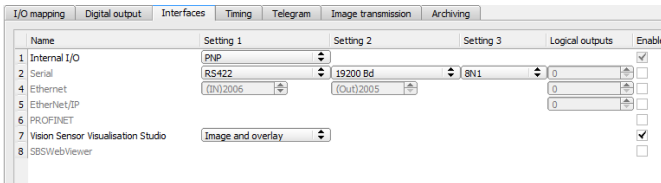
Fig. 201: Output, tab Interfaces

Parameter	Function
Internal I/O	Selection of I/O-type: PNP or NPN
RS422 (baud rate)	RS422 zur Datenausgabe mit Auswahl der Datenübertragungsrate. Basic settings: 8 data bits, 1 stop bit, no parity.
External (digital I/O)	External inputs and outputs (with I/O and encoder extension module)
Ethernet	Ethernet TCP/IP for data output. Sensor is a socket server. There are used two ports which can be defined by the user. Default is port 2006 (IN) for commands to sensor and port 2005 (OUT) for data transfer. Festo offer utilities for explanation of Ethernet communication. They are installed together with this software in utilities directory.
EtherNet/IP	Field bus EtherNet/IP for data output. SBS vision sensor EtherNet/IP, Introduction (Page 364)
PROFINET	Field bus PROFINET for data output, PLC communication. **Please note:** The sensor starts the PROFINET stack as soon as a job with PROFINET is selected. This causes a small slow down of the execution

Parameter	Function
	speed. Switching to another job without PROFINET does not stop the PROFINET-stack. Only a new start / reset starts the sensor without execution of the -stack. SBS vision sensor PROFINET, Introduction (Page 331)
Vision Sensor Visualisation Studio	Activation or deactivation of the module "Vision Sensor Visualisation Studio". When the checkbox is deactivated, the button "View" in Vision Sensor Device Manager can no longer be used to access Vision Sensor Visualisation Studio. If the checkbox "Vision Sensor Visualisation Studio" is activated (default), the following settings can be selected for the image transfer: • **Overlay** When "Overlay" is selected, only the overlay is transferred to Vision Sensor Visualisation Studio. Image and pre-processing settings are not transferred. • **Image and overlay** When "Image and Overlay" is selected, the image with the overlays is transferred into Vision Sensor Visualisation Studio. Pre-processing settings are not transferred. • **Image with pre-processing and overlay** When this setting is selected, the image with the pre-processing settings and the overlay are transferred in Vision Sensor Visualisation Studio. Additional information: Configure overlay: (Page 124) and Tab Pre-processing (Page 71)
SBSxWebViewer	Activates the webserver on the SBS vision sensor. Similar like in the local installed module "Vision Sensor Visualisation Studio" now via SBSxWebViewer"" images and result data can be displayed via webbrowser. Following browsers are supported: Microsoft Internet Explorer®ab IE10, Google Chrome® and Mozilla Firefox®. To start SBSxWebViewer: • Activate SBSxWebViewer, at Output/Interfaces/SBSxWebViewer • "Start sensor" (press button in Vision Sensor Configuration Studio)

Parameter	Function
	- Open Browser - Type the IP address of the sensor (see Vision Sensor Device Manager) into the address field of the browser. Format: "http://Your Sensor IP", e.g.: "http://192.168.100.100" (default). See also: SBS – SBSxWebViewer (Page 234)

For further informations see User manual, chapter "Communication"

Logical outputs:

By using the RS422, Ethernet and EtherNet/IP interface additional pure logic outputs can be defined, which just exist logically and can be communicated via one of these interfaces only.

Logical outputs can be assigned to an e.g. detector result or to a logic expression (formula).

8.4.3.1 SBS – SBSxWebViewer

This program enables the monitoring of the image from the camera and the inspection results. No new settings can be made on the sensor.
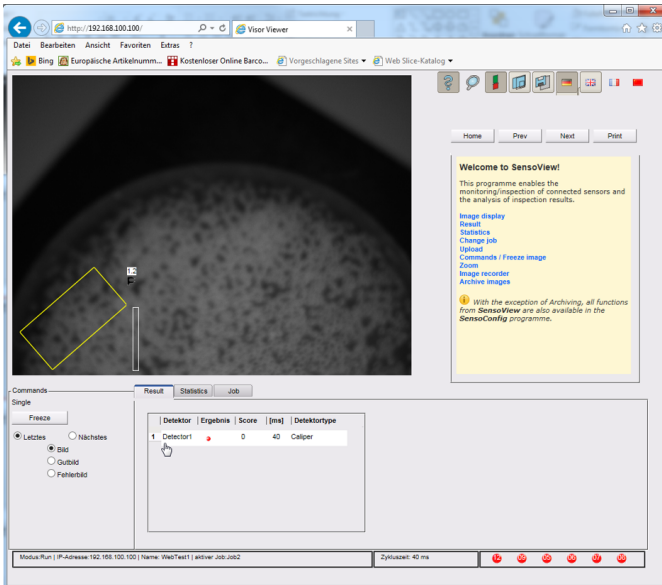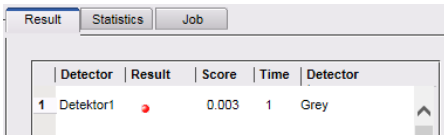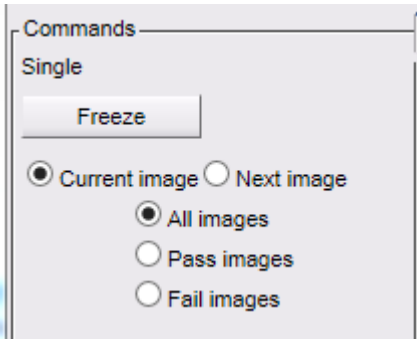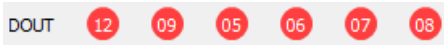
Fig. 202: SBSxWebViewerin the Browser / Results

Function

	Switch off help window.
	Zoom of image. A click into the images brings back the original, smaller view.
	On / off of result bargraph.
	On / off of overlays.
	Store current image as a file.
	Switches between languages
	Switches between Result, Statistics and the list of Jobs available on the sensor.
	Commands for image control: Possibility to"Freeze" an image. Only the image view is frozen, image capturing and execution is continued.
	Status of outputs

Fig. 203: SBSxWebViewer/ Statistics
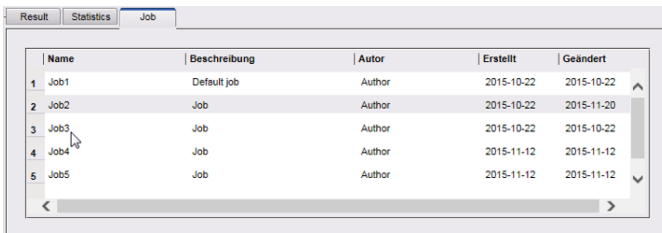
Fig. 204: SBSxWebViewer/ Job

To start SBSxWebViewer:

1. Activate SBSxWebViewer, at Output/Interfaces/SBSxWebViewer

2. "Start sensor" (press button in Vision Sensor Configuration Studio)

3. Open Browser

4. Type the IP address of the sensor (see Vision Sensor Device Manager) into the address field of the browser.format: "http://Your Sensor IP", e.g.: "http://192.168.100.100" (default).

> **Please note:**
>
> - The following web browsers are supported: Microsoft Internet Explorer®from IE10, Google Chrome® and Morzilla Firefox®.
> - With http://192.168.100.100/zoom.html (IP address of the sensor) a zoomed view is directly accessible.
> - Per one SBS vision sensor only one browser connection is allowed.

8.4.4 Tab Timing

In this tab, you determine the time response of the selected signal output. If encoder was selected the delays are entered in encoder steps. Depending on the settings in the I/O configuration all following time delays are done in ms or in encoder steps.
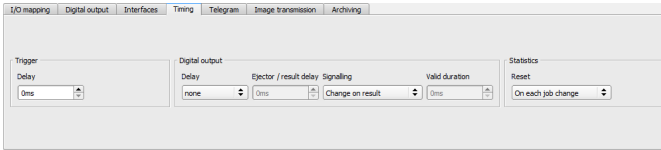
Fig. 205: Output, tab Timing

Parameter	Function
Trigger delay	Time between trigger and start of image capturing (in ms or encoder pulses). Max. time / no. of steps, is 3000 ms / encoder pulses. In case of use of: • H/W Trigger (digital input): this delay is effective. • Trigger (via Ethernet, PROFINET): this delay is not effective (image is captured on trigger directly)
Digital outputs	All outputs can be delayed or only the ejector output.
Ejector / result delay	Time between trigger and appearance of result level at the signal outputs (in ms or encoder pulses). Between trigger and ejector maximum 20 parts are allowed (buffer size). Max. time / no. of steps, is 3000 ms / encoder pulses. In case of use of: • H/W Trigger (digital input): this delay is effective and starts with the trigger. • Trigger (via Ethernet, PROFINET): this delay is effective, but starts only after image is processed (not with the trigger!)
Reset signal	Determines, how to reset outputs. Change at the next result (default setting) Change with trigger Result Duration (fixed duration in ms, then reset to inactive)
Duration of result	Duration of the result signal in ms or encoder pulses. Maximum setting value 3000 ms / encoder impulses

Attention:
At Job Change and change from Run- to Config Mode outputs will get the following states: Buffer of delayed outputs will be deleted.

Digital outputs:

Will be reset to default at change from "Run" to "Config". Defaults are set by flag "Invert" in Vision Sensor Configuration Studio/output tab. "Invert" inverts the default setting and also the result.

Reset of digital outputs:

The reset of the result outputs can happen depending on different settings 7 events. This are:

- "Change on result" (default).
  The output changes its level according to the logical result when the next logical result is generated and valid. Typical use at controlling switch points e.g. in sorting applications.
- "Change on trigger"
  The output is set to "inactive" (in operating mode PNP = low) with the next trigger. Typical use at operation with a PLC.
- "Valid duration"
  The output changes back to inactive after the "Valid" duration time setting here in ms. typical use with e.g. pneumatic ejectors.

S. Vision Sensor Configuration Studio/Output/Timing/Signalling

READY AND VALID

- If Ready = high: Ready for next image / evaluation.
- If Valid = high: Results are valid at the outputs.

PNP or NPN operating mode.

All the described examples are in the operation mode "PNP". If the setting "NPN" is used, the examples are valid, but with inverted signal levels.

S. Vision Sensor Configuration Studio/Output/Interfaces/Internal I/O

8.4.4.1 The following cases for output timing are available:

8.4.4.1.1 Normal trigger, no delays:

Sequence: (Signalling here: Change in result)

- Rising edge at Trigger input (Pin03 WH)
- Consequence of Trigger = high: Ready = low, and Valid = low
- After the SBS has evaluated the image and the results are valid the defined outputs change to the according logical states. Ready and Valid are set to high again (SBS ready for next task, outputs valid).
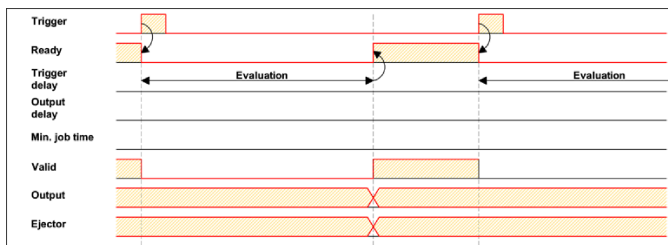
Fig. 206: Output timing, standard sequence at normal trigger

8.4.4.1.2 Trigger delay active

(Trigger delay concerns hardware trigger only)

This setting is used to delay the image capturing / start of evaluation against the real physical trigger, which was e.g. caused by a light barrier or by the PLC. With this function the fine tuning of the trigger point in time can be done without any change in mechanics or PLC programming.

Sequence:

Image is taken after the trigger delay time is elapsed. The cycle time is trigger delay time + evaluation time.

See Vision Sensor Configuration Studio/Output/Timing/Trigger/Delay

- Rising edge at Trigger input (Pin03 WH)
- Consequence of Trigger = high: Ready = low, Valid = low, all defined result outputs = low (Signalling = Change on trigger)
- Before the image for evaluation is taken, the adjusted Trigger delay time elapses.
- Now the evaluation starts. As soon as the results are valid the outputs change to the according logical levels. Ready and Valid are set to high again (SBS ready for next task, outputs valid).
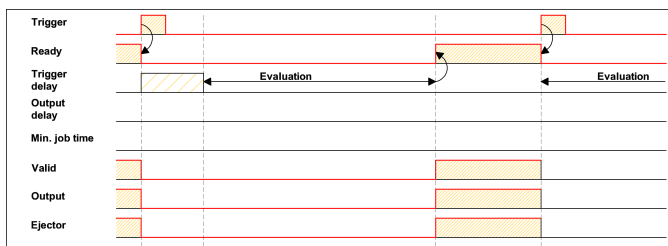
Fig. 207: Output timing, and Trigger delay

8.4.4.1.3 Trigger delay + Result delay (here: Ejector only):

(Trigger delay concerns hardware trigger only)

The result delay (if for all outputs or ejector only) is used to fine tune the ejector point in time, independent from evaluation time, as especially the evaluation time can have slight variations.

Sequence:

Image is taken after the trigger delay time is elapsed. Furthermore the Result delay is active. In this example just for the ejector output (pin 12 RDBU)

For all defined result outputs, except the ejector output the cycle time is: Trigger delay time + evaluation time.

For the ejector output the cycle time is: Result delay only (Counted from trigger, only make sense if longer than summation of above mentioned times!). See Vision Sensor Configuration Studio/Output/Timing/Output/Delay.

- Rising edge at Trigger input (Pin03 WH)
- Consequence of Trigger = high: Ready = low, Valid = low, all defined result outputs = low. Except Ejector, as for this a fix result delay is defined.
- Before the image for evaluation is taken, the adjusted Trigger delay time elapses.
- Now the evaluation starts. As soon as the results are valid the outputs change to the according logical levels. Ready and Valid are set to high again (ready for next task, outputs valid).
- In this operation mode the Ejector output only is set after the Result delay is elapsed. In this example the Ejector output is also used with Result duration, therefore it´s reset after the Result duration time is elapsed.
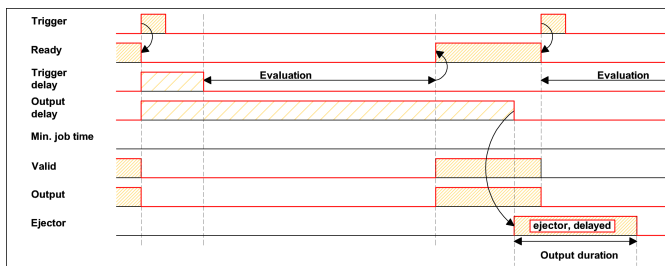
Fig. 208: Output timing, Result delay, ejector

8.4.4.1.4 Trigger delay + Result delay (here: all outputs):

(Trigger delay concerns hardware trigger only)

The result delay (if for all outputs or ejector only) is used to fine tune the ejector point in time, independent from evaluation time, as especially the evaluation time can have slight variations.

Sequence:

Image is taken after the trigger delay time is elapsed. Furthermore the Result delay is active, in this example to ALL outputs.

For all defined outputs, the cycle time is: Result delay only (Counted from trigger, only make sense if longer than summation of Trigger delay + Evaluation time)! See Vision Sensor Configuration Studio/Output/Timing/Output/Delay.

- Rising edge at Trigger input (Pin03 WH)
- Consequence of Trigger = high: Ready = low, Valid = low.
- Before the image for evaluation is taken, the adjusted Trigger delay time elapses.
- Now the evaluation starts. As soon as the results are valid, only the Ready signal is now directly set to high again (ready for next evaluation). Now the result delay time must elapse. After this has happened all defined outputs change to the according logical levels. Now also the Valid signal is reset to high level (Valid = high: results / outputs valid.

Signalling = Change on result). In this operation mode the Ready signal only is reset to high level after Trigger delay + Evaluation time is elapsed. This make sense as the SBS independent from the later setting of the other outputs, is now already available for the next evaluation task.
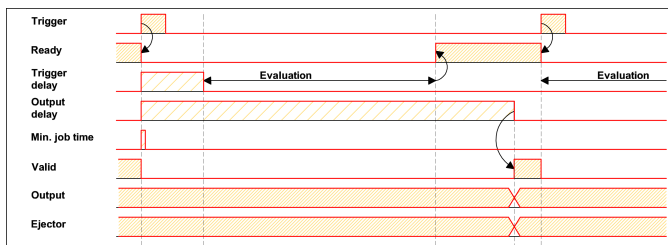
Fig. 209: This make sense as the independent from the later setting of the other outputs, is now already available for the next evaluation task.

8.4.4.1.5 Output timing, Result delay for all outputs.

Result duration active (Here e.g. all outputs): This timing setting is used to achieve a pulse at an output of defined length, for e.g. control of a pneumatic ejector in case of a bad part.

All defined result outputs are reset to low level (inactive in PNP operation) after the Result duration in ms is elapsed.
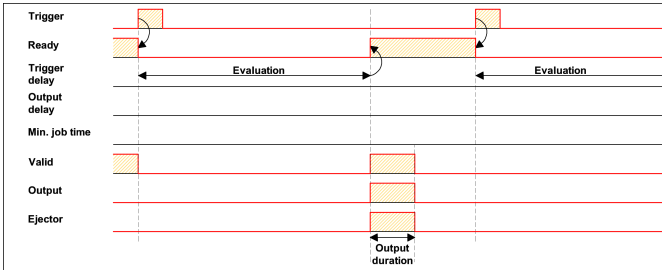
Fig. 210: Output timing, Result duration

8.4.4.1.6 Cycle time (Min, Max) active:

(Here: Signalling: Change on Trigger)

Parameter control for the minimum and maximum time for a job.

Minimum job time blocks trigger signals which are coming in before the minimum job time was reached. (If during the Min Cycle time a further trigger is coming in it is ignored)

Maximum job time interrupts a job after a defined time. Job result after a timeout is "not o.k.". Maximum job time should be selected higher than the time demand for one execution.

The Cycle time measures the time from Trigger till the setting of the outputs. If this cycle time should be limited (e.g. if the machine cycle should not be exceeded) this function can be used. The result of all detectors which are not processed / finished after this processing time has elapsed are set to "failed". As the currently processed detector will still be finished, please consider that the adjusted job time may not be met a 100% exactly, and it may last a few milliseconds longer till the job is interrupted. It's recommended to check this possible exceeding of the Cycle time in real operation and to decrease the value for the setting according to this offset.

Sequence:

All outputs and the signal "Valid" (Outputs valid) are set directly after evaluation.

But the signal "Ready" (Ready for next evaluation) is set not until the Min Cycle time is elapsed. Therefore only from this point in time the next trigger will be accepted.
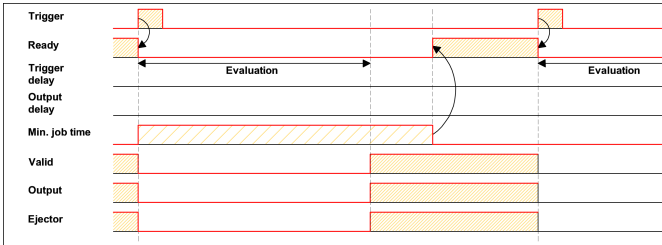
Fig. 211: Output timing, Cycle time

8.4.4.1.7 Multiple Result delay for Ejector

This mode of operation is used, if between trigger / evaluation for part A and it's ejection is so much time / distance, that the SBS already has to check n (up to 20 parts possible) further parts which also has to be ejected later.

(Only available in mode: Vision Sensor Configuration Studio/Output/Timing/Delay: "Ejector only / Ejector- / result delay"

Here: Signalling = Result duration (alternatively also "Change on result")

This function is limited on 20 parts between trigger and ejector.
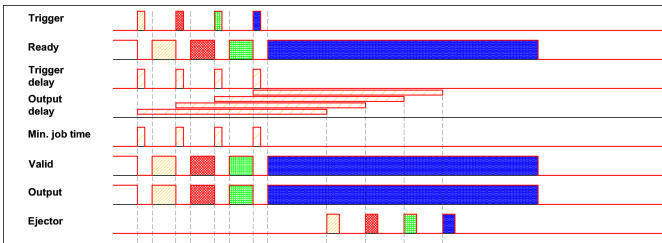
Fig. 212: Output timing, Multiple Result delay, ejector

8.4.5 Tab Telegram, Data output

Configuration of data output via serial interfaces RS422 and Ethernet as well as for archiving in .csv- files. Here all settings can be done, which result data of the SBS should be transferred via the before selected interface.
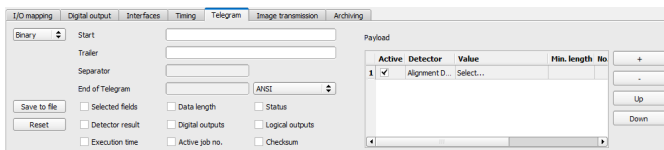
Fig. 213: Output, tab Telegram

Parameter	Function
Binary / ASCII	Output data in Binary- (Hex) or ASCII- format.
Save to file	Exportation of file format with current results as .csv. Detailed file format of the free defined output string as .csv file with: Byte position (start position in string), Data type, Field name, Detector name, Value, Length (in Byte), Detector number and Detector type.
Reset	Reset of all parameters in this tab

Standard contents of protocol

Often required standard contents can be added to the output string by simply filling them in, or activation via the checkbox.

Parameter	Function
Start	Characters which are inserted at the beginning of the payload data string (Binary or ASCII)
Trailer	Characters which are inserted at the end of the payload data string (Binary or ASCII)
Separator	Characters which are inserted behind each payload value (ASCII only)
End of telegram	Characters which are sent at the end of a response to a PC or PLC (Reaction to a command, not with payload data, in ASCII mode only, output selectable in ANSI or Hexa Decimal)
Selected fields	Shows which of the following checkboxes are activated.
.... further standard content, like e.g. "Selected fields, Data length"	to data string: "Payload" Sequence: Selected fields, Data length, Status, Detector result, Digital outputs, Logical outputs, Execution time, Active job no., Checksum

Detector-specific individual results

Available payload data at:

First create a new entry by activating the "+" button.

Function of buttons

- "+": Insert new entry
- "-": Delete marked entry
- "Up", "Down": Displace marked entry

You can add **detector specific individual results** to the data telegram in the required flexible order via the selection list. Adding new values via button "+".
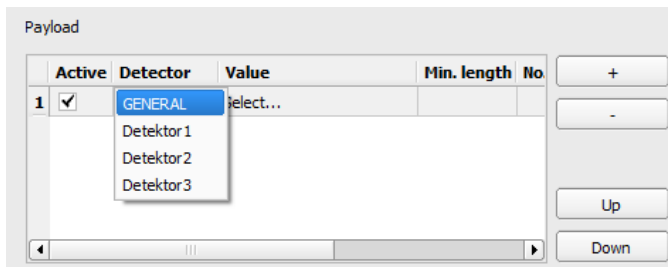
Fig. 214: Output, Detector specific payload

Column	Function
Active	Activates/deactivates the marked output value
Detector	Detector name (select from drop-down list)
Value	Available detector results (select from drop-down menu): Payload (Page 495)
Min. length	Define the minimum length of the Value box; if the actual length is smaller than that specified, the box is filled with spaces (ASCII) or zeros (binary)
No. of results	BLOB only! Number of results of a BLOB detector which found several objects. Example: feature "area" was selected and 10 BLOBs have been found. Here up to 10 of these area values can be transmitted. All available output data see: Serial Communication ASCII (Page 419), Serial communication BINARY (Page 501), chapter: Data Output in ASCII / Binary

8.4.5.1 Possibilities of data output of (see also chapter: Communication)

8.4.5.1.1 (Ethernet-) port 2005 / RS422

Numerical data, which has been defined under Output/Telegram, now can be transferred in ASCII- or Binary- format.

Ethernet: The sensor here is the (socket-) "server" and serves the Data via a "server-socket" interface. This is basically a "programming interface". To read or process the Data a "socket client" (PC, PLC, ...) must establish a (socket-) connection (active) to the sensor.

8.4.5.1.2 PC-Archiving (Vision Sensor Visualisation Studio)

Here images and numeric result data (in .csv-format) can be stored by "Vision Sensor Visualisation Studio" into a folder on the PC. The configuration (folder, ...) of this archiving function is done via "" (Menu: File/Result archiving). This is a pure PC- function.

8.4.5.1.3 Sensor- archiving (ftp, smb)

With this function images and numeric result data (in .csv format) can be stored actively by the sensor via ftp/smb. This kind of archiving is configured under "Job/Archiving". In this case:

a. With "ftp" used: the senor is a "ftp client" and "writes" the data to a "ftp server" folder on a drive which is available in the network. With Job/Start the sensor connects to the ftp-Server.

b. With "smb" used: the sensor "writes" the data direct in a folder in a network. With Job/Start the sensor connects/mounts with this folder.

8.4.5.1.4 Ram disk (in the sensor)

In the sensor the last image as well as the numeric data of the last evaluation, which has been configured under Output/Telegram, are stored (in a .csv file) in a Ram disc- folder under "/tmp/results/". This function is activated under "Job/Image transmission". To access this data an ftp- connection must be established actively to the sensor. Therefore an ftp client is necessary.

Please note:

- The format of the .csv files is always the same (ftp, smb, ram-disk, Vision Sensor Visualisation Studio).
- The data are stored readable (by default separated by comma) into the .csv file.
- Only payload data which has been defined under (Output/Telegram) are transferred.

8.4.5.2 Communication settings

Communication	TCP / IP	RS422 / RS232	EtherNet/IP	PROFINET
Telegram format	ASCII / Binary	ASCII / Binary	Binary	Binary

Also see chapter: Overview telegram (Page 411)

Protocol settings

Parameter	Function
Binary / ASCII	Output data in Binary- (Hex) or ASCII- format.
Save to file	Exportation of file format with current results as .csv

Basics for establishing of a connection:

SBS is always tcp/ip (socket-) server.

SBS vision sensor opens always two (socket-) communication ports (default: 2005 + 2006).

- 2005 = Data port for sending of numerical results.
- 2006 = Command port for receiving of commands.

At a time only one (socket-) client (PC or PLC) can be connected to a port.

Recommendations:

Existing socket connections have only to be reconnected, if an error occurred (e.g.: PLC or client in stop mode or error mode, etc.). During normal operation there is no need to reconnect existing connections.

Ethernet data handling: Especially if several SBS are used Ethernet should be preferred.

Please see also installed help:

...:\Program files\Festo\SBS vision sensor\Utilities\Ethernet

8.4.6 Tab Image transmission

Image transmission and / or the image recorder and the Ram disc can be activated in the Image transmission tab. Set image sharpness with the focus setting screw on the back of the SBS vision sensor.

Attention:
The icon inside life image means, that image display / transfer on PC is slower than image processing on SBS. Not all pictures taken by the SBS will be displayed. This may cause lost images during bad (fail) image archiving.

If this icon occurs often, PC-programs running in background should be closed in order to improve PC performance.

Parameter	Function
Image recorder	Storage of max. 10 images in the sensor's internal ring buffer. Setting possibilities via pop-up menu: Off, Any, Pass, Fail.
Ram Disk	Storage of last image in ram memory, this image can be taken by a FTP-client. Settings: Off, Any, Pass, Fail. The image is stored in the RAM of the SBS under the name "image.bmp" in the folder /tmp/results/. Parameters for FTP-client: user "user", password "user" Example Windows Console: Microsoft Windows XP [Version 5.1.2600] (C) Copyright 1985-2001 Microsoft Corp C:\>ftp 192.168.100.100 Connection with 192.168.100.100 was established. 220 Welcome to SBS ftp-server! User (192.168.100.100:(none)): user 331 Please specify the password. Password: user 230 Login successful. ftp› cd /tmp/results 250 Directory successfully changed ftp› get image. bmp 200 PORT command successful. Consider using PASV. Consider using PASV. 150 Opening BINARY mode data connection for image.bmp (354358 bytes). 226 File send OK. FTP: 64d Bytes receive 0.23 seconds 1514,35 KB/s ftp› Image is now in drive C of executing PC. If activated, results can be also received in the same way via the file "results.csv" (all defined data in "Output/Telegram", with divider ";".

Different types of archiving images

Access	Description	Max. number of images	Image filter	Drawings
Image recorder in SBS (Ram)	Images stored in run-mode on SBS. The images can be	10	like predefined	No

Access	Description	Max. number of images	Image filter	Drawings
	transferred by Vision Sensor Configuration Studio or Vision Sensor Visualisation Studio to a PC.		in settings "Filter"	
Vision Sensor Visualisation Studio archiving / Vision Sensor Configuration Studio save image	Images transferred to Vision Sensor Visualisation Studio can be stored on hard disc of PC.	unlimited (Limit is size of hard disc in PC)	like predefined in settings "Filter"	selectable Yes / No
Saving of filmstrips in Vision Sensor Configuration Studio	Current images from filmstrip can be saved as filmstrip (*.flm) or as bitmap (*.bmp) on hard disc of PC.	50	without filtering	No
Last image in SBS (Ram Disk)	Last image is stored in ram disk of SBS and can be taken by FTP from directory /tamp/results.	1	without filtering	No
Archiving of images via FTP or SMB	Archiving of images via FTP or SMB	unlimited (Limit is size of hard disc in PC)	selectable with / without filtering	No
Get Image Request	Last image from SBS by using GetImage command in a program of a PLC or PC.	unlimited (Limit is size of hard disc in PC)	like predefined in settings "Filter"	No
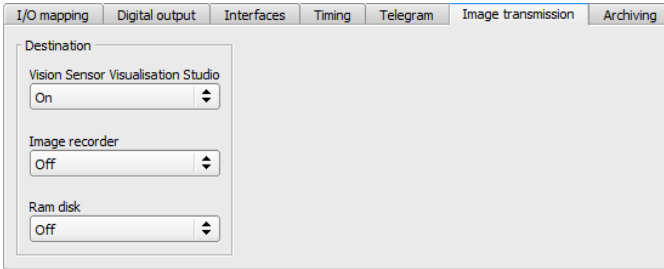
Fig. 215: Tab Output / Image transmission

8.4.7 Tab Archiving

In tab Archiving the archiving of data can be defined.

Parameter	Function and possibility
Off: No archiving,	FTP: Archiving to FTP server, SMB: Archiving to a drive via SMB-service (Server Message Block) If archiving server is in different sub network set gateway first with . **Please note:** If archiving server is in different sub network set gateway first with Vision Sensor Device Manager.
IP-Address of target server	Sharing name
Sharing name, specified in dialog "Advanced Sharing" in PC	Workgroup
(Domainname)	Option !, Workgoup / Domainname of server / client
User name	User name for FTP / SMB connection.
Password	Password for FTP / SMB connection.
Result files	If protocol file is active, there will be generated automatically a .csv file for each inspection (trigger). Contents of the file are specified in "Output / Telegram". Filename with incremented counter.
Image files	Activates archiving of images.

Parameter	Function and possibility
	Please note: • Images are stored without preprocessing settings, but with the settings for the arrangement (e.g. rotated or mirrored) • FTP and SMB save images without overlays. To store images with overlays, please use Vision Sensor Visualisation Studio.
Storage mode	Limit: after reaching maximum number of files transmission is stopped. Unlimited: files are stored, until target drive is full. Cyclic: after reaching maximum number of files the older files are replaced by the newer ones.
Max. number of files	Maximum number of file sets (image+protocol) which are allowed to be stored in the target directory.
Directory name (pass)	Directory for archiving of data of good parts (pass) (for C:\TESTPASS just enter TESTPASS)
Directory name (fail)	Directory for archiving of data of bad parts (fail) (for C:\TESTFAIL just enter TESTFAIL)
Filename	Filename for images and protocol file, this name is extended automatically by the image number (e.g. TESTFILE).
Add expression	A dynamic part (information such as date and time) is added to the filename. See table below

The following table shows the expressions that can be added to the filename.

Expression	Description	Example
TIME	HHhMMmSSsSSSms	09h05m11s034ms
HOUR	hh	09
MIN	mm	05
SEC	ss	11

Expression	Description	Example
MSEC	sss	034
DATE	YYYY-MM-DD	2011-09-21
YEAR	YYYY	2011
2YEAR	YY	11 (for 2011)
MONTH	MM	09
DAY	DD	21
STRINGID	"Data" entry from extended trigger request "TRX"	Part 34
COUNTER	Taken from statistics.	3824
XXCOUNTER	Counter taken from statistics with a defined number of digits. XX indicates the number of displayed digits and can accept values from 01 to 09. **Please note:** If number of counter digits is too small, leading 0 will be added. If number of counter digits is too large most significant digits will be discarded.	06COUNTER → 003824
RESULT	Overall result of job	Pass or Fail
SENSORNAME	As specified in Vision Sensor Device Manager	
JOBNAME	As specified in Vision Sensor Configuration Studio	

Fig. 216: Tab Archiving

8.5 Setup Result

With this function the defined job is processed in the PC, and the "Results/statistics" window with the detector list and the evaluation results is displayed. The cycle times are not displayed in

this mode as they are not available from the sensor.

Detailed inspection results from the detector marked in the selection list are displayed in run mode. In the image window – if adjusted – the image, the search- and feature-frames, and the result- graphs are displayed.
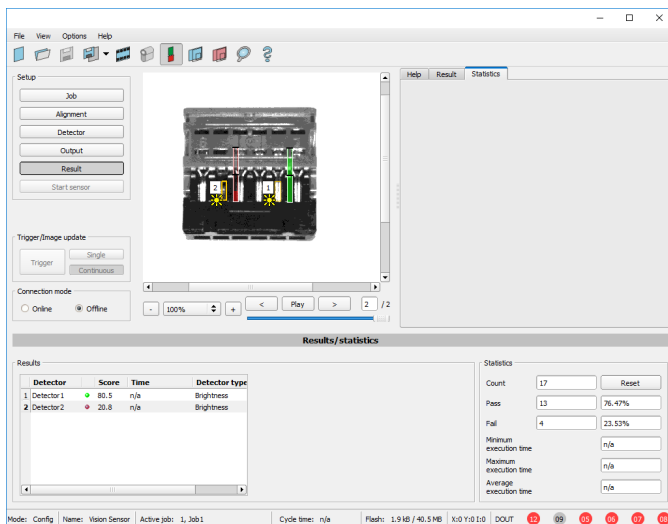
Fig. 217: Result

Parameter results displayed	Function	Detector type
Detector result	Boolean detector result	All detectors
Score value 1 ... n	Score (0..100%), e.g. Detector pattern matching: degree of agreement of the found pattern with the taught-in pattern	All detectors
Execution time	Execution time of individual detector in [msec].	All detectors
Distance	Calculated distance, [1/1000] *1)	Caliper
Position X 1 ... n	Position found X (x-coordinate). [1/1000] *1)	Pattern matching Contour Edge

Parameter results displayed	Function	Detector type
		detector Caliper Datacode Barcode OCR
Position Y 1 ... n	Position found Y (y-coordinate). [1/1000] *1)	Pattern matching Contour Edge detector Caliper Datacode Barcode OCR
DeltaPos X	Delta position X between object taught and object found [1/1000] *1)	Pattern matching Contour Edge detector
DeltaPos Y	Delta position X between object taught and object found [1/1000] *1)	Pattern matching Contour Edge detector
Angle	Orientation of object found (0°..360°) [1/1000] *1)	Pattern matching Contour Edge detector Datacode Barcode OCR
Delta Angle	Angle between object taught and object found (0°..360°) [1/1000] *1)	Pattern matching Contour Edge detector

Parameter results displayed	Function	Detector type
Scaling	Only with contour (0.5 ... 2) [1/1000] *1)	Contour
R(ed)	Value for color parameter, signed integer [1/1000] *1)	Color value Color list
G(reen)	Value for color parameter, signed integer [1/1000] *1)	Color value Color list
B(lue)	Value for color parameter, signed integer [1/1000] *1)	Color value Color list
H(ue)	Value for color parameter, signed integer [1/1000] *1)	Color value Color list
S(aturation)	Value for color parameter, signed integer [1/1000] *1)	Color value Color list
V(alue)	Value for color parameter, signed integer [1/1000] *1)	Color value Color list
L(uminanz)	Value for color parameter, signed integer [1/1000] *1)	Color value Color list
A	Value for color parameter, signed integer [1/1000] *1)	Color value Color list
B	Value for color parameter, signed integer [1/1000] *1)	Color value Color list
Result index	Index in list, signed integer [1/1000] *1)	Color list
Color distance	Distance between taught and current color, signed integer [1/1000] *1)	Color list
Area	Area of the BLOB, without holes, in pixels, signed integer [1/1000]	BLOB

Parameter results displayed	Function	Detector type
	*1)	
Area (incl. holes)	Area of the BLOB, including holes, in pixels, signed integer [1/1000] *1)	BLOB
Contour length	Number of pixels of outer contour, signed integer [1/1000] *1)	BLOB
Compactness	Compactness of BLOB (Circle = 1, all other ›1), signed integer [1/1000] *1)	BLOB
Center of gravity X	X- coordinate of center of gravity of BLOB, signed integer [1/1000] *1)	BLOB
Center of gravity Y	Y- coordinate of center of gravity of BLOB, signed integer [1/1000] *1)	BLOB
Center X	X- coordinate of fitted, geometric element (rectangle, ellipse), signed integer [1/1000] *1)	BLOB
Center Y	Y- coordinate of fitted, geometric element (rectangle, ellipse), signed integer [1/1000] *1)	BLOB
Width	Width of geometric element. Width ›= 0, width ›= height, negative value indicates failure, signed integer [1/1000] *1)	BLOB
Height	Height of geometric element. Heigth ›= 0, height ‹= width, negative value indicates failure, signed integer [1/1000] *1)	BLOB
Angle (360)	Orientation of width of object in degree (range: -180 ... +180°, 0° = east, counterclockwise), signed integer [1/1000] *1)	BLOB
Eccentricity	Eccentricity numerical (range 0,0 ... 1,0), signed integer [1/1000] *1)	BLOB
Face up/down, area	Face up/down discrimination, based on area, indicated by sign, signed integer [1/1000] *1)	BLOB
String	Contents of Code, depending from code string length may change. If a fix string length is needed, parameters minimum string length	Datacode Barcode OCR

Parameter results displayed	Function	Detector type
	(detector specific data output) and maximum string length (detector parameters) have to be used.	
String length	Length of Code in Bytes	Datacode Barcode OCR
Truncated	Code truncated	Datacode Barcode OCR
Compare result	Result of string comparison	Datacode Barcode OCR
Quality parameter	Output of quality parameters according to selection	Datacode Barcode
Contrast	Contrast of the code (0-100%)	Barcode
Correction	Number of modules corrected by error corrections	Barcode
Module height	Height of modules in pixels	Datacode
Module width	Width of modules in pixels	Datacode
Confidence	Output of the confidence values of the individual characters	OCR
Result	Degree of similarity between the read string and the reference string from 0 to 100%	OCR
Min. Quality	Minimum required quality was achieved	OCR

*1) All detector-specific data with decimal places are transmitted as integers (multiplied by 1000) and must therefore be divided by 1000 after data reception. The values are transmitted in "big endian" format.

The displayed parameters vary depending on the selected detector type.
To see the results of another detector mark it in the detector list.
In module Vision Sensor Visualisation Studio numeric results, statistics and images with or without the selected frames can be archived.

8.5.1 1) Score value with result of caliper detector.

in case of Caliper- detector the result value "Score", "Score 1" and "Score 2" have the following meaning:

Score 1 / Score 2: value of Edge strength in gray values, normalised to 100 (hight of maximum in histogram).

Score: smaller value of both: Score 1 or Score 2.
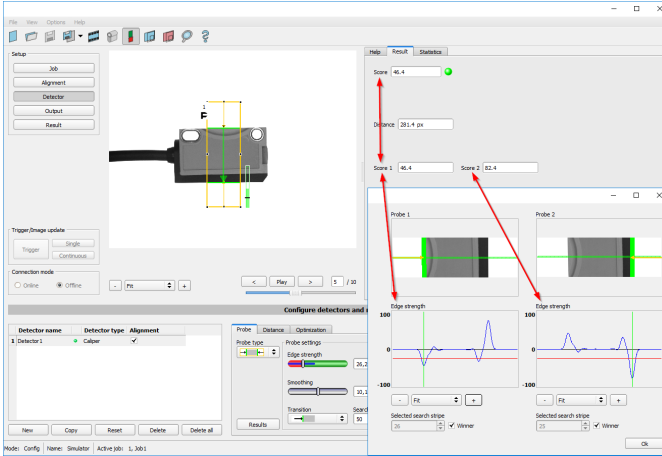
Fig. 218: Score value caliper detector

8.6 Setup Start sensor

This function sets the sensor to run mode and executes the job.

Starting execution of a job:

Click on the "Start Sensor" button.

The active (= marked in the selection list) job is transmitted to the sensor, stored in the sensor's non-volatile memory and started (run mode).

The parameters found are shown in the display window; the inspection results from the first detector or the detector selected in the selection list are shown in the configuration window along with statistical parameters.

Changing detector display:

To display the inspection results for another detector, mark it in the selection list or click on its graphic representation in the display window.

Quitting job execution:

Click on the "Stop Sensor" button. You are now back in configuration mode and can edit your job.
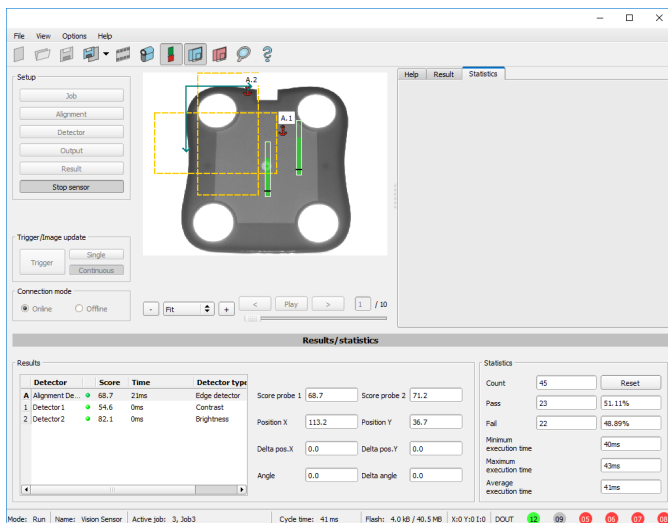
Fig. 219: Start sensor

8.7 Trigger settings

Select the required trigger mode in the job settings in the "General" tab:

Parameter	Function
Triggered	Operation with external trigger, or trigger button in the inVision Sensor Configuration Studioterface
Free run	Operation with automatically running self-trigger; the sensor supplies images with the maximum possible frequency

Select the form in which the images are to be supplied by the sensor using the option buttons in the zone Trigger/Collect image:

Parameter	Function
Single image	Recording of a single image, image recording occurs once when: 1. Trigger mode = triggered: First external trigger signal or with the trigger

Parameter	Function
	button on the Vision Sensor Configuration Studio interface 2. Trigger mode = free run: First click on the "Single image" button on the Vision Sensor Configuration Studio-interface (Important, for example, in set-up mode)
Continuous	Continuous supply of images, image recording occurs continuously when: 1. Trigger mode = triggered: Each external trigger or with each click on the trigger button on the Vision Sensor Configuration Studio interface 2. Trigger mode = free run: Continuously through internal self-triggering with maximum frequency

When exposure time, amplification, illumination or resolution parameters are modified in the Job settings, a new image is automatically requested from the sensor.

To obtain a continuously updated live image even without trigger, carry out the following (if necessary temporary) settings:

- Set to free run under "Job/General"
- Set to continuous under "Trigger / Collect image"

8.8 Connection mode

Two operating modes are available for sensor configuration and test run, which you can select in the Connection mode window.

- Online mode: Configuration with connected sensor.
- Offline mode: Simulation of a sensor with the help of images stored in film strips.
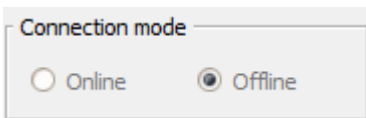
Fig. 220: Connection mode

When the sensor is connected, both modes are available; it is possible to switch between the two. If no sensor is available, it is only possible to work in Offline mode, i.e. with sensor simulation.

8.9 Displays in image window

8.9.1 Image section and enlargement:
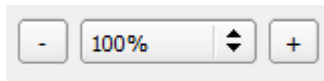
Fig. 221: Zoom

You can select the required image section using the buttons or drop-down menu under the display window.

8.9.2 Graphical display of results

You can active or deactivate the following graphics in the View menu:

- Bar graph result: Displays the inspection result as a bar graph.
- Drawings: Displays search, parameter and position frames detectors and alignment detectors.
- Focussing aid: Displays image sharpness (see also Job settings).
- Enlarged display: Insertion of a separate enlarged display window, which can be adapted to the required scale using the adjustment handles at the corners of the frame.

The module Vision Sensor Visualisation Studio offers a limited selection of these functions.

8.9.3 Controlling image reproduction

Fig. 222: Image reproduction

You can control the selection and reproduction of stored images using the buttons as well as the slide bar underneath the display window. The image counter indicates the number of the current image as well as the number of images in the active filmstrip.

Buttons	Function
◄	Move to previous image.
►	Starts / Stops the reproduction of the stored images.

Buttons	Function
▶️	Move to next image.
▶▶️	Move to last image. The statistics are reset and all images are evaluated.

8.10 Load and save jobs and job sets (File)

Jobs can be loaded and stored individually or as a whole set of jobs in a job set. If several jobs are stored on the sensor, they form a job set, which you can store as an XML file on your PC or on an external storage medium just like an individual job.

Saving a job / job set:

1. Select Save job as ... from the File menu.
2. Select Save job set (Backup) ... from the File menu.

Loading a job / job set:

1. Select "Load job ..." or "Load job set (Backup) ..." from the File menu.
2. Activate the button "Start Sensor" to transfer jobs to the sensor.

All the jobs stored on the sensor are deleted when a new job / job set is loaded !
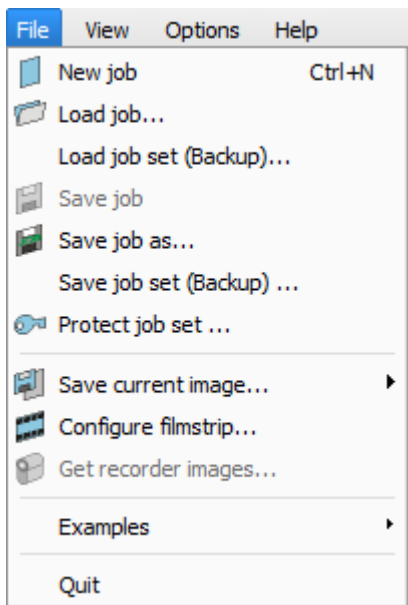
Fig. 223: Vision Sensor Configuration Studio, Load / save job

8.11 Protect job set ... (File)

In the Vision Sensor Configuration Studio menu it is possible to protect the job set with a password with the function "Protect job set ...". The job sets as well as all jobs are protected with a password. They can only be opened with Vision Sensor Configuration Studio, if the correct password has been entered. If the password is not entered correctly, the job set cannot be displayed or changed. The SBS vision sensor or the access to the SBS vision sensor is not blocked, i.e. SBS vision sensor works normally in run mode.
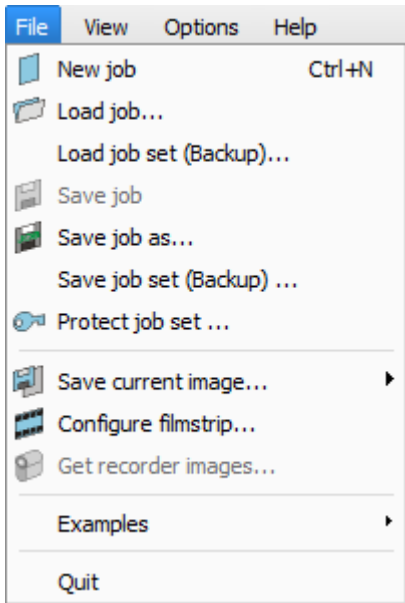
Fig. 224: Menu Vision Sensor Configuration Studio, Protect job set ...

Attention:
There is no way to restore forgotten or lost passwords.
In case of forgotten or lost passwords, the entire job set must be recreated.

Enter a password

1. Select "Protect job set ..." via "Vision Sensor Configuration Studio/Menu/Protect job set ..."
2. Enter a password and provide additional information if desired.
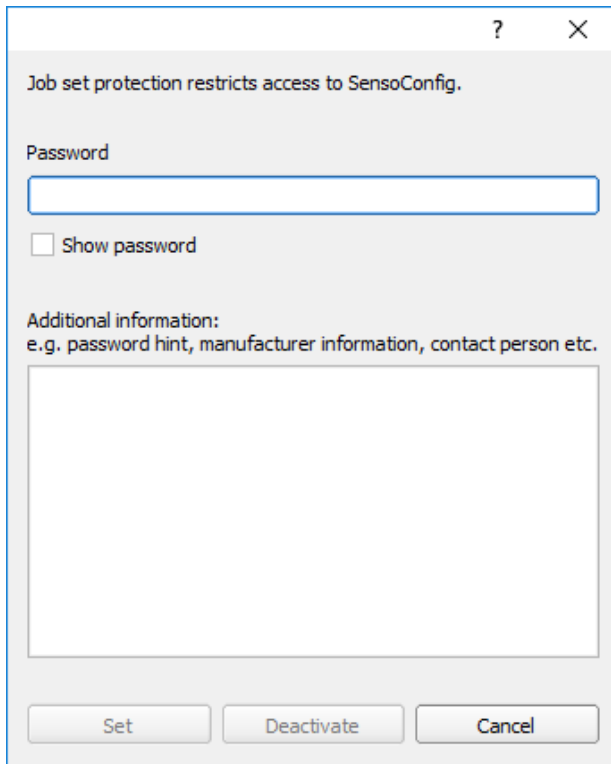
Fig. 225: Enter a password

○
🔲 **Please note:**
    The password must be between 1 and 100 characters long.

3. Confirm the entries with the button "Set". Another window to confirm the password opens.

4. Confirm the password by re-entering the password.
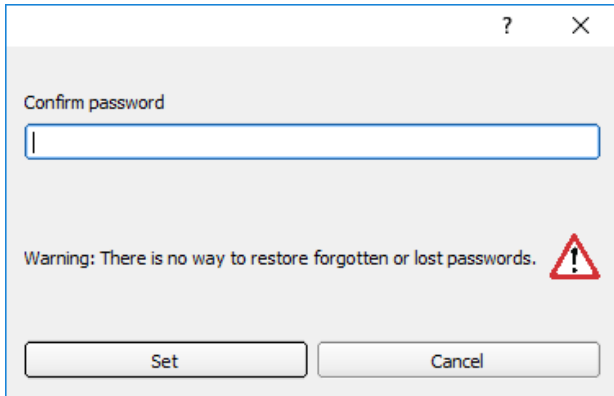
Fig. 226: Confirm password

5.   Press "Set".

6.   Save the protected job set

   a.   ... on your SBS vision sensor by selecting the "Start Sensor" setup.

   b.   ... via menu/Saving a job / job set: (Page 262)

   Please note:
   When saving the job or the job set, you can choose between the save types "With password protection (* .job)" and "Without password protection (* .job)".
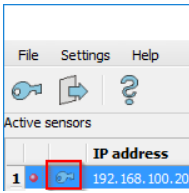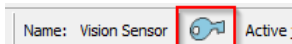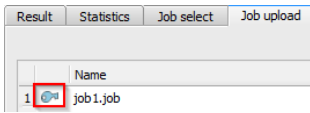
- "With password protection (* .job)": The job / job set with the entered password for the job / job set is saved. The job / job set can only be opened by entering the correct password for the job / job set.

- "Without password protection (* .job)": The job / job set is saved without password protection. The job / job set can be opened and edited at any time without entering the password.

The following table explains the behaviour when loading a protected / unprotected job into a protected / unprotected job set:

	Protected job set on the SBS vision sensor	Unprotected job set on the SBS vision sensor
Load a protected job	Job set protection remains. To open the password of the protected job must be entered, then the password is transferred from the active job set.	After opening the protected job and saving the job set or starting the sensor, the password protection is applied to the entire job set.
Load an	Job set protection remains unchanged	Job set remains unprotected.

| **unprotected job** | and is applied to the unprotected job when saving. | |

A protected job set is marked with a "key symbol". See also the following table:

Vision Sensor Device Manager	**Vision Sensor Configuration Studio / Vision Sensor Visualisation Studio**	**Vision Sensor Visualisation Studio**
Fig. 227: Protected job set, displayed in Vision Sensor Device Manager	Fig. 228: Protected job set, displayed in Vision Sensor Configuration Studio / Vision Sensor Visualisation Studio	Fig. 229: Protected job set, displayed in Vision Sensor Visualisation Studio
An SBS vision sensor with a protected job set will be marked with a key symbol in the "Active sensors" list.	A protected job / job set is marked with a key symbol in the status bar.	A protected job / job set is marked in the "Job upload" tab with a key symbol.

Change Password

1. Select "Protect job set ..." in "Vision Sensor Configuration Studio/Menu/Protect job set ...".
2. Enter the existing old password and press the "Change" button.
3. Confirm the password by re-entering the password and press the button "Set".
4. Save the new password
    a. ... on your SBS vision sensor by selecting the "Start Sensor" setup.
    b. ... via menu/

Deactivate password

1. Select "Protect job set ..." via "Vision Sensor Configuration Studio/Menu/Protect job set ..."

2. Enter the existing password and press the "Deactivate" button.
3. Save the job set
    a. ... on your SBS vision sensor by selecting the "Start Sensor" setup.
    b. ... via menu/

8.12 Creating filmstrips

In configuration mode, images from the sensor are continuously loaded into the PC's RAM. After switching from online to offline mode, max. 30 images are available and can be stored as a series of images in a filmstrip file. Alternatively or in addition to the images stored on the sensor, you can load series of archived images or individual images on your PC or an external storage medium and combine them into new films.

When you mark an image in the list, it is displayed in small format in the preview window on the right.

8.12.1 Storing images from the sensor as filmstrips:

1. First connect the PC to the sensor. Fill the memory with images in free run and collect image / continuous (Mode of connection = online).
2. Select option button "offline" in the window mode of connection.
3. Select configure filmstrips in the File menu or click on the icon filmstrips in the toolbar. The images loaded from the sensor appear in the selection list that appears below:
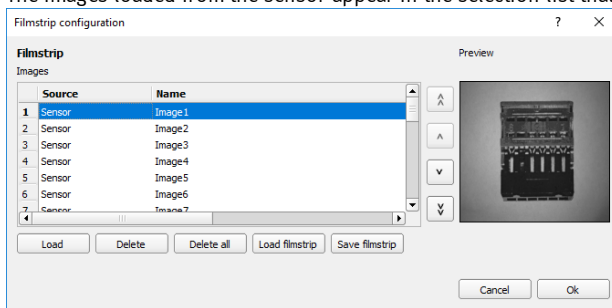
Fig. 230: Filmstrip
The images now can be examined; re-sorted or individual images can be deleted or added. The maximum number of images in a filmstrip is 30.
4. Click on Button "Save filmstrip" under the selection list.

All images in the list will be saved in a filmstrip file (extension .flm) in the order shown and are now available for future simulation.

8.12.2 Loading filmstrips and individual images from PC:

1. Select option button "Offline" in the window Mode of connection.
2. Select configure filmstrip in the File menu or click on the icon filmstrip in the tool bar.
3. Select a film file from the selection list and click on "Load filmstrip" button or load individual images from your PC or an external storage medium with the "Load image" button.

The loaded images are added to the selection list.

The type and memory location of the file is shown in the column source: filmstrips stored on the PC (Film), individual image stored on the PC (File), image in sensor memory (Sensor). After switching from online to offline mode all entries are Sensor.

8.12.3 Editing filmstrips:

You can create new films from the individual images in the selection list regardless of their source.

The following functions are available for this purpose:

Button	Function
" < ", " < < ", " > ", " > > "	Change order of images: The marked image is moved up/down one place or is moved to the end of the list.
Load image	Load further images from an external storage medium
Delete, Delete all	Delete image from the list/Delete all images from the list. (The images on the data carrier are not deleted here.)
Abort	Quit the list without any modification
Import	Load all images into the film memory on the PC in the order shown. These are now available for display and analysis in offline mode.
Load / Save film strip	Load filmstrip from data carrier or save there

8.13 Image recorder

An image recorder is available in the Vision Sensor Configuration Studio and Vision Sensor Visualisation Studio programmes. When the recorder is activated, either all images or just error images are continuously loaded into the internal memory. This covers 10 images, the oldest images are in turn replaced (FIFO buffer). The recorded images can then be called-up and

displayed with a PC, or stored on a PC or on an external storage medium, and are then available for analysis or simulation purposes in offline mode.

In the Vision Sensor Visualisation Studio program, you may be required to enter a password (if activated) to call up recorder images (User user group, see user administration).

Activating recorder:

Activate the recording function in the setup "output" under the "Image transmission" tab. You can select whether all images ("Any"), only "Pass" images or only "Fail" images should be recorded in the pop-up list of recorder parameters.

Selecting and recording images:

Select "Get images from sensor" from the File menu or click on the button "Rec.images" (only in Vision Sensor Visualisation Studio).

A display window appears in which you can load images stored in the sensor's RAM on to the PC and then examine and save them:

Fig. 231: Image recorder

Parameter	Function
Back	Displays the previous image
Next	Displays the next image

Parameter	Function
Save	Saves the image displayed on the PC or an external storage medium
Save all	Saves all images

Please note:

- The running number of the selected image and the total number of images recorded on the sensor (max. 10) are displayed in the counter under the display window.
- During storage, the images are deposited in bitmap format (extension .bmp) with a resolution of 640 x 480 pixels (VGA).
- The inspection results associated with the images (OK or error) and the date are stored in the file name (format YYMMDD_running no._Pass/Fail.bmp, e.g. 090225_123456_Pass.bmp).
- If you want to record detailed inspection results with the images, use the function Archive in Vision Sensor Visualisation Studio.
- If you only want to record a single image with or without overlay, you can use the function save current image in the file menu, instead of using the recorder.
- Images will get a time stamp when loading them from .
- Loading images from the sensor on to the PC deletes data on the sensor. If the recorder window is closed without images having been saved, they will also be deleted from the PC.
- Images are lost from the buffer in the event of a loss of power.

8.14 Application Examples

In Menu "File" "Examples" predefined examples can be loaded. A filmstrip is loaded together with a job-file.

8.15 Search and parameter zones

You can define search and parameter zones in the configuration steps alignment and detectors. These are identified in the image window by different colored frames.

Drawings in the screen (yellow, red frames etc.) can be activated or deactivated for any detector or category in the menu item "View/all drawings". With "View/drawings of current detector only", all drawings on the screen can be deactivated with the exception of the detector currently being processed.

8.15.1 Definition of search and parameter zones

When a new detector is created, a yellow frame is displayed, which defines the detector's search zone. The standard shape of the search zone is a rectangle. With contrast and gray level detectors, a circle can also be selected. The defined parameters (red frame) are found (green frame) provided its center is within the search zone (yellow frame).

With pattern matching and contour detection detectors, there is also a parameter zone within the search zone which is represented by a red or green frame:

- Red frame = teach parameters
- Green frame = parameters found

If position control / check is defined, a blue frame appears also (either a rectangle, circle or ellipse).

If an alignment detector is defined, it's frame is shown in dotted yellow lines.

At the according upper left corner of each frame the number of the detector is shown.

8.15.2 Adapting search and parameter zones

The zones initially displayed in standard size and position can be selected / marked in the image or in the detector list and altered in size and position. Eight adjustment handles on the frame enable you to adapt the shape and size of the frame. Its position can be displaced by clicking anywhere inside the frame. The arrow at the side of the frame pointing to the center can be used to change the rotational position of the frame.

The taught sample is represented in original size in the General or Parameters tab in the bottom, right-hand corner of the screen. Only the frame of the currently active detector, selected in the image or detector list, is shown with thick lines and adjustment handles, all other frames which are not selected are shown with thin or dotted lines (alignment detector).
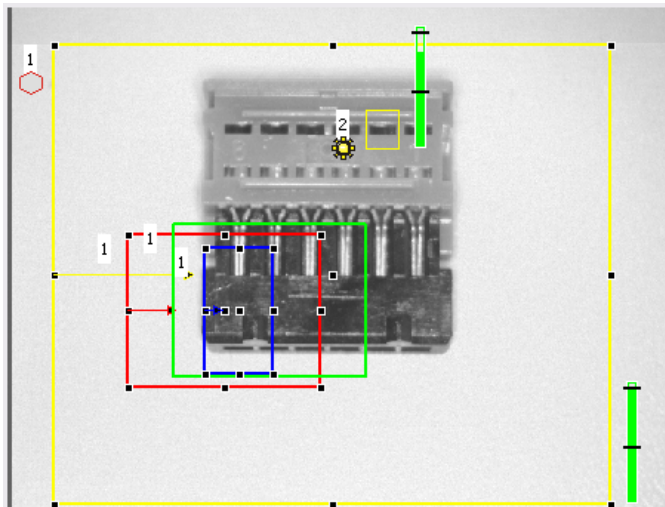
Fig. 232: Search- and feature frames

Please note:

- For optimum detection, parameters must be distinct and not contain any variable parts, e.g. shadows.
- Significant contours, edges and contrast distinctions are of advantage.
- To reduce evaluation time, the search zone selected should not be unnecessarily large.

Result bar

On the right next to the search zone, the degree of concordance of the parameter searched for and found is displayed as a fixed result bar with a set threshold value:

- Green bar = The searched for parameter has been found and the pre-set threshold value of minimum concordance has been achieved.
- Red bar = The object could not be found with the required degree of concordance. The graphics displayed can be selected in the View menu.

8.16 Color models

For description of colors there are available color models. SBS Color is able to work on different color models.

The following color models can be selected:

8.16.1 Color model RGB

RGB color model is an additive color model, which describes colors by adding the components of the base color red, green and blue.

The RGB- color space is described as a linear color space, as a cube with the three axis Red, Green and Blue.
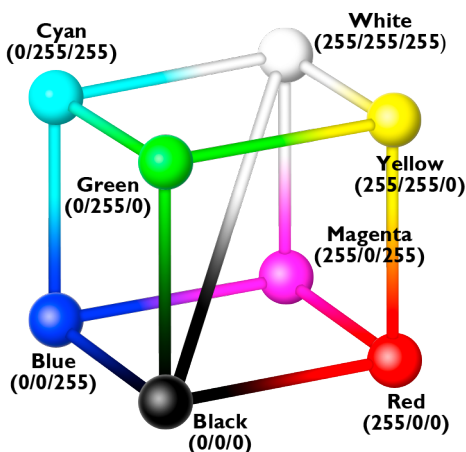
Fig. 233: Color model RGB

Red, green, blue, 0-255

RGB color model is used from image capturing chip and from display to define the colors. But image capturing chip and display have different sensitivities on each channel. Because of this there has to be a compensation, means RGB is never the same as RGB.

Linear RGB

RGB values are calculated as linear RGB values, as the sensor chip delivers linear RGB values. Advantage of the linear RGB value is the linear relation between physical impact and RGB value.

Example: Doubling the shutter time leads to doubling of RGB values, if all other illumination conditions remain stable.

8.16.2 Color model HSV

HSV color model is the most similar to describe what the human eye sees.
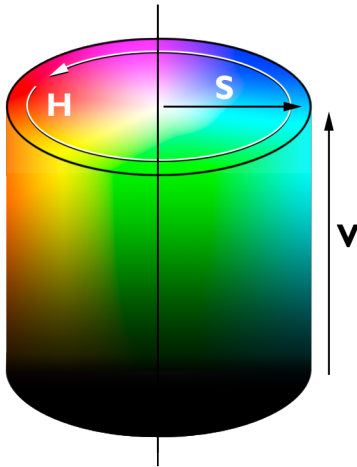
Fig. 234: Color model HSV

- H (hue) stands for the angle on the color circle (e. g. 0° = red, 120° = green, 240° = blue)
- S (saturation) in percent (0 % = light gray, 50 % = low saturated color, 100 % = maximum saturated color)
- V (value) in percent (0 % = dark, 100 % = full brightness)

8.16.3 Color model LAB

LAB or L*a*b*-color model is built from a three dimensional coordinate system:
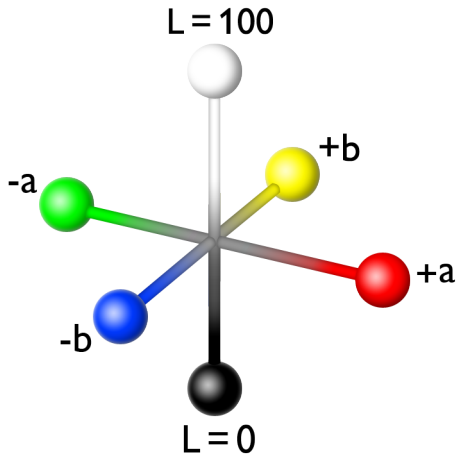
Fig. 235: Color model LAB

- a*-axis describes the red and green components of a color, negative values stand for greenand positive values stand for red. Range of values from -150 to +100.
- b*-axis describes the blue and yellow components of a color, negative values stand for blue positive values stand for yellow. Range of values from -100 to +150.
- L*-axis describes the lightness of the color with values from 0 to 100.

One of the most important properties of the L*a*b color model is the independency from the technology used for capturing and displaying the images. LAB values are calculated from linear RGB values. This is based in a D65 illuminant and a 2° observer.

8.17 Simulation of jobs (offline mode)

You can create and test your configuration without a sensor being connected using stored film strips (= series of images). Simulation can be worthwhile to prepare a configuration or to improve a configuration carried out online.

Please note:

- Several films are available in Vision Sensor Configuration Studio when delivered.
- Further methods for image acquisition: Image recorder (Page 280).

9 SBS – Operating- and configuration software – Vision Sensor Visualisation Studio, all functions

This program enables the monitoring of the image from the camera and the inspection results. No new settings can be made on the sensor.

It is only possible to switch between already existing jobs on the sensor, or predefined job sets can be uploaded from the PC / control to the sensor by the authorized worker. Thus, this display tool is mainly used to visualize images and results, and to change job at e.g. part change on the machine.

9.1 Image display

The graphical display of an image and the inspection results in the display window depend on the setting of the parameter in tab "Image transmission" in job settings ("Parameters for image transmission" in Vision Sensor Configuration Studio) program:

- Image transmission active: The current image along with the frames for the defined search, parameter and position zones and parameters found are displayed.
- Image transmission inactive: Only the frames for the defined search, parameter and position zones and parameters found are displayed (current image is not displayed).

The degree of concordance between the parameter searched for and the parameter found appears to the right next to the search zone of the respective detector, in the form of a vertical result bar with a set threshold value:

- Green bar: The parameter searched for has been found and the pre-set threshold value for concordance has been reached.
- Red bar: The object could not be found with the required degree of concordance.

Attention:

The icon inside life image means, that image display / transfer on PC is slower than image processing on SBS. Not all pictures taken by the SBS will be displayed. This may cause lost images during bad (fail) image archiving.

If this icon occurs often, PC-programs running in background should be closed in order to improve PC performance.

In the menu Vision Sensor Visualisation Studio / view you can configure the graphical representation of the test results.
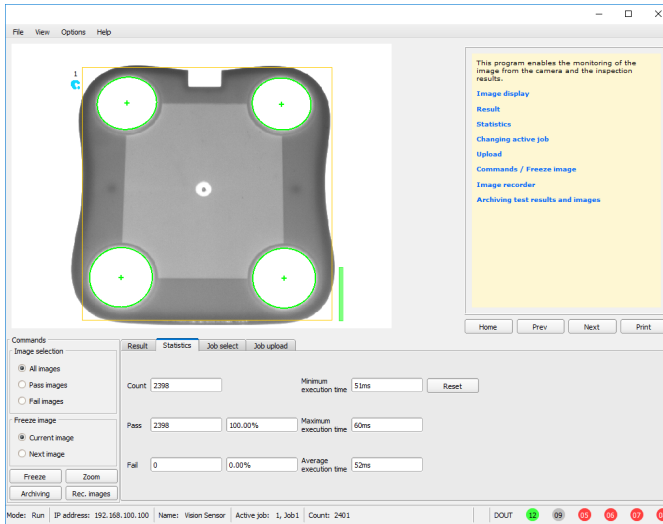
Fig. 236: Vision Sensor Visualisation Studio

Except the archiving all functions of Vision Sensor Visualisation Studio are available also in the module Vision Sensor Configuration Studio.

9.2 Commands

9.2.1 Freeze image

With the "Freeze image" button, you can request single images according to the type required (current image, next image, next failed image) and freeze them in the display window.

The required single image is displayed and the image counter stops at the corresponding image number.

Press "Continue" to end the frozen image state.

9.2.2 Zoom

With the button "Zoom" the image is opened in a new window with enlarged display.

9.2.3 Archiving test results and images

You can archive images with and without graphics, and inspection results on to your PC or an external storage medium for analysis or simulation purposes (see Offline mode).

Access to this function may require password entry (user group, see user administration).

Configuring archiving:

1. Select Configure archiving ... from the File menu.
   A dialogue box appears with the following options:
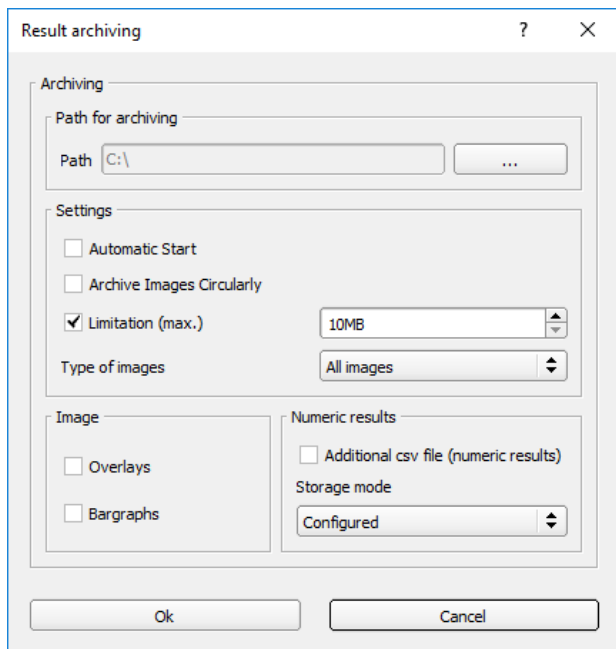
Fig. 237: Archiving configuration

Parameter	Function
Path for archiving	Directory in which archived file(s) are stored.

Parameter	Function
Settings, Automatic Start	Starts archiving automatically after start of Vision Sensor Visualisation Studio.
Settings, Archive image circularly	Activates cyclic overwriting of oldest images if limitation of storage is reached.
Settings, Limitation (max.)	In this drop-down menu it is possible to specify which images (all images or only good or bad images) are to be stored.
Type of images	Specifies, whether all, good or bad pictures have to be stored.
Graphics, Bar graph result	Choice of graphics to be archived in the image.
Numerical results	If "record with" is activated, numerical result data such as coordinate values etc. are archived in an additional .csv file. Setting "Legacy" / "Configured" determines the format of storage (.csv). With "Legacy" *1) the content is predefined, with "Configured" the content can be defined in "Output/Telegram". *1) The storage mode "Legacy" is obsolete and only provided for reasons of backward compatibility. It will be omitted with one of the next versions.

2. Select the required options and confirm your choice with OK.

Start / end archiving:

Click on the button "Archive images" in the "Commands" filed to start or end the archiving function with the above mentioned settings. The name of the image file currently to be stored appears in the status bar. Archiving is carried out for as long as the button "Archive images" is pressed.

9.2.4 Image recorder

An image recorder is available in the Vision Sensor Configuration Studio and Vision Sensor Visualisation Studio programmes. When the recorder is activated, either all images or just error images are continuously loaded into the internal memory. This covers 10 images, the oldest images are in turn replaced (FIFO buffer). The recorded images can then be called-up and

displayed with a PC, or stored on a PC or on an external storage medium, and are then available for analysis or simulation purposes in offline mode.

In the Vision Sensor Visualisation Studio program, you may be required to enter a password (if activated) to call up recorder images (User user group, see user administration).

Activating recorder:

Activate the recording function in the setup "output" under the "Image transmission" tab. You can select whether all images ("Any"), only "Pass" images or only "Fail" images should be recorded in the pop-up list of recorder parameters.

Selecting and recording images:

Select "Get images from sensor" from the File menu or click on the button "Rec.images" (only in Vision Sensor Visualisation Studio).

A display window appears in which you can load images stored in the sensor's RAM on to the PC and then examine and save them:

Fig. 238: Image recorder

Parameter	Function
Back	Displays the previous image
Next	Displays the next image

Parameter	Function
Save	Saves the image displayed on the PC or an external storage medium
Save all	Saves all images

Please note:

- The running number of the selected image and the total number of images recorded on the sensor (max. 10) are displayed in the counter under the display window.
- During storage, the images are deposited in bitmap format (extension .bmp) with a resolution of 640 x 480 pixels (VGA).
- The inspection results associated with the images (OK or error) and the date are stored in the file name (format YYMMDD_running no._Pass/Fail.bmp, e.g. 090225_123456_Pass.bmp).
- If you want to record detailed inspection results with the images, use the function Archive in Vision Sensor Visualisation Studio.
- If you only want to record a single image with or without overlay, you can use the function save current image in the file menu, instead of using the recorder.
- Images will get a time stamp when loading them from .
- Loading images from the sensor on to the PC deletes data on the sensor. If the recorder window is closed without images having been saved, they will also be deleted from the PC.
- Images are lost from the buffer in the event of a loss of power.

9.3 Tab Result

This function executes the job defined on the PC and the Result statistics window is displayed with Detector list and Evaluation results. Execution times are not updated in this mode, as they are not available from the sensor.

Detailed inspection results from the detector marked in the selection list are displayed in run mode.

The image, search and parameter zones and result graphs appear – when set –in the display window.

The parameters displayed vary according to the type of detector selected:
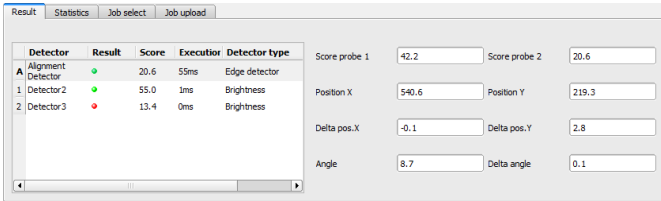
Fig. 239: Vision Sensor Visualisation Studio, Result

Parameter results displayed	Detector type	Function
Result	all	Part / parameter detected (detected = green, not detected = red)
Score 1 .. n	all	Degree of concordance of pattern found with pattern taught
Execution time	all	Cycle time for an evaluation in ms
Distance	Caliper	Calculated distance
Position X 1 ... n, Position Y 1 .. n	Pattern match., Contour, Caliper	Coordinates of parameter found (center point)
Delta X, Delta Y	Pattern match., Contour	Deviation of coordinates found in contrast to taught position / through alignment
Position check	Pattern match., Contour	Position found within the defined position frame
Angle	Pattern match., Contour	Orientation (absolute angle) of parameter found
Delta angle	Pattern match., Contour	Angle deviation between parameter taught and parameter found
Scale	Contour	Scale of contour found in contrast to taught contour.
Result index	Color list	Number in list
Color distance	Color list	Distance of measured color to taught color
Red (Color model RGB)	Color list, Color value	Mean value red

Parameter results displayed	Detector type	Function
Green (Color model RGB)	Color list, Color value	Mean value green
Blue (Color model RGB)	Color list, Color value	Mean value blue
Hue (Color model HSV)	Color list, Color value	Hue value of color
Saturation (Color model HSV)	Color list, Color value	Saturation of color
Brightness (Color model HSV)	Color list, Color value	Brightness of color
Lightness (Color model LAB)	Color list, Color value	Lightness of color
A (Color model LAB)	Color list, Color value	A- value of color
B (Color model LAB)	Color list, Color value	B- value of color

To show inspection results for another detector, mark it in the selection list.

You can archive inspection results and statistical evaluations including selected graphics in the Vision Sensor Visualisation Studio program.

9.4 Tab Statistics

Statistical data from the inspection process is displayed in the Statistics tab in run mode. The statistical data displayed is identical for all types of detectors:

Parameter	Function
All evaluations	Total number of inspections
Good parts	Number of inspections with result "OK"
Bad parts	Number of inspections with result "Error"
Min./max./mean execution time	Min./max./mean execution time for evaluation in ms

All statistic values can be reset to zero with the "Reset" button.

You can archive inspection results and statistical evaluations including selected graphics in the Vision Sensor Visualisation Studio program.

9.5 Tab Job select

In the Job tab, the jobs available on the sensor are displayed in the selection list. Here you can switch between different jobs stored on the sensor. The green arrow (▶) marks the active job

The use of functions which stop an active sensor may require in Vision Sensor Device Manager the password entry (User group user, see user administration).

Password levels
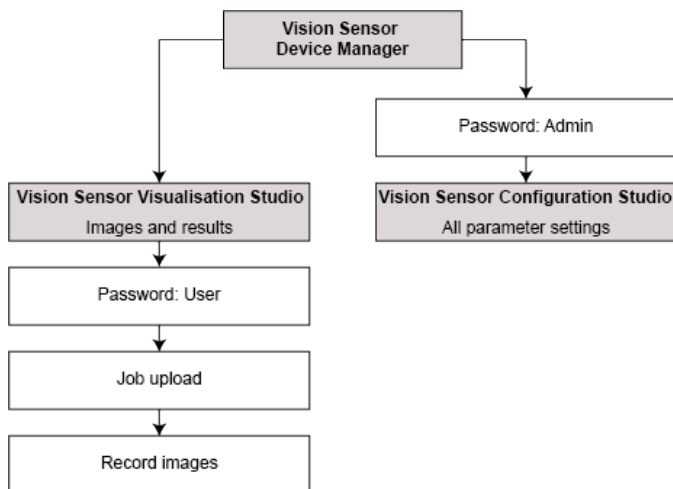
Fig. 240: Password levels
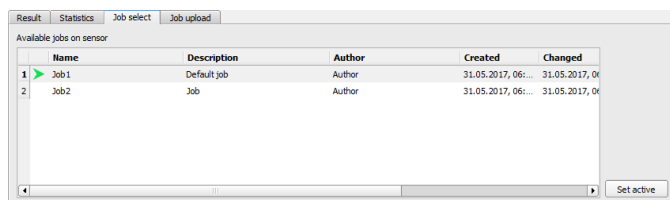
Fig. 241: Vision Sensor Visualisation Studio, Job select

Sequence

Select a job from the list and activate it with the "Activated" button.

The previous job is deactivated; the selected job is now active.

> **Please note:**
> At Job Change and change from Run- to Config Mode outputs will get the following states:
>
> - Buffer of delayed outputs will be deleted.
> - Digital outputs: will be reset to default at change from "Run" to "Config". Defaults are set by flag "Invert" in output tab. "Invert" inverts the default setting and also the result.
> - Ready and Valid: Ready and Valid show at Job change and at change of operation mode from Run to Config, that the is not ready and that results are not valid (Low level).

9.6 Tab Job upload

You can load new jobs or entire job sets from the PC to the sensor memory in the Upload tab. The available jobs and job sets are displayed in the selection list.

Jobs and job sets can be created in the Vision Sensor Configuration Studio program and stored there under File / Save Job / Save Jobset as ...
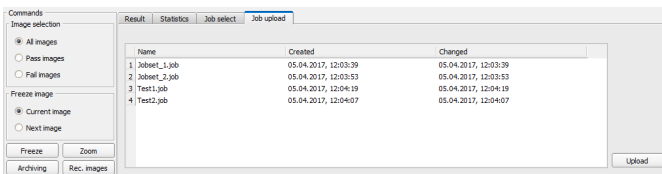
Fig. 242: Vision Sensor Visualisation Studio, Job set upload

> **Please note:**
>
> - A job set consists of one or several jobs which are simultaneously stored in the sensor or on the hard disk.
> - Use of functions which can stop the active sensor may require password entry (User user group, see user administration).
> - Select a job or job set from the list and load it on to the sensor with the "Upload" button.
> - This action deletes all jobs previously stored on the sensor!

10 Communication

10.1 Possibilities of image- / data transfer and archiving

The SBS is able to communicate and exchange data via different communication channels with a PLC, I/O extension or a PC. It´s possible to send data on request or cyclical from the SBS to a PLC/PC. But the PLC/PC can also actively communicate with the SBS, for e.g. only on demand / request to get result- or settings- data or to do a job switch.

The physically available communication interfaces are:

- Ethernet
- RS422

Via Ethernet also the fieldbus interface EtherNet/IP is supported. Via RS422 and the according interface converter the fieldbus Profibus is supported.

A complete overview about all available telegrams you find in chapter .Serial Communication ASCII (Page 419)

In the following pages the function and the according settings how to use the different possibilities to communicate with a is illustrated in a few examples.

The following examples show how to work on the PC end with the Serial- and Ethernet- software-tool "Hercules". This tool and the settings made here are examples for your PC- or PLC application, and all settings necessary you can see in these examples. If you also like to use the tool Hercules SETUP utility - produced by www.HW-group.com, you can download as freeware.

10.1.1 Ethernet, Port 2005 / 2006

Numerical data, which has been defined under Output/Telegram, now can be transferred in ASCII- or Binary- format.

The sensor here is the (socket-) "server" and serves the Data via a "server-socket" interface. This is basically a "programming interface".

To read or process the Data a "socket client" (PC, PLC, ...) must establish a (socket-) connection (active) to the sensor.

Handling, settings

10.1.1.1 Ethernet example 1: Pure data output from SBS to PC/ PLC

Step 1:

After the job with all necessary detectors, if so alignment is set up, here the Ethernet interface gets activated and if necessary it's parameter are set also.
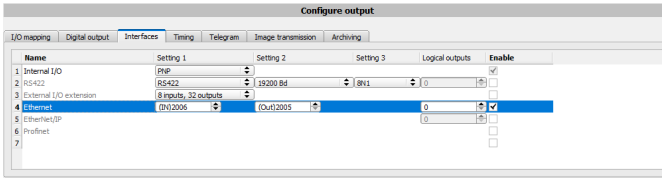
Fig. 243: Data output, Ethernet

In the example the Ethernet interface in the parameter field at the bottom in tab "interfaces" is activated by marking the checkbox. The default settings for input port (IN) = 2006 and output port (OUT) = 2005 remain as they are in this example. Of course here any other settings can be chosen to do a setup which fit to your network environment. If necessary please contact your network administrator.

Step 2:

In tab "Telegram" the payload which should be transferred via Ethernet port 2005 are set up.

In this example it is:

- Start: "010"
- Overall result of detector 1
- Trailer: "xxx"

As format "ASCII" is defined, that makes traceability easier. The function with other payload data or in binary format works analogue to this example and to the here made settings.
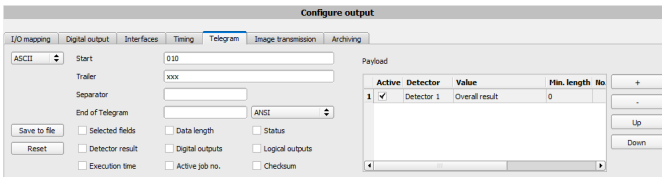
Fig. 244: Data output, configuration of output data

Step 3:

After starting the Ethernet tool "Hercules" the tab "TCP-Client" must be selected to communicate via Ethernet with the socket- server SBS.
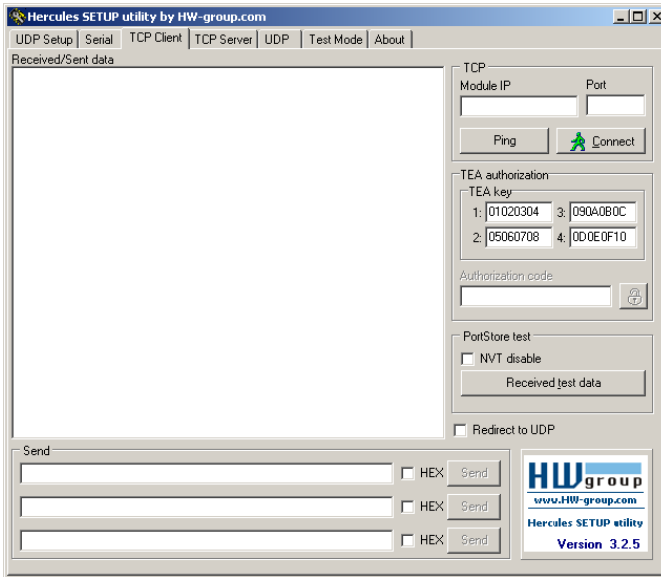
Fig. 245: Data output, Ethernet tool / 1

Here the IP address of the SBS and the correct port number must be set up to receive data.

The IP address of the SBS you find in Vision Sensor Device Manager. Please look at the first line in the window "Active Sensors" = 192.168.60.199
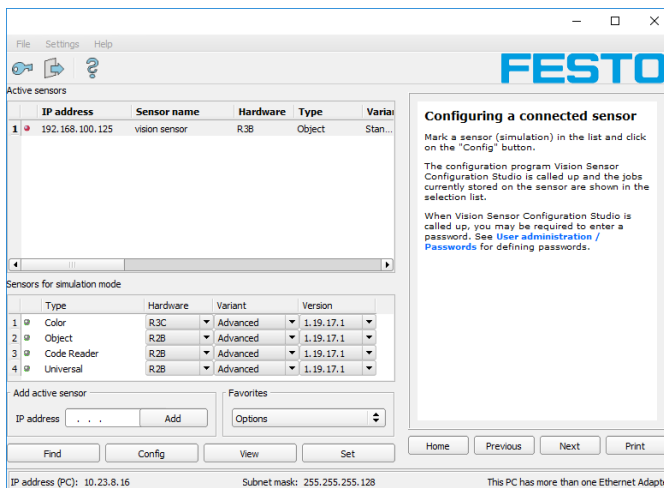
Fig. 246: Vision Sensor Device Manager, IP address …

The port number for the output port was taken over from Step 1 with port 2005.

Step 4:

Therefore the following settings are made in Hercules: Module IP = 192.168.60.199, Port = 2005. The rest of all settings remain on default. With a click to the button "Connect" the connection to the SBS is established and shown in the main window in green letters.
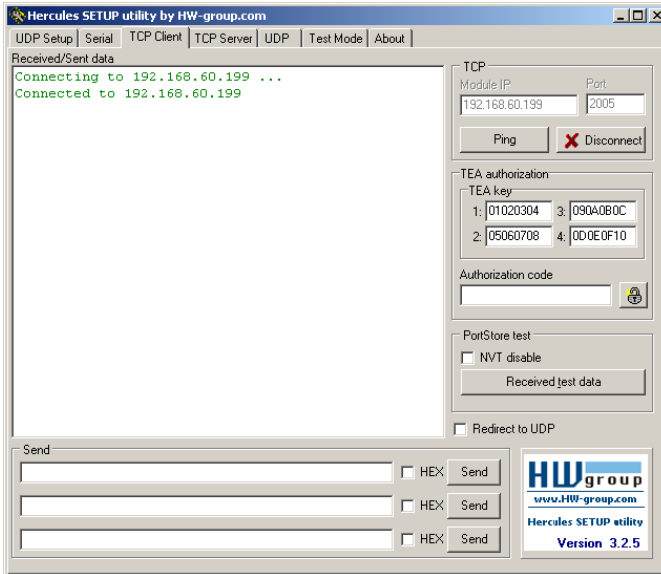
Fig. 247: Figure 168 Data output, Ethernet Tool / 2

Step 5:

The SBS now needs to be started form the PC application with "Start sensor" (Later in autonomous operation the SBS directly starts after power on, and sends data, if configured this way). In the example Trigger mode is "Continuous", that means evaluation is done continuously and data is sent continuously too. All this data is visible in the main window of Hercules.
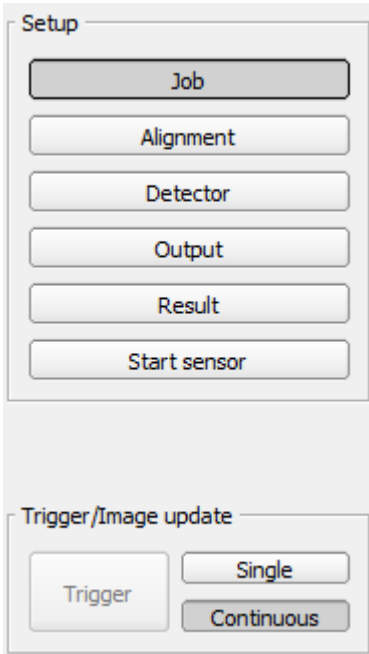
Fig. 248: Data output, Ethernet, Start sensor
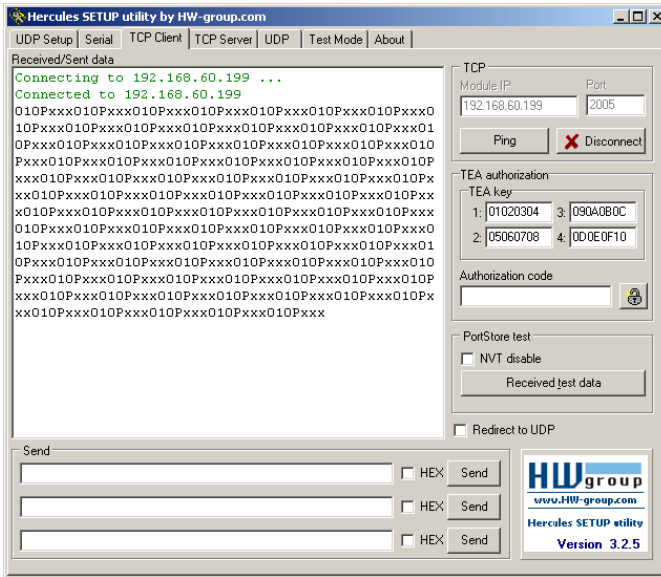
Fig. 249: Data output, Ethernet, Tool / 3

Then here visible data are displayed (as set up in "Output"):

- Start: "010"
- Overall result of detector 1 ("P" for positive, as result of detector Brightness is = "Pass")
- Trailer: "xxx"

10.1.1.2 Ethernet example 2: commands (requests) from PC / PLC to SBS

mit Quittierung / Datenausgabe vom SBS

Step 1

For better traceability in this example the triggered mode is used. That can be done as follows: Adjust Job/Image acquisition/Trigger mode = Trigger. All other settings on SBS remain the same like in example 1.
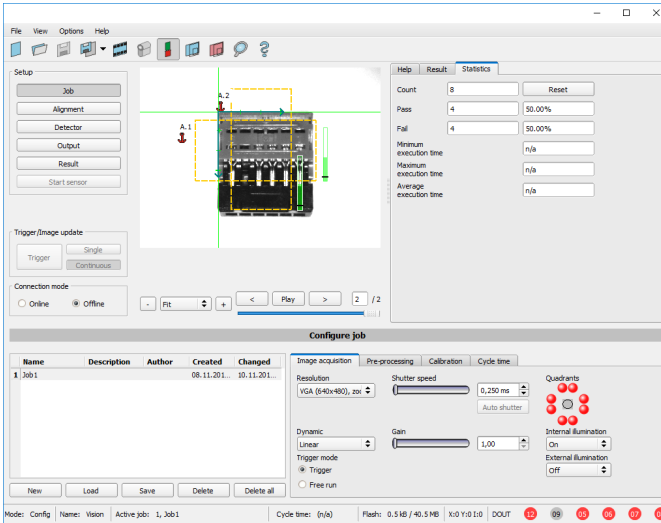
Fig. 250: Data output, Ethernet, Trigger

Step 2

To send commands / requests to the SBS, a second instance of Hercules is started. This time with Port 2006 as input port of the SBS, where it can receive commands. All telegrams (commands and response strings) to and from SBS you find in chapter Serial Communication ASCII.
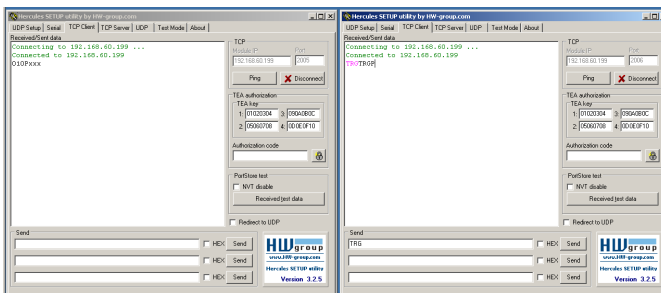
Fig. 251: Data output, Ethernet Tool / 4

In the window to the right the command "TRG" (for Trigger, command see below, first line) was sent to the SBS, by a click to the according button "Send". This command is shown as soon as it´s sent in the main window in red letters. The SBS responds via port 2006 as a acknowledge to

the command with "TRG", and in this case with "P" for a positive result for detector 1, both in black letters, also in the right Hercules window.

In the left window the SBS sends via the output port 2005 the Output defined values "010Pxxx", like in example Ethernet 1.
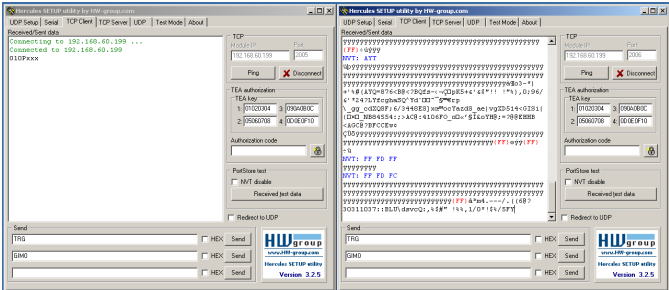
Fig. 252: Data output, Ethernet Tool / 5

In the example the command GIM0 (GetIMage0) was sent to the SBS. It responds with the binary image data which are shown in the right window. That means, the data output of the manually under "Output" defined payload data happened via port 2005. But the response to the request "GIM0" was transferred via port 2006. This rule is valid for all payload- or response data.

> **Please note:**
> To use the command GIMx the image recorder must be switched on.

10.1.1.2.1 Ethernet example 2.1 command job switch from PC/PLC to SBS

With response / data output from SBS

Step 1

For better traceability in this example the triggered mode and ASCII format is used. That can be done as follows: Adjust Job/Image acquisition/Trigger mode = Trigger. All other settings on SBS remain the same like in example 1. All data output definitions are made here in "ASCII" for better traceability of the examples.

For this example Job 1 was set up with the below visible data output:

- Start: "010"
- Trailer: "xxx"
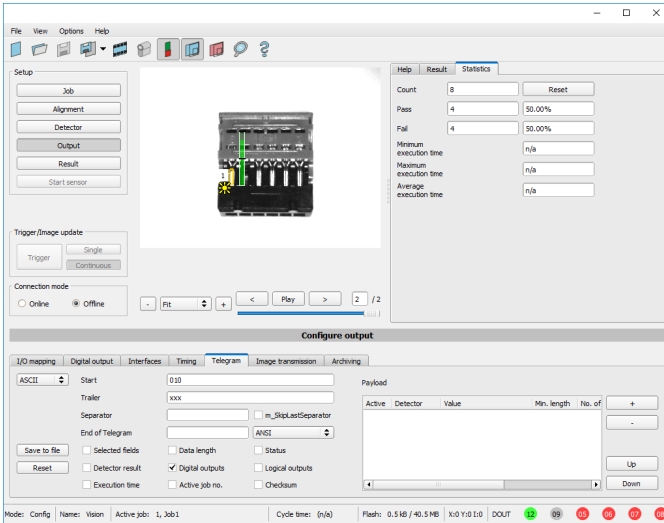
Fig. 253: Data output, Ethernet, Job switch Job 1

Job 2 was set up with detector 1 and data output:

- Start: "020"
- Overall result of detector 1
- Trailer: "yyy"
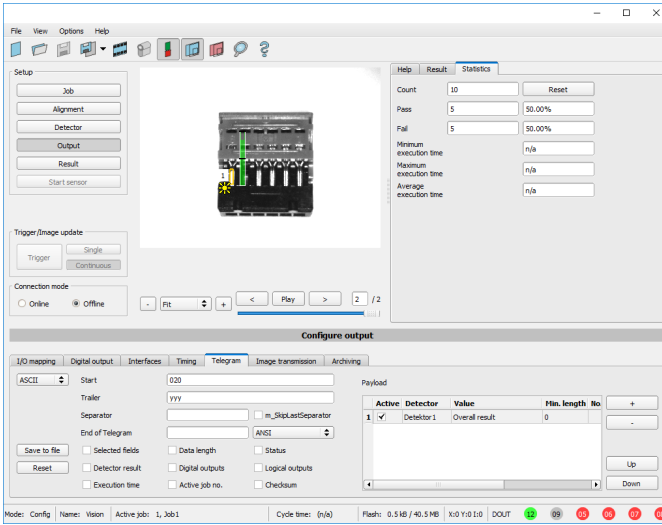
Fig. 254: Data output, Ethernet, Job switch, Job 2

Step 2

Here the application Hercules is started two times again. First with port 2005 (to receive results like defined under "Output") and port 2006 (commands and response), as the input port of the SBS to receive commands.

All telegrams (commands and response strings) to and from SBS you find in chapter Serial Communication ASCII.
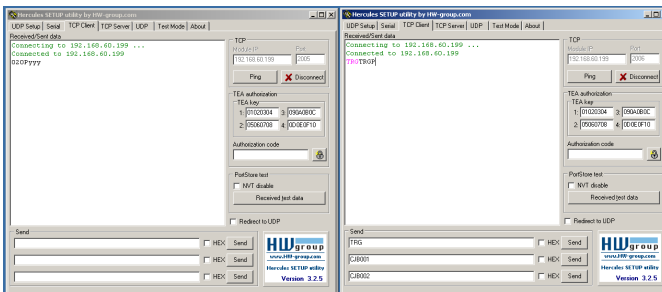
Fig. 255: Data output, Ethernet, Job switch, tool / 1

In the window to the right (port 2006) the command TRG (Trigger, see below, first line "Send") was sent. This is displayed in the main window in red letters "TRG". The SBS responds with the acknowledge "TRGP" (repetition of the command "TRG" and "P" for positive)

In the window to the left (port 2005) the SBS, where currently Job 2 is active, sends the according result string which was defined under "Output" in Job 2 with "020Pyyy".
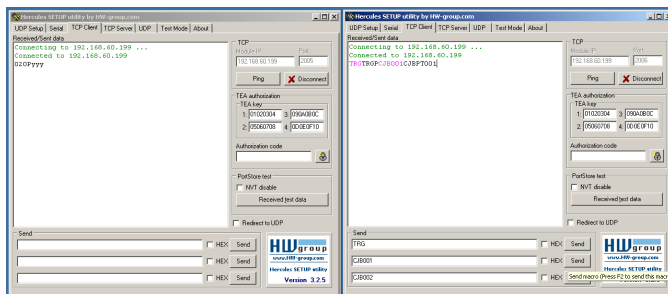
Fig. 256: Data output, Ethernet, Job switch, tool / 2

Now in the right window (port2006) the command CJB001 (ChangeJoB 001, 001 = Job Nr. 1, see below, second line "Send") was sent. This is displayed in the main window in red letters "CJB001". The SBS responds with the acknowledge "CJBPT001" (repetition of command "CJB", "P" for positive, "T" = Triggered, "001" Job number to which was switched).
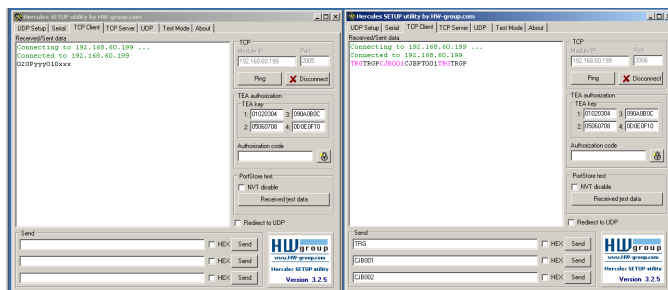
Fig. 257: Data output, Ethernet, Job switch, tool / 3

After the next Trigger command TRG (see below third line "Send") the command "TRG" is displayed again in the main window in red letters. The SBS responds with "TRGP" (repetition of command "TRG" and "P" for positive)

In the window left (port2005) the SBS, after switching to Job 1!, now the according result sting which was defined under Output in Job 1 with "010xxx"!

Function of the both Ethernet- ports for in- and output:

*A: Port 2005, only one direction: Sensor » PC, all payload data, defined in "Output"

*B: Port 2006, both directions: Sensor ◊ PC, commands / requests to the SBS, with acknowledge, + all response data to the request (no payload data !).
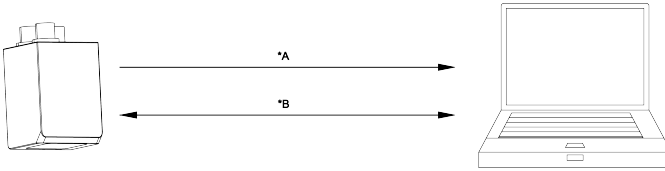
Fig. 258: Ethernet- ports

10.1.2 RS422

Numerical data that has been defined under Output/Telegram, now can be transferred in ASCII- or Binary- format.

Ethernet: The sensor here is the (socket-) "server" and serves the Data via a "server-socket" interface. This is basically a "programming interface". To read or process the Data a "socket client" (PC, PLC, ...) must establish a (socket-) connection (active) to the sensor.

Handling, settings

10.1.2.1 RS422 example 1: Data output from SBS to PC / PLC, and commands (requests) to the SBS

mit Quittierung / Datenausgabe vom SBS

Step 1:

After the job with all necessary detectors, if so alignment is set up, here the RS422 interface gets activated and if necessary it's parameter are set also.
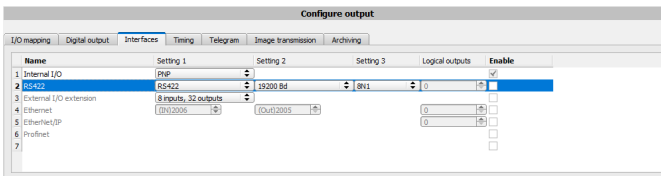
Fig. 259: Data output RS422

In the example the RS422 interface in the parameter area at the bottom in tab "Interfaces" gets activated by marking the checkbox.

The default settings for Baud rate = 19200 and Logical outputs = 0 remain as they are. Here of course any other settings can be done which must have its corresponding setting at the other side (at the PC or PLC, whatever used).

Step 2:

In tab "Output" the payload data which shall be transferred via RS422 are defined. In this example this is:

- Start: "010"
- Overall result of detector 1
- Trailer: "xxx"
  As format "ASCII" is defined, that makes traceability easier. The function with other payload data or in binary format works analogue to this example and to the here made settings.
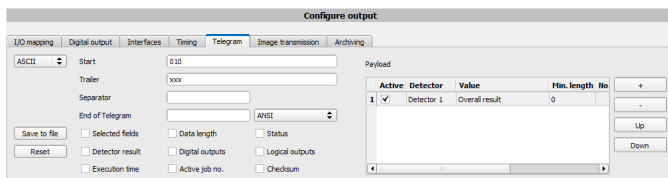
Fig. 260: Data output RS422, configuration of output data

Step 3:

The SBS now needs to be started form the PC application with "Start sensor" (later in autonomous operation the directly starts after power on, and sends data, if configured this way).

In the example Trigger mode is continuous, that means evaluation is done continuously and data is sent continuously too. All this data is visible in the main window of Hercules.
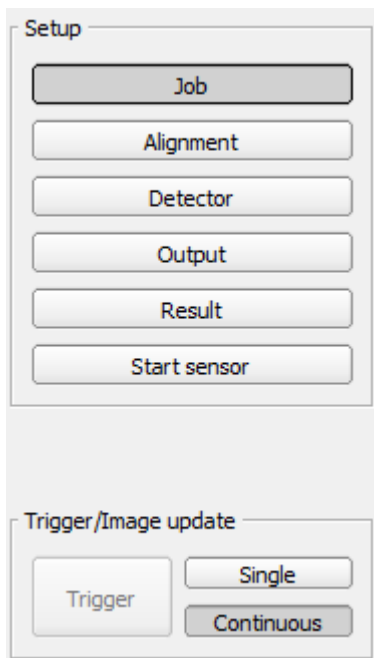
Fig. 261: Start sensor

Step 4:

After start of Serial- tool Hercules, tab "Serial" must be selected to communicate via RS422 with the socket server SBS.
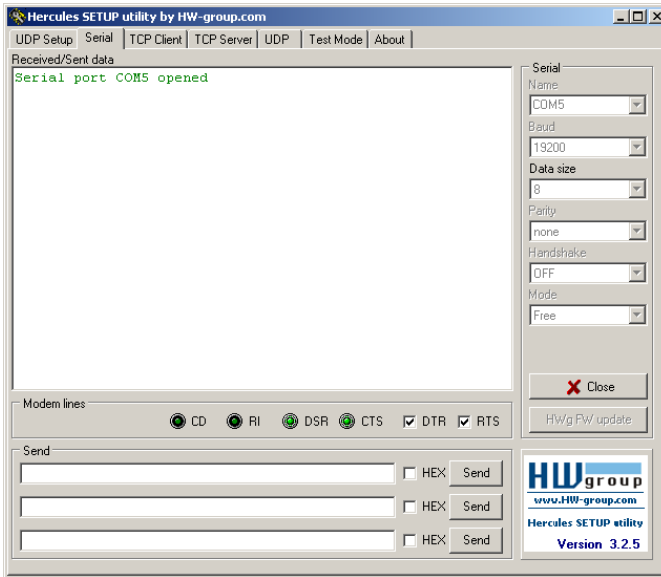
Fig. 262: Data output, RS422 tool / 1

Now the corresponding settings for baud rate like in SBS vision sensor must be done. Also the correct serial port COMx must be set up here to receive data.

The baud rate you see in tab Output/Interfaces. The number of the serial COM port (COM x of the PC) you find out in Windows at: Start/Control Panel/Performance and Maintenance/System/Hardware/Device Manager, at Universal Serial Bus Controllers (Here COM5).

The rest of the settings at the right are the default values of Hercules. "DTR" and "RTS" must be activated.

With a click to the button "Connect" the connection to the SBS is established and shown in the main window in green letters.
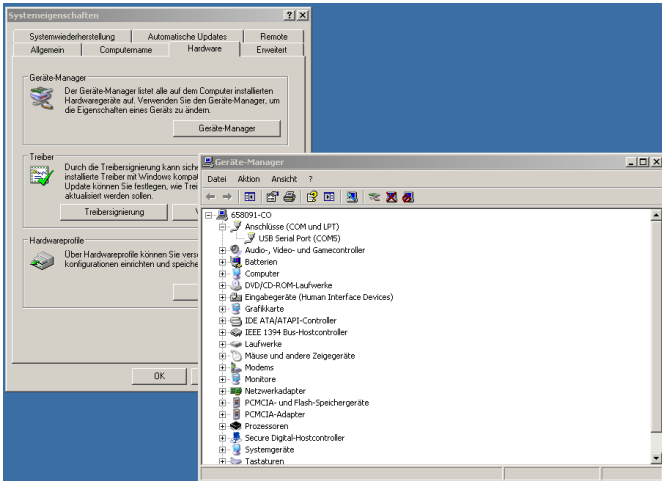
Fig. 263: Data output, RS422 COMx

Step 5:

With a click to button "Send" the command "TRG" is sent to the SBS. It responds with "TRG", followed by "P" for positive and the payload data "010Pxxx".
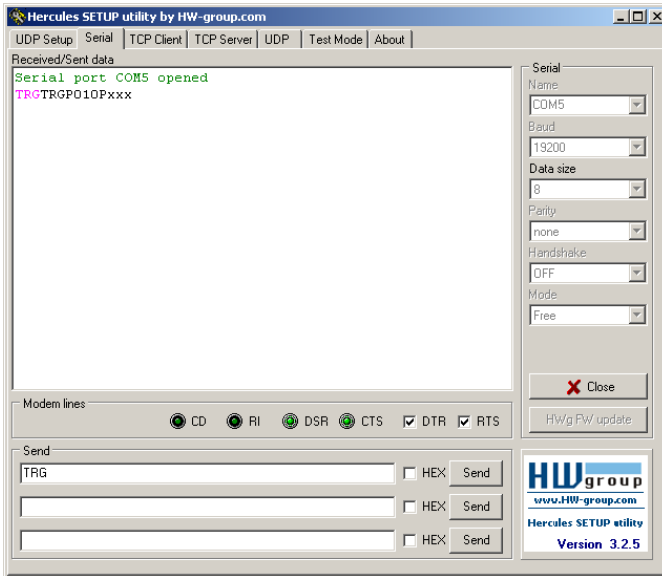
Fig. 264: Data output, RS422 tool / 2

Step 6:

In the following example the command "SST041000" (SetShutterTemporary, 04 = number of letters of shutter value, 1000 = shutter value in microseconds) is sent and the SBS responds with SSTP (SetShutterTemporary, P = positive). All available telegrams you find in chapter Serial Communication ASCII and are used in analogue way.
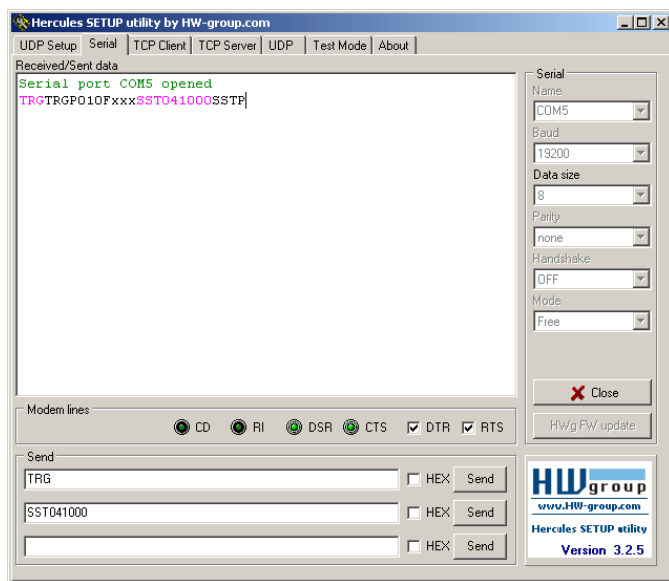
Fig. 265: Data output, RS422 tool / 3

10.1.2.1.1 RS422 example 1.1: command Job switch from PC / PLC to SBS

With response / data output from SBS

Step 1

Here the same setting for Job and Output are used as in "Ethernet Example 2.1".

For better traceability in this example the triggered mode and ASCII format is used. That can be done as follows: Adjust Job/Image acquisition/Trigger mode = Trigger. All other settings remain the same like in example 1. All data output definitions are made here in "ASCII", also for better traceability of the examples. In Output/Interfaces here the interface RS422 was activated.

For this example Job 1 was set up with the below visible data output:

- Start: "010"
- Trailer: "xxx"
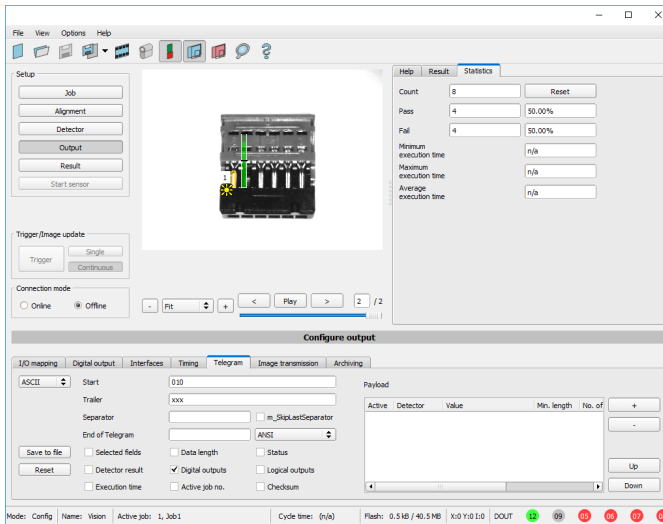
Fig. 266: Data output, RS422, Job switch, Job 1

Job 2 was set up with detector 1 and data output:

- Start: "020"
- Overall result of detector 1
- Trailer: "yyy"
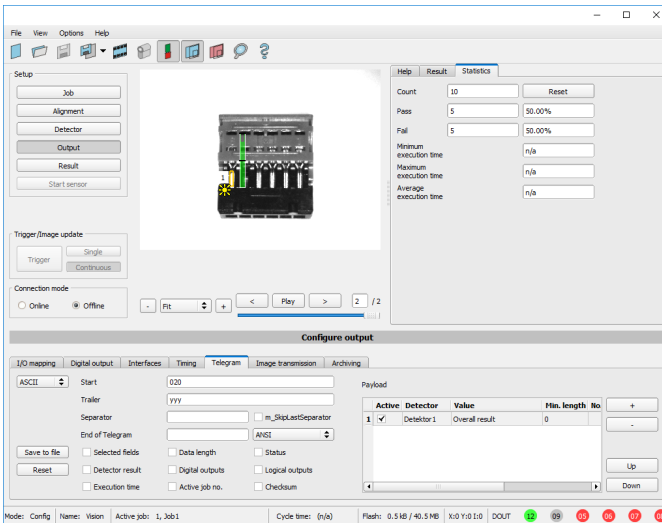
Fig. 267: Data output, RS422, Job switch, Job 1

Step 2

After start of Serial- tool Hercules, tab "Serial" must be selected to communicate via RS422 with the socket server SBS.

Now the corresponding settings for baud rate like in SBS vision sensor must be done. Also the correct serial port COMx must be set up here to receive data.

The baud rate you see in tab Output/Interfaces. The number of the serial COM port (COM x of the PC) you find out in Windows at: Start/Control Panel/Performance and Maintenance/System/Hardware/Device Manager, at Universal Serial Bus Controllers (Here COM5).

The rest of the settings at the right are the default values of Hercules. "DTR" and "RTS" must be activated. With a click to the button "Connect" the connection to the SBS is established and shown in the main window in green letters.

Step 3

With the command "TRG" (Trigger, s. below, line 1, "Send") an image acquisition and an evaluation was initiated. Der SBS sendet sofort die Kommando- Quittung: „TRGP" („P" für Positiv).The SBS immediately responds with "TRGP" ("P" for positive).Außerdem, da im Moment Job1 aktiv ist, den Datenausgabestring „010xxx" wie in Job 1 definiert.Also, as in this moment Job 1 is active, the result data string "010xxx" is sent.
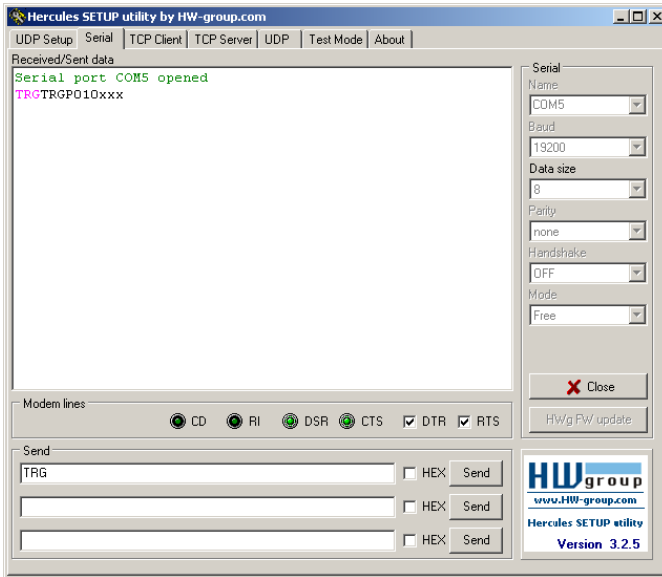
Fig. 268: Data output, RS422, Job switch tool / 1

Step 4

With the command "CJB002" (ChangeJoB, Job Nr. 002, s. below line 2, "Send") the now switches to Job 2.

The response: "CJBPT002" (repetition of command "CJB", "P" for positive, "T" = Triggered, 002 Job number switched to) is sent and displayed in main window.
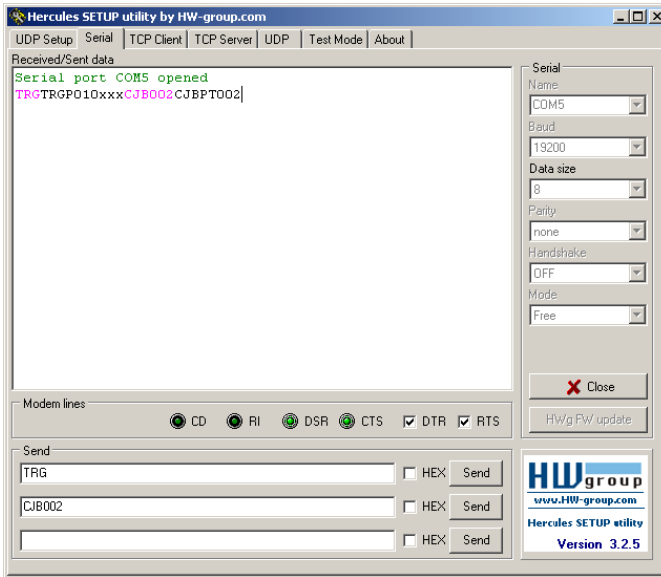
Fig. 269: Data output, RS422, Job switch tool / 2

Step 5

After the next Trigger command TRG (s. below line 1, "Send") the command "TRG" the next evaluation on the SBS is performed and the response "TRGP" (repetition of command "TRG" and "P" for positive) is sent. Also, as now Job 2 is active, the result string "020Pyyy" like in Job 2 defined is transmitted.
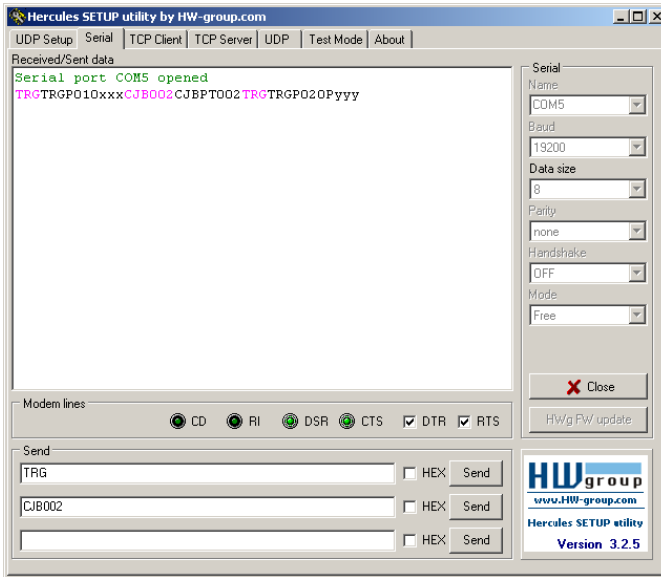
Fig. 270: Data output, RS422, Job switch tool / 3

10.1.3 PC-Archiving (Vision Sensor Visualisation Studio)

Via Vision Sensor Device Manager images and numerical data (in .csv format) can be stored into a folder on the PC.

The setup (folder ...) is done via Vision Sensor Visualisation Studio in menu "File/Archiving". This function is available on PC only.

Step 1:

Start Vision Sensor Visualisation Studio with a click to the button "View" in Vision Sensor Device Manager.
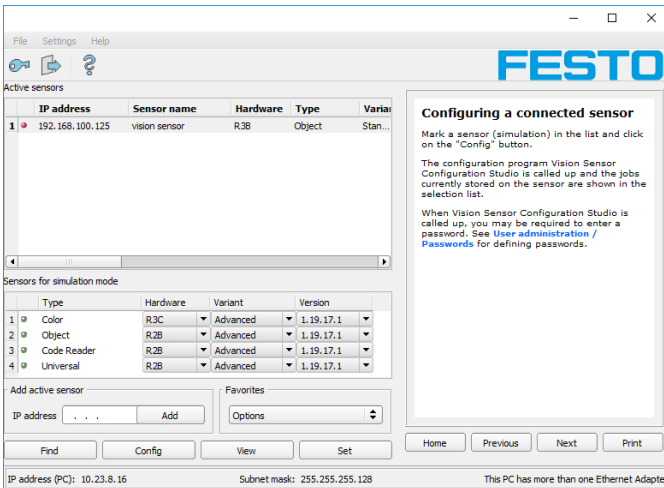
Fig. 271: Vision Sensor Device Manager

Vision Sensor Visualisation Studio is started.

The conditions for a correct image display are the settings:

- Free run (set in Job/Image acquisition) or
- At least one trigger happened
- Image transmission is active at: Vision Sensor Configuration Studio/Job/Image transmission)

Step 2

Select in Vision Sensor Visualisation Studio/File "Result archiving"
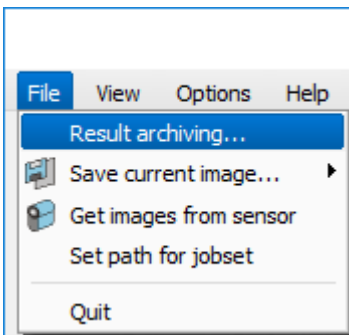
Fig. 272: Vision Sensor Visualisation Studio, Archiving

Now the following dialog box occurs to set up parameter for archiving.

Parameter	Function
Path for archiving	Directory in which archived file(s) are stored.
Settings, Automatic Start Start	Starts archiving automatically after start of Vision Sensor Visualisation Studio.
Settings, Archive image circularly Overwrite	Activates cyclic overwriting of oldest images if limitation of storage is reached.
Settings, Limitation (max.)	In this drop-down menu it is possible to specify which images (all images or only good or bad images) are to be stored.
Type of images	Specifies, whether all, good or bad pictures have to be stored.
Graphics, Bar graph result	The image data can be stored in various ways. By activating "Overlay" the ROI of detectors and alignment are saved. By activating "Result Bargraph" the result bars of detectors and alignment are saved. If none of the options are activated here, the image data is saved in raw state.
Numerical results	If "record with" is activated, numerical result data such as coordinate values etc. are archived in an additional .csv file. Setting "Legacy" / "Configured" determines the format of storage (.csv). With "Legacy" the content is predefined, with "Configured" the content can be defined in "Output/Telegram".

Select the required options and confirm your choice with OK.

10.1.3.1 Start / end archiving:

Click on the button "Archive images" in the "Commands" filed to start or end the archiving function. The name of the image file currently to be stored appears in the status bar. Archiving is carried out for as long as the button "Archive images" is pressed.
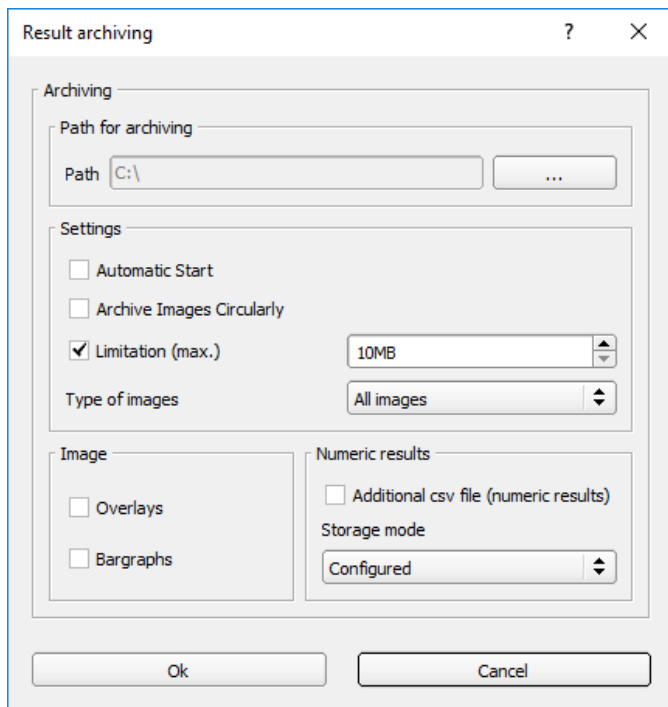
Fig. 273: Vision Sensor Visualisation Studio, Archiving configuration

10.1.4 Archiving via ftp or smb

With this function images and numeric result data (in .csv format) can be stored actively by the sensor via ftp/smb.

This kind of archiving is configured under "Job/Archiving".

In this case with

a. **"ftp" used**: the sensor is a "ftp client" and "writes" the data to a "ftp server" folder on a drive which is available in the network.
With Job/Start the sensor connects to the ftp-Server.

b. **"smb" used**: the sensor "writes" the data direct in a folder in a network. With Job/Start the sensor connects/mounts with this folder.

With this kind of data archiving in normal operation case no PC application like Vision Sensor Device Manager or Vision Sensor Configuration Studio is running, just a accordingly SBS configured ftp- or smb- server.

10.1.4.1 Example: Archiving via ftp

In this example with the ftp- server freeware "Quick´n Easy FTP Server" a ftp communication was established and image- and result data are stored on the hard disc of the PC.

In the ftp server with the account wizard a user account with the name "SBS_FTP" was created. A password and a path for data storage have been specified, and upload and download are activated.
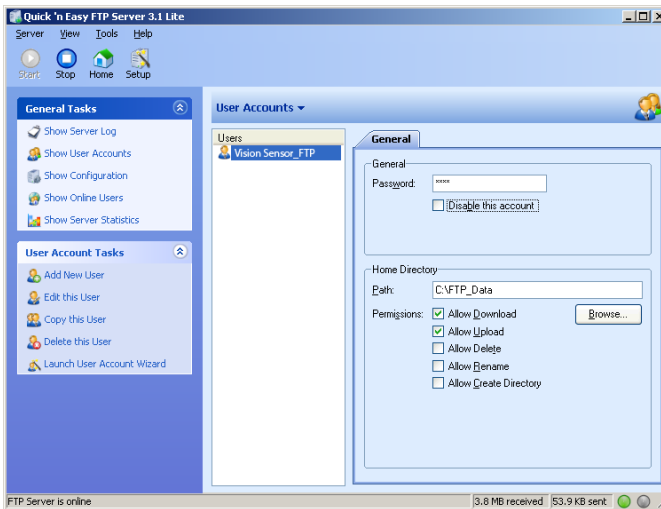
Fig. 274: FTP Server

In Vision Sensor Configuration Studio now at: Output/Archiving the according settings for the ftp server on the SBS must be done. This are:

- Archive type = FTP
- IP address = IP of the PC where the ftp server is running (IP address of PC connected you find in status line in Vision Sensor Device Manager in the corner left, below)
- User name = Name of the user account in the ftp server
- Password = in the ftp account used Password (option)

With this the for ftp communication according settings are done.

Also other settings like: Filename, Max. number of files, Storage mode ... can be made here
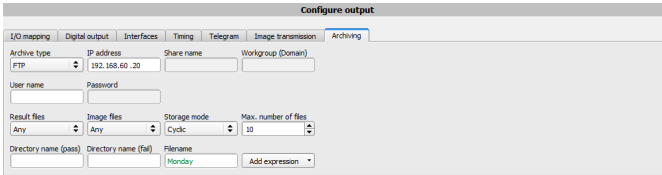
Fig. 275: FTP Server, settings in Vision Sensor Configuration Studio

As soon as this settings are done and transferred to the SBS (with "Start Sensor"), the image and result data are transferred and stored into the specified folder on the PC, without any of the applications Vision Sensor Device Manager, Vision Sensor Configuration Studio or Vision Sensor Visualisation Studio active.
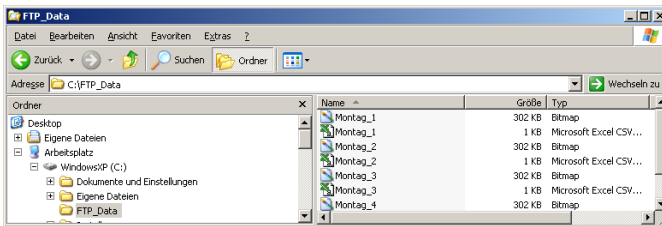
Fig. 276: Transferring files with FTP.

The function via smb works analogue via a smb server, which must be set up in the according kind.

10.1.4.2 Example: Archiving via SMB

To archive data and / or images via SMB (Server message block), at the end of the PC a folder must be shared.

The following example shows the settings for archiving data via SMB exemplarily.

10.1.4.2.1 Settings for SMB on PC: Create folder and share it

1. Via right- click to the folder (here "Test_SMB"), select "properties".
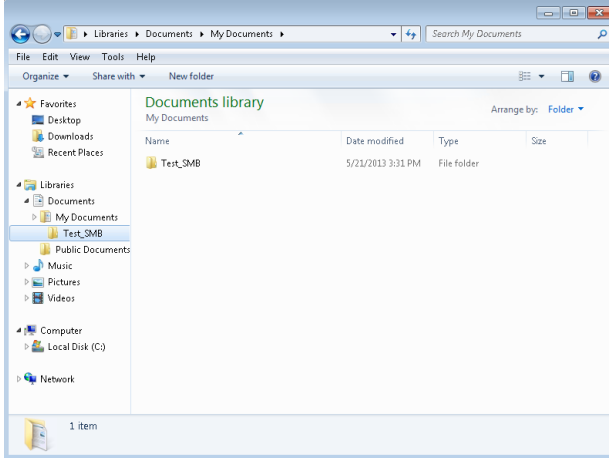
Fig. 277: Create folder to write data and / or images.

2. In the following dialog "Test_SMB Properties" select tab "Sharing" and open "Advanced Sharing".
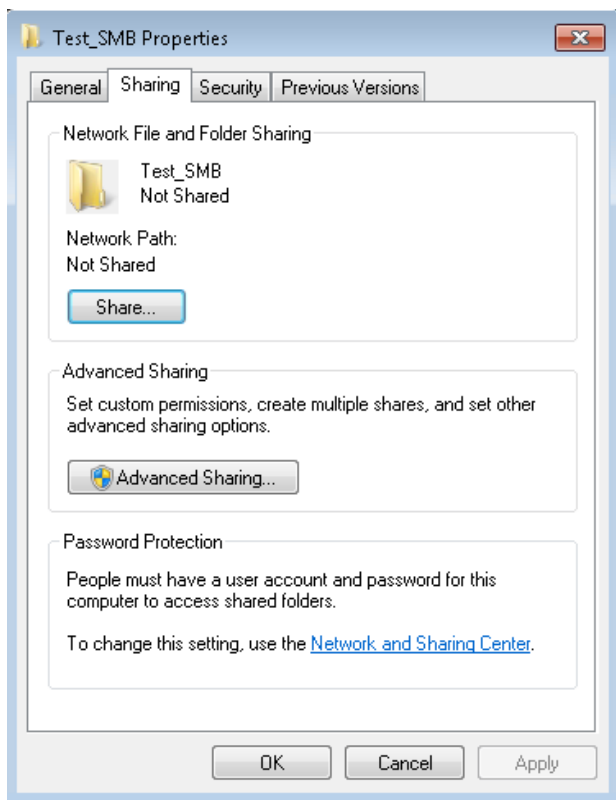
Fig. 278: Sharing of folder › Advanced sharing.

3. In the dialog "Advanced Sharing" activate "Share this folder". As "Share name" the name of the folder "Test_SMB" is suggested. Here any other name can be set. In this example the suggested folder name is used.
    Important: This "Share name" must be set later in the SBS - SMB- Interface!
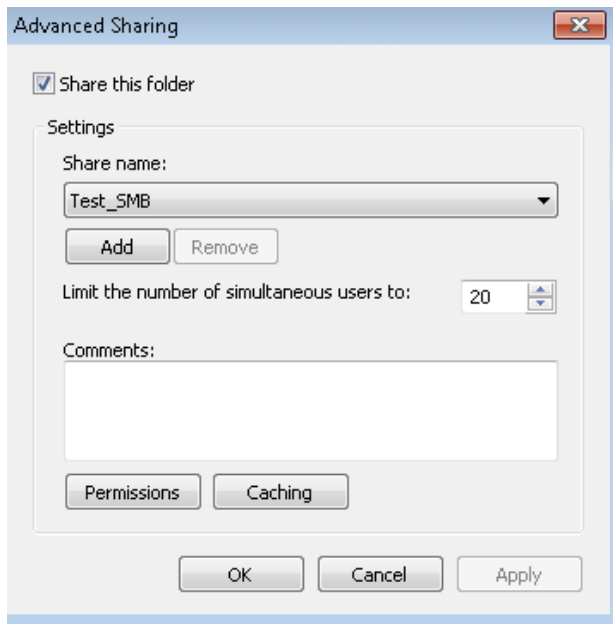
Fig. 279: Set Share name.

4. With a click to "Permissions" the following dialog appears.
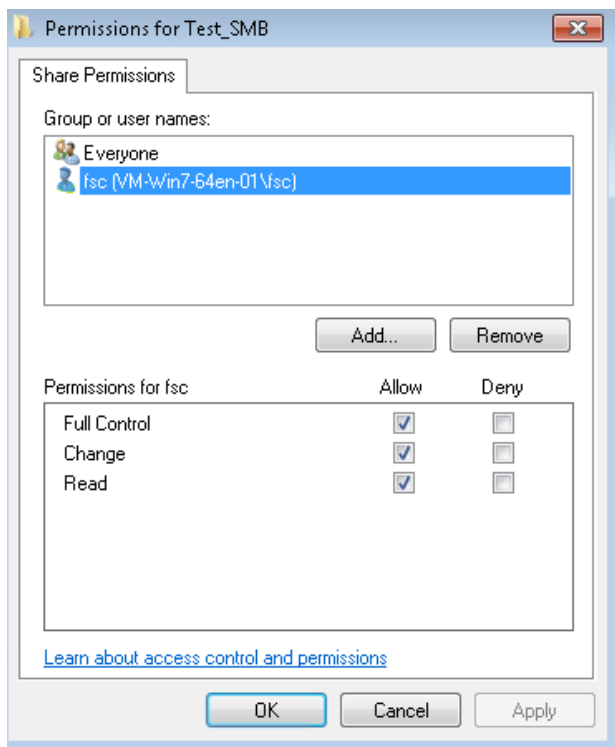
Fig. 280: Set permissions

5. In the window "Permissions for Test_SMB", select a user (here "fsc"), (for which user name and password is known). User name and password are necessary later to be set in the SBS - SMB- Interface.

6. Activate "Full control", and close the dialog with "Apply" and "OK".

7. Now close the dialog "Advanced Sharing" and "Test_SMB Properties" with "Apply" and "OK" also.

8. The access for the here selected user to the selected folder on the PC now is set, and now the corresponding settings in the SBS - Interface "Vision Sensor Configuration Studio" can be made.

10.1.4.2.2 Settings SMB
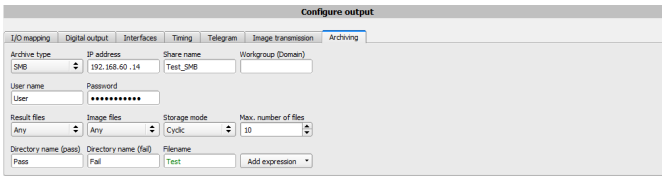
Fig. 281: Settings in SBS - SMB- Interface

After starting Vision Sensor Configuration Studio, select select Job/Archiving/Archive type: "SMB".

Do the following settings:

- IP address: IP addresse of PC (this can be found with command "ipconfig" via Start/run/cmd, s. following screenshot). In this example: 192.168.60.14
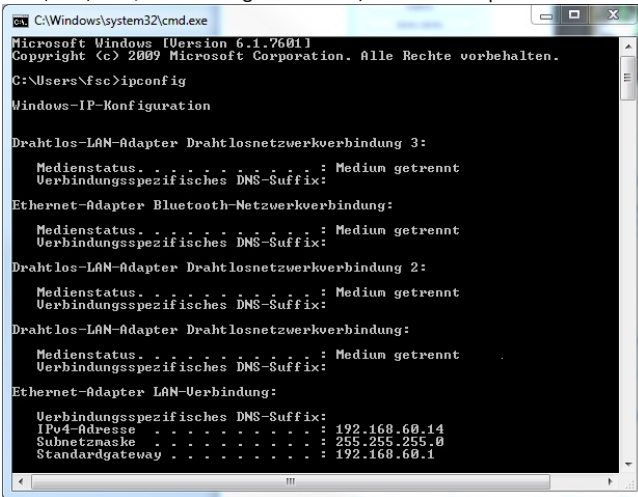
Fig. 282: IP- Adresse des PC via Start/Ausführen/cmd/ipconfig

- Share name: Here enter Share name like set in PC- dialog "Advanced Sharing".
- Workgroup: Option! Enter name of workgroup.
- User name and Password: Depending on the selection made in dialog "Test_SMB Permissions":
    1. User group "Everyone": User name and Password remain empty
    2. Enter corresponding User name and (here in example user name "fsc")

- Directory name (Pass), Directory name (Fail): Chose a name for the folders in which in case of Pass- or Fail- parts the data and images should be archived. These folders are crated below the shared folder (here: "Test_SMB").

- Filename: Enter any filename.

- Result files: If protocol file is active, there will be generated automatically a .csv file for each inspection (trigger). Contents of the file is like specified in "Output / Telegram". Filename with incremented counter.

- Image files: Archiving the images as .bmp: None, All, only pass parts, only fail parts

- Storage mode: Limit: after reaching maximum number of files transmission is stopped. Unlimited: files are stored, until target drive is full. Cyclic: after reaching maximum number of files the older files are replaced by the newer ones.

- Max. number of files: Maximum number of filesets (image+ data) which are allowed to be stored in the target directory.

10.1.4.2.3 Archiving via SMB, output data

After starting of the sensor the images and data (as .csv- file), which has been defined under: Vision Sensor Configuration Studio/Output/Telegram are stored in the corresponding subfolder of the shared folder.
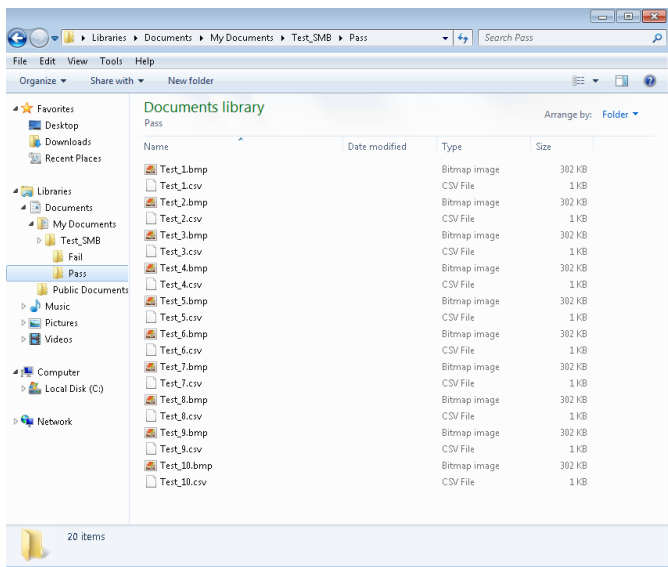
Fig. 283: Successful processed data and image archiving via SMB.

10.1.5 Ram disk (on the sensor)

If Ram disk is active, always the according last image and the numeric result data, which have been specified in: "Output/Telegram" (in format .csv) are stored on the sensor in the ram disk folder /tmp/results/.

This function is activated in "Job/Image transmission". To access these data an ftp client connection must be established to the sensor.

If:

- Vision Sensor Configuration Studio/Job/Image transmission/Ram Disk is activated in the SBS always the last image (any, pass, failed parts) are stored. File: image.bmp in folder /tmp/results/
- Vision Sensor Configuration Studio/Output/Telegram data has been specified this are also stored in format .csv, on the SBS in folder "/tmp/results".
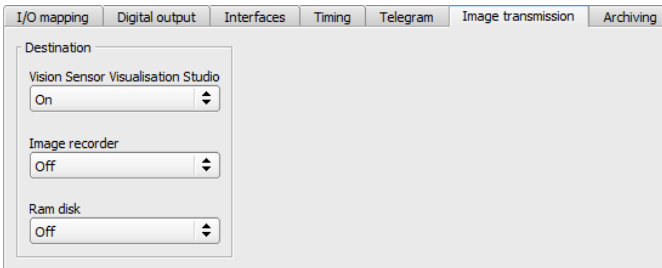
Fig. 284: Ram Disk

To access this data an ftp client connection like follows e.g. with Windows Explorer is established via: ftp://IPAdr_SBS/tmp/results.
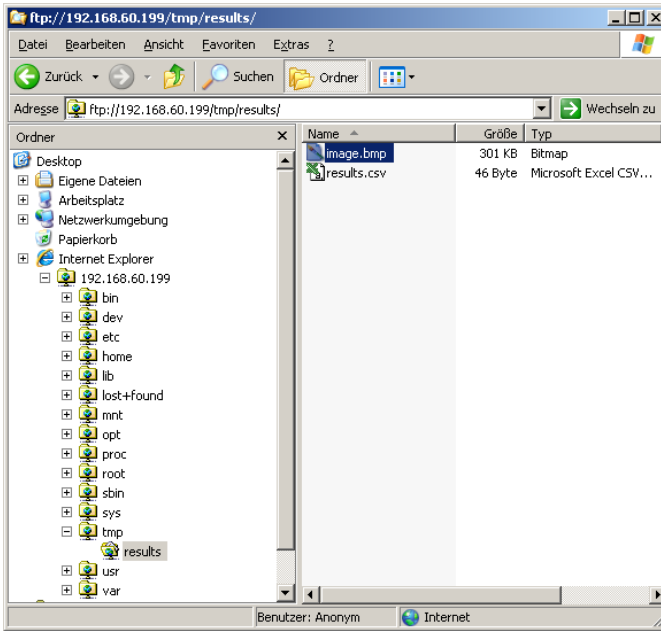
Fig. 285: Ram Disk Sensor via Explorer

A further possibility to access the data on the sensor e.g. is: Use Windows command "cmd" in Start/Run to open a DOS- window. Process the following commands. The password in factory setting is "user".

- First change to the folder on the PC where the data should be stored.
- With ftp "IP_Adr_SBS" a connection to SBS is established.
- User name: user
- Password: user
- Go to folder: /tmp/results on the SBS.
- There are the both files: image.bmp and results.csv (if in Output/Telegram a data string was defined), as image and result data of the latest evaluation.
- With command "get image.bmp", or "get results.csv" the files are copied to the selected folder on the PC

Fig. 286: Ram Disk via DOS

Please note:

- The format of all .csv files (ftp, smb, ram-disk, Vision Sensor Visualisation Studio) is always the same.
- The data is readable (by default divided with semicolon comma) stored into the .csv file.
- Only (payload) data, which have been defined under Output/Telegram are transmitted.

10.2 Backup

10.2.1 Backup creation

Save the settings of the sensor that were made to check one or more parts with the command "Save job as ..." or "Save job set as ..." under Vision Sensor Configuration Studio / File. The stored job settings can be reloaded with the command "Load Job ..." or "Load job set ...".

10.2.2 Austausch SBS

Before exchanging a sensor store all necessarily settings (as described in chapter Backup creation). By exchanging one SBS vision sensor against another please consider that the sensors are not calibrated optically or mechanically. That means the new SBS must be: installed mechanically / electrically like described in chapter Installation (Page 25) Installation and also

must be optically focused and set up correctly to work in the network. Danach können ggf. gespeicherte Jobs oder Jobsätze wieder geladen werden.After this the in advance stored parameter settings can be restored from the PC to the sensor.

10.3 Job switch

10.3.1 Job switch via digital inputs

To switch between several jobs, which are already stored on the sensor, via digital inputs the following options are available:

Also see chapter: Tab I/O mapping (Page 222), timing diagrams and comments

10.3.1.1 Job 1 or Job 2

To switch between Job1 and Job2 any input can be defined in Vision Sensor Configuration Studio/Output/I/O mapping with the function "Job 1 or 2". After the according logical level is connected to this input Job 1 or Job 2 is processed Low = Job1, High = Job 2). Also see chapter: Tab I/O mapping (Page 222) / Function of inputs.

10.3.1.2 Job 1... 31 via binary bit pattern

To switch between up to 31 jobs by binary input pattern via the up to 5 digital inputs, all needed inputs in Vision Sensor Configuration Studio/Output/I/O mapping are set to the according function "Job switch (Bit x)". The in the following graphics shown binary input pattern then switch directly to the according job number. Also see chapter: Tab I/O mapping (Page 222) / Function of inputs.

Please note:

- Job switch starts / happens immediately after the input pattern has changed.
- The display of the active job changes with the first following trigger.
- The mapping of the I/O´s is not fixed. It's depending on the settings in Vision Sensor Configuration Studio/Output/I/O mapping.
- The change of the logical level of all related inputs must happen at the same time (within a maximum of 10 ms, all levels must be stable).
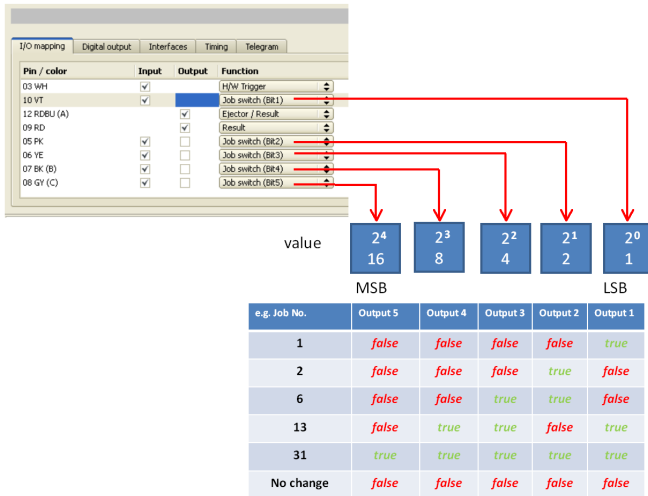
Fig. 287: Job- switch binary

10.3.1.3 Job 1 ... n via pulses

To switch between job´s with function "Job 1 ... n" any input can be set up with this function in Vision Sensor Configuration Studio/Output/I/O mapping. Only possible if Ready = High. After the last impulse (+50 ms) Ready is set to low. Impulses are counted until the first delay of >= 50 ms and then switches to the appropriate job. Ready remains low until switch-over to the new job occurs. Pulse length for job change should be 5 ms pulse and 5 ms delay. If the option "Job change confirm" is used, this signal occurs after the job change, and hereafter Ready is set high again. During Job Change over binary inputs there must not be sent any trigger signal. See chapter: Tab I/O mapping (Page 222) / Function of inputs.

If possible job change should be made by binary coded signals, this is the faster way. See chapter:. Job 1... 31 via binary bit pattern (Page 323)

10.3.2 Job- Umschaltung Ethernet

See chapter: Ethernet example 2.1 command job switch from PC/PLC to SBS

10.3.3 Job switch via Serial

See chapter: RS422 example 1.1: command Job switch from PC / PLC to SBS

10.3.4 Job- Umschaltung mit Vision Sensor Visualisation Studio

In the application Vision Sensor Visualisation Studio a job switch can be made, or completely new job set's can be uploaded. Also see chapter: Tab Job select (Page 285)

In tab "Vision Sensor Visualisation Studio/Job" on in the sensor stored jobs are displayed. If there is more than one job in the sensor memory, one of them can be marked in the job list, and activated with button "Set active".
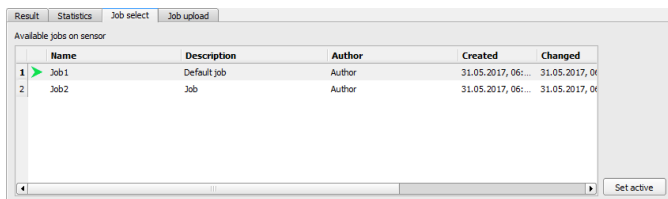
Fig. 288: Vision Sensor Visualisation Studio, Job switch

In tab "Vision Sensor Visualisation Studio/Job upload" all on PC available job set are displayed. This can be marked in the job list and uploaded to the sensor via the button "Upload".

> ⚠️ **Attention:**
> By uploading a new job set all jobs in the sensor memory are deleted.
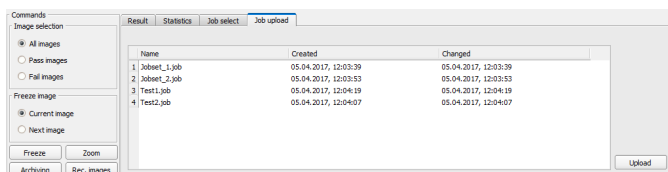
Fig. 289: Vision Sensor Visualisation Studio, Job upload

10.4 Operation with PLC

10.4.1 Profibus plug adapter (RS422)

Via the Profibus plug adapter the communication between sensor and PLC can be established. This is realized with the RS422 / Profibus converter described in document: "Anybus Profibus operating instruction" in: Startmenue/Festo/SBS vision sensor/Tools/Anybus Profibus/...

10.4.2 Example Siemens S7

The connection to a Siemens S7 PLC and it´s parameter settings is described in document: "Siemens S7 operating instruction" in: Startmenue/Festo/SBS vision sensor/Tools/SPS/PLC/...

10.4.3 Example Beckhoff CX 1020

The connection to a Beckhoff CX 1020 and it´s parameter settings is described in document: "Beckhoff operating instruction" in: Startmenue/Festo/SBS vision sensor/Tools/SPS/PLC/...

10.5 Network connection

10.5.1 Installation of SBS into a network / gateway

In Vision Sensor Device Manager/Active sensors, all SBS vision sensors, which are installed in the same network segment as the PC which runs Vision Sensor Device Manager are displayed as list. To update this list press the button "Find", to see sensors which e.g. have been powered after Vision Sensor Device Manager was started.

For sensors, which are installed in the network, but are located in a different network segment via a gateway, please enter their IP address in the field "Add active sensor" and press button "Add".

The according sensor now appears in the list "Active sensors" and can be accessed now.

10.5.2 Proceeding / Troubleshooting - Direct Connection

Creating a functioning Ethernet connection between SBS vision sensor and PC.

Important:
To configure the PC via **direct connection**, the PC's IP configuration must be changed. Inform the system administrator of this change in advance!

Sensor correctly connected
- Power supply 24V?
- Ethernet cable

→ no → **Connect Sensor correctly!**
- Power supply 24V
- Ethernet cable

yes ↓

Electrical connection OK?
- green Pwr LED on SBSI is active
- Status LED on network adapter active
- and/or LAN status shows "Connection established". (system control ⇨ network connection ⇨ LAN-Connection ⇨ status)

→ no →

PC's IP address matches sensor?
Sensor IP: 192.168.100.100/24 (default)
- PC: e. g. 192.168.100.101/24
(/24 means 24Bit subnet mask = 255.255.255.0)

→ no → **Check/correct settings**
PC's IP (fixed IP corresponding with sensor):
e.g. 192.168.100.100; - subnetmask: 255.255.255.0
Configuration: Start ⇨ system control ⇨ network connections ⇨
LAN connection ⇨ properties ⇨ internet protocol (TCP/IP)

Vision Sensor Device Manager finds Sensor?
- Start Vision Sensor Device manager
- Press button "Find"
- Mark Sensor
- Is "Connect" button active?

→ no → **"Repair" Network connection**
Check with system administrator, if necessary.
Start system control network connections right mouse click on LAN connection used repair (delets e.g. ARP Cache).

Check IP-Connection
- in command prompt: ping 192.168.100.100 (sensor's IP address) [ENTER] .
When four positive answers have been emitted, continue with "Yes" (Command prompt:
Start ⇨ all programs ⇨ accessories ⇨ command prompt)

→ no → **Deacticate / adjust firewall**
Check with system administrator
IP-Connection Test (see above)

Attention!
Reactivate firewall once parameter settings have been completed.

Vision Sensor Device Manager starts user-software?
- Double click on sensor in the list
- PC application software starts

→ no → **Check sensor- and software version**
-Sensor version is displayed in the Vision Sensor Device Manager (e.g. 1.0.0.0).

Now the parameter setting of the sensor / can be done

Fig. 290: Direct connection sensor / PC, proceeding / troubleshooting

10.5.3 Proceeding / Troubleshooting - Network Connection

Establishing an operational Ethernet connection between SBS vision sensor and PC

Important:
To configure the Vision Sensor for the network, it must be integrated into the network. Before connection, check
whether the sensor's address has already been assigned (default: 192.168.100.100/24). Network failure can otherwise occur.

Configuration of the sensor requires the Vision Sensor software and communication between sensor and PC.
The sensor requires a free IP address*1) to establish this connection.

yes

Ask system administrator whether the IP
address 192.168.100.100/24 is free? — no → Reconfigure alternative IP address via direct connection
(see 3.3.1.1. Direct connection)

yes

yes

Sensor correctly connected?
- Power supply 24V
- Network cable — no → Connect Sensor correctly!
- Power supply 24V DC
- Network cable

yes

Electrical connection OK?
- green PWR LED at Vision Sensor active?
- Status LED at network adapter active?
- and/or LAN Status shows "Connection
established" (system control ⇨network
connections ⇨LAN connection ⇨Status). — no →

— no →

yes

yes

**Vision Sensor Device manager
finds Sensor?**
Insert sensor in network and switch on
⇨ start Vision Sensor Device manager
⇨ select sensor — no → "Repair" network connection
Check with system administrator,
if necessary
Start ⇨ system control ⇨ network connections
⇨ right mouse click on LAN connection
used ⇨ Repair (deletes e.g. ARP Cache).
Check IP connection
- in command prompt: ping xxx.xxx.xxx.xxx
(sensor's IP address*1) [ENTER] .
When four positive answers have been emitted, continue with
"yes" (Command prompt:
Start ⇨ All Programs ⇨ Accessories ⇨ Command prompt)

yes

Configure sensor's IP address
Set IP ⇨IP address *1) and enter subnet mask
⇨set IP ⇨restart sensor
(disconnect power supply for at least 6 s.)

yes

no — yes →

**Vision Sensor Devive Manager
finds Sensor with new IP**
- Press button "Find"
- Mark Sensor
- Is "Connect" Button active? — no → Deacticate / adapt firewall
Check with system administrator
Check IP-Connection
When four positive answers are emitted, continue with "yes".
Attention!
Reactivate firewall once parameters settings have been
completed.

yes

Vision Sensor Devive Manager
starts application- software?
- Double click on sensor in list
- PC software starts ← yes —

— no → Check sensor- and software version
Sensor version is displayed in Vision Sensor
Device Mananger (e.g. 1.0.0.0).

yes

Parameter settings can now be carried out on
the sensor

*1) a suitable new, free IP address is assigned by the system administrator

Fig. 291: Connection via network sensor / PC, proceeding / troubleshooting

10.5.4 Used Ethernet - Ports

If the SBS should be installed into a network, the following ports must be enabled, if so by the network administrator. This is necessary only in case that this specific ports have been locked e.g. in a company network by a firewall installed on a PC.

To communicate between a PC fur configuration and the SBS the following ports are used:

- Port 80, TCP (SBSxWebViewer)
- Port 2000, TCP
- Port 2001, UDP Broadcast (to find sensors via Vision Sensor Device Manager)
- Port 2002, TCP
- Port 2003, TCP
- Port 2004, TCP

To communicate between PLC (PLC- PC also) and the SBS the following ports are used.

- Port 2005, TCP (Implicit results, that means, user configured result data)
- Port 2006, TCP (Explicit requests, e.g. trigger or job switch)

If the ports 2005 or 2006 are changed in , the according ports also must be enabled in the firewall by the administrator.

If the interface EtherNet/IP is used the following two ports must be enabled too.

- Port 2222, UDP (EtherNet/IP)
- Port 44818, TCP (EtherNet/IP)

10.5.5 Access to SBS via network

Exemplary values for IP etc.

Access to SBS 1 from PC 1, if in same subnet.

- Via Vision Sensor Device Manager (/find)

Access to SBS 2 from PC 1, if in different subnet.

Only if:

- Gateway is set correct in sensor 2 (here to 192.168.30.1) - and
- in Vision Sensor Device Manager via Add- IP- the sensor IP of sensor 2 is set correct
  Now the SBS 2 appears in the list "Active Sensors" in Vision Sensor Device Manager!
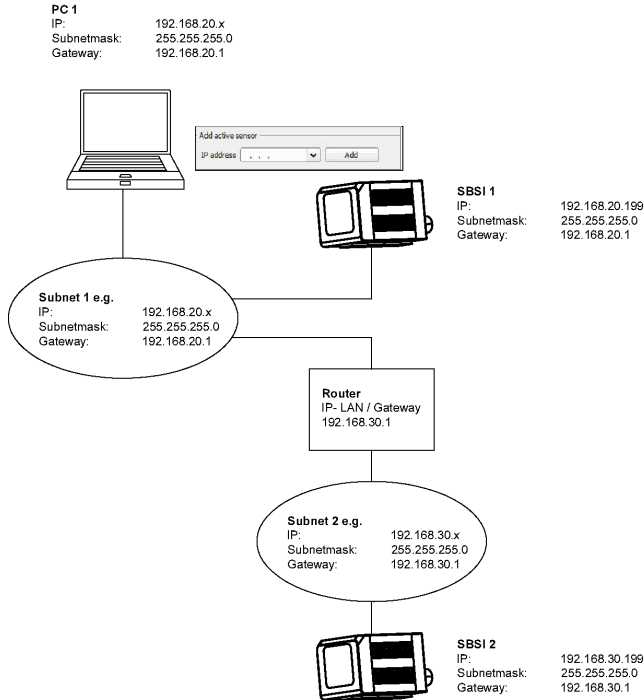
Fig. 292: Access to SBS via network, same or different subnet

10.5.6 Access to SBS via Internet / World Wide Web

Exemplary values for IP etc.

Access from PC 1 (company network 1), via Word Wide Web, into company network 2 to SBS 1.

1. Add the IP- WAN of router 2 (company network 2) in PC1 (company network 1) in Vision Sensor Device Manager under "Add active sensor" (here in example: 62.75.148.101).

2. In router 2 the ports which should be used by the sensor must be defined (See chapter:Used Ethernet - Ports).
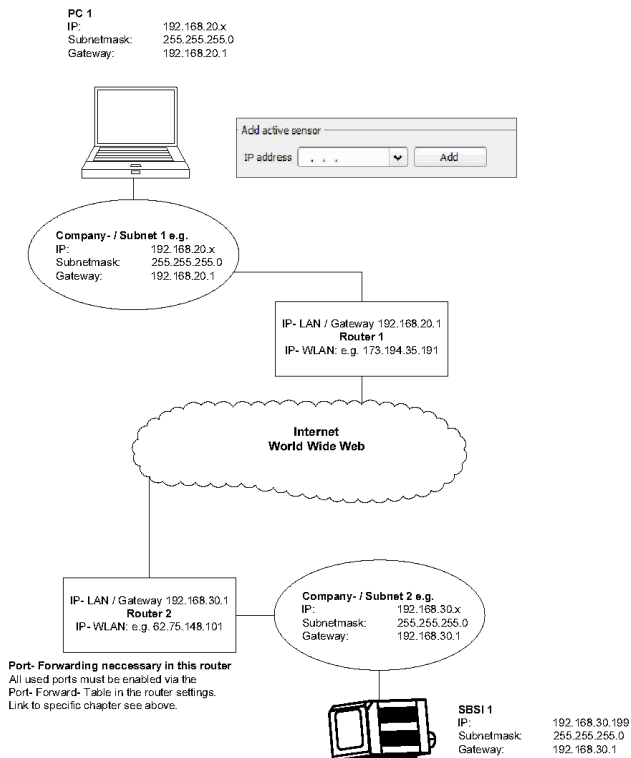
Fig. 293: Access to SBS via Internet / World Wide Web

10.6 SBS vision sensor PROFINET, Introduction

This chapter explains the use of SBS vision sensor with PROFINET. The PROFINET interface is implemented starting with version 1.12.x.x.

10.6.1 Electrical connection of the SBS in the PROFINET network

The SBS vision sensor is connecPROFINETted via an Ethernet TCP/IP and a Ethernet switch to the network.PROFINET

SBS Vision-Sensor PROFINET connections

PROFINET switch
Gateway: 192.168.100.1

Main control, company network, internet...

IP 192.168.100.105
HMI Panel

IP 192.168.100.102
S7-1200

IP 192.168.100.101
Laptop
(Optional
only for setup)

IP 192.168.100.100
Vision-Sensor

IP 192.168.100.99
Vision-Sensor

IP 192.168.100.98
Vision-Sensor
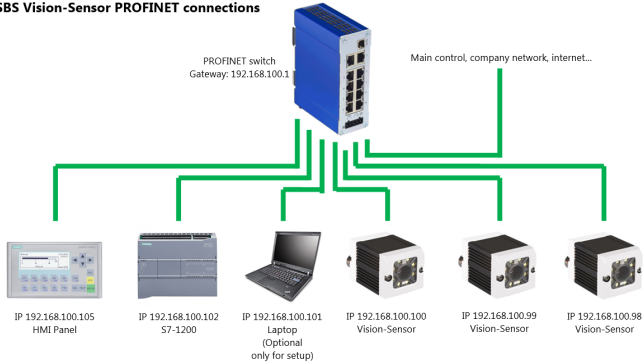
Fig. 294: Connection of SBS vision sensor via PROFINET switch

10.6.2 Configuration of SBS via Vision Sensor Configuration Studio for the use with PROFINET

In this example the configuration of SBS R2B Code Reader Advanced is described. For all other SBS types the configuration works analogue.

10.6.2.1 Settings in Vision Sensor Device Manager
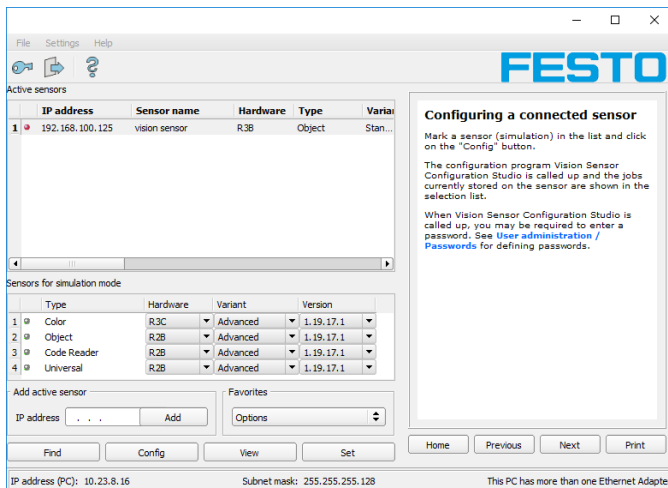
Fig. 295: SBS is displayed and selected in Vision Sensor Device Manager

At the start of Vision Sensor Device Manager or by click to the button "Find" the sensor is listed in window "Active sensors". By click to the button "Set" the following dialog starts.

10.6.2.2 Setting of IP and name
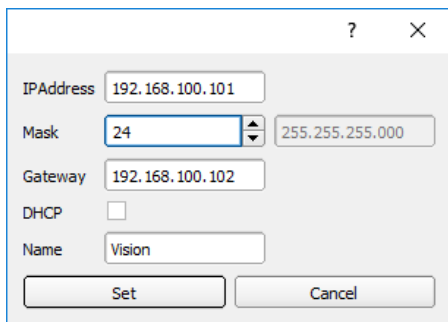
Fig. 296: Setting of IP and name

Here the IP address of the SBS and it's name is set.

If here a name is set which shall be used permanently, the identical name must be used in the PLC as well.

Please note:
Caution: these settings are active not before a reboot of the sensor.

Close the dialog with "Set"

Important conditions:

Independent from which possibility is used to do the settings, for a properly working PROFINET communication it's necessary:

- The SBS name must be identical in PLC and sensor
- The IP address of SBS and PLC must correspond (same address range)

IP address and name of the SBS can be set in different ways:

- Either via SBS software (Vision Sensor Device Manager), or
- Via PLC interface, here Siemens TIA.

The name must be DNS compatible. That means:

- Hostnames may only consist of the characters 'a'-'z', '0'-'9', '-' and '.' (lower case only)
- The Character '.' may just occure as divider between labels in domain names.
- The character '-' may not occure as first or last character

Setting a name via Vision Sensor Device Manager please take care to meet the above mentioned DNS conventions, as they are not checked. Via the input in the TIA PLC interface the names are converted automatically. See chapter: Set the name with TIA interface (Page 342)
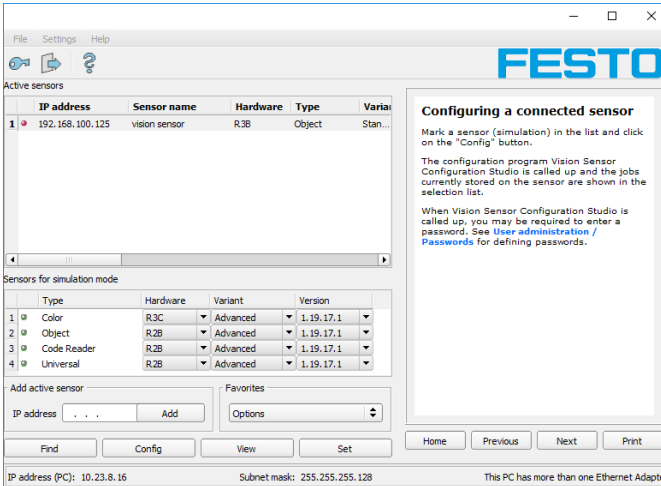
Fig. 297: IP and name has been updated

10.6.2.3 Open Vision Sensor Configuration Studio

When the desired SBS vision sensor in Vision Sensor Device Manager is selected, click on "Config". Confirm the following dialog box with "OK" to stop Vision Sensor Device Manager and start the configuration in Vision Sensor Configuration Studio.
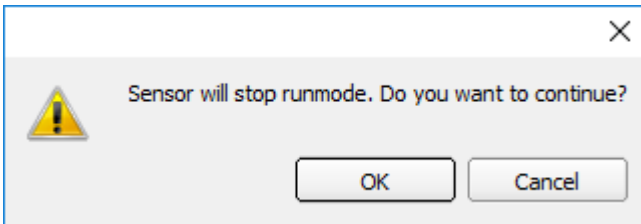
Fig. 298: Open Vision Sensor Configuration Studio

10.6.2.4 Select Interface "PROFINET"

In Output/Interface/PROFINET via the checkbox the PROFINET interface is selected. By this command the PROFINET stack gets started.
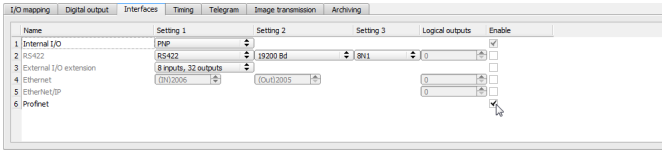
Fig. 299: Activation of PROFINET in Vision Sensor Configuration Studio

10.6.2.5 Definition of the telegram

In the tab "Telegram" the data which should be transferred can be defined completely free. For the use with PROFINET this must be done with format "Binary".

10.6.2.5.1 Definition of the output data

The output data itself are configured identically as the data output via Ethernet TCP/IP or RS422 in: Vision Sensor Configuration Studio/Output/Telegram.

See chapter: Tab Telegram, Data output (Page 243)
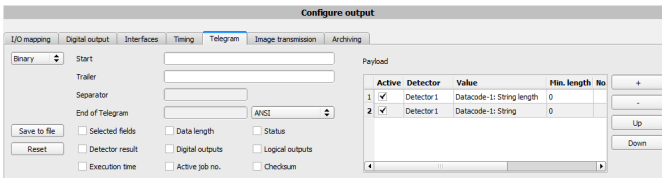
Fig. 300: Data output, protocol: Binary

10.6.2.6 Start sensor, data output

With "Start sensor" the configuration data are transferred to the SBS. The sensor get's started and now the output data are transferred as defined.
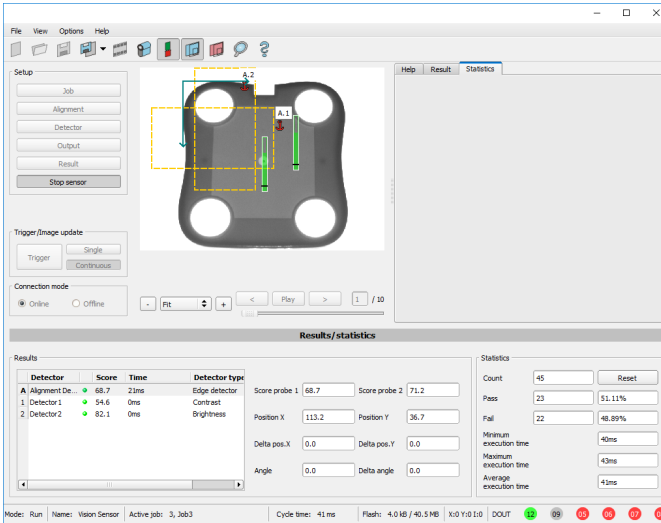
Fig. 301: Start sensor

10.6.3 PROFINET configuration of PLC, example Siemens S7-1200 TIA

Diese Beschreibung zeigt alle SPS Screenshots in englischer Sprache, ggf. TIA Software auf Englisch umstellen.

10.6.3.1 Create a new project

New project with: Project / Create new project
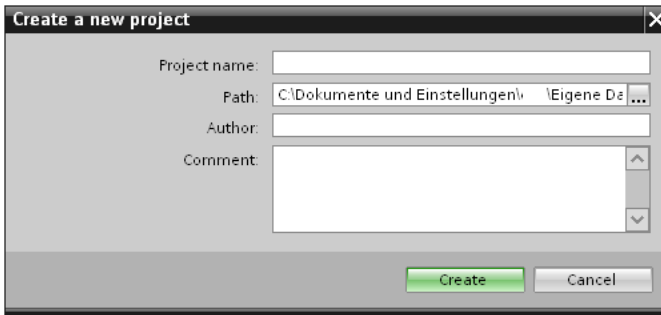
Fig. 302: Create a new project

10.6.3.2 Select GSD file

First a PROFINET PLC must be added to the project.

To use the PROFINET functions of the SBS vision sensor, the GSD file for the SBS must be installed in it's latest version. This is done at: Options/Install general station description file. The GSD file is available in the installation path of SBS: ...\Festo\SBS vision sensor\Tools\PROFINET, and as download at www.festo.com.
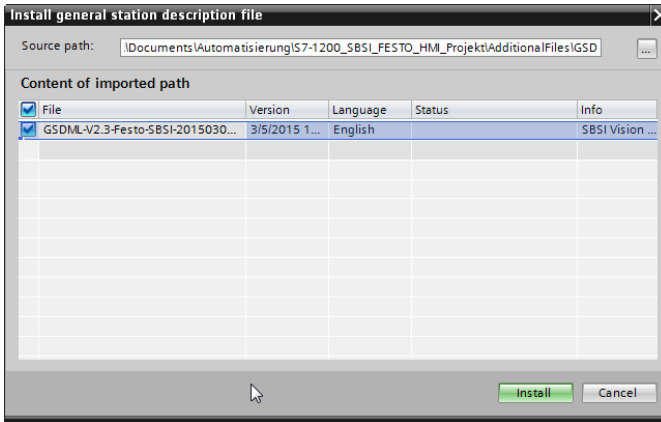
Fig. 303: Select and install GSD file

10.6.3.3 Adding SBS to Project

The SBS modules are added in the hardware catalog: Other field devices/PROFINET IO/Sensors/Festo AG & Co. KG.
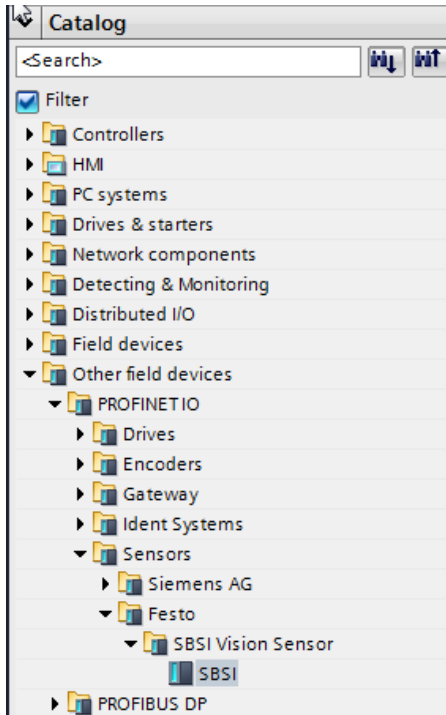
Fig. 304: Adding SBS to Project

10.6.3.4 Connect SBS to PLC

With drag and drop a SBS module can be put into the Network view. Now connect the SBS via PROFINET to the PLC (Tab. Network view).
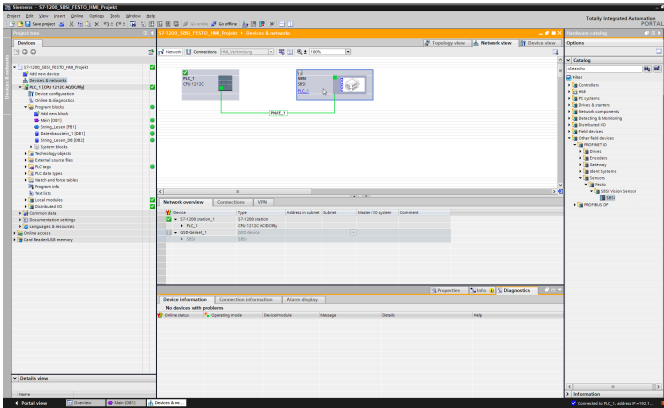
Fig. 305: Connect SBS to PLC

10.6.3.5 Definition of I/O data

In the tab "Device view" as default the modules CTRL (Control) and STAT (Status) are active. As an option the module DATA (Data module) can be added with a certain size of payload.

In the example: 2 Byte + 16 Byte payload (1 Byte: Image ID; 1 Byte: Result data overrun (see Module 3: "Data" (From SBS to PLC) (Page 355)), + 16 Byte payload data). If the data is longer than the defined range the payload is truncated (in this case: Result data overrun = 1), if it's shorter the rest of the 16 byte are filled with 00h.
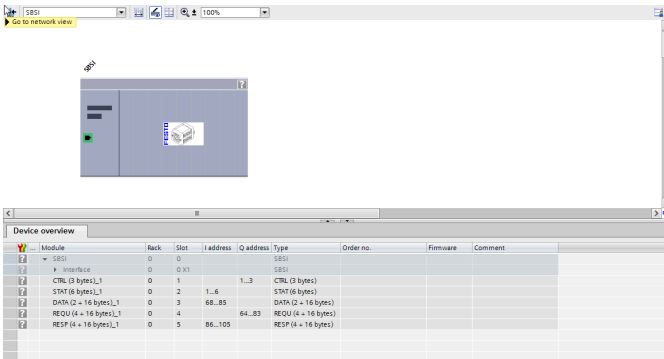
Fig. 306: Define I/O data

10.6.3.6 Set IP address of SBS in the project (Option 1)

The IP address of the SBS can be set via the project. Select option "Set IP address in the project" and set IP address. Address from the field "IP address" is written into the SBS. The IP address of the PLC and of the SBS must not be the same, but must correspond, what means they have to be in the same address range.
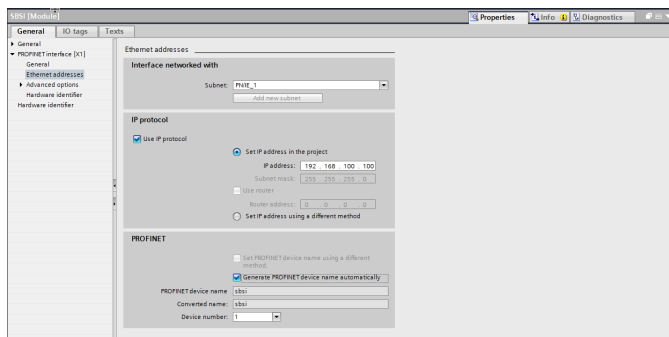
Fig. 307: Set IP address SBS in project

The SBS can be used without a started PROFINET also, and so can be configured via Vision Sensor Device Manager. If the IP address of the SBS does not correspond to the one in the TIA project, the PLC is setting a IP address. In this case the IP address of the SBS is overwritten with 0.0.0.0. That means that the IP address is set correctly, but the IP configuration is deleted (this is important for a restart without a connected PLC).

10.6.3.7 Set IP Address with Vision Sensor Device Manager (Option 2)

The IP address of the SBS can be set also via Vision Sensor Device Manager. Select option "Set IP Address using a different method" in the PLC / TIA Interface: Set IP address via Vision Sensor Device Manager (See chapter: Setting of IP and name (Page 333)).
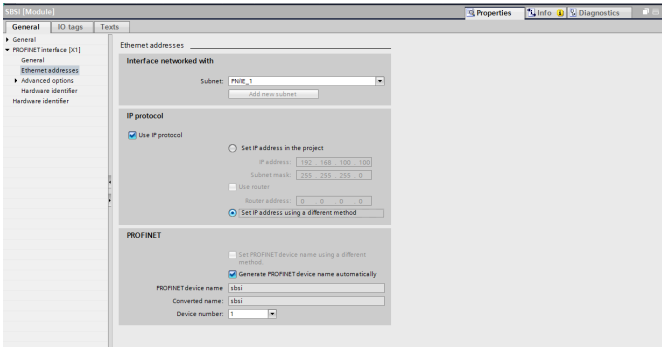
Fig. 308: Set IP address of SBS via Vision Sensor Device Manager, settings therefor in the PLC / TIA interface

10.6.3.8 Set the name with TIA interface

To set the name of SBS from TIA interface there are two options.

10.6.3.8.1 Generate name automatically

The PROFINET name of the SBS can be generated automatically from the PLC. Option: "Generate PROFINET device name automatically" takes the name from the project. This name originally comes from the GSD- file.

10.6.3.8.2 Set name manually

If the option "Set PROFINET device name using a different method" is selected any name can be set.

Information: In the field "Converted name" a different name may be shown than the one edited. As with PROFINET not all characters can be used a conversion may be necessary and is done automatically (names must be DNS compatible, see also chapter:). also chapter: Setting of IP and name (Page 333)).

If a name for the SBS vision sensor is set via this option, in each case it must be written to the sensor with the "Assign PROFINET device name" Tool (as described in chapter Write name into SBS (Page 343)).

The PROFINET name in the project and in the SBS must be the same.
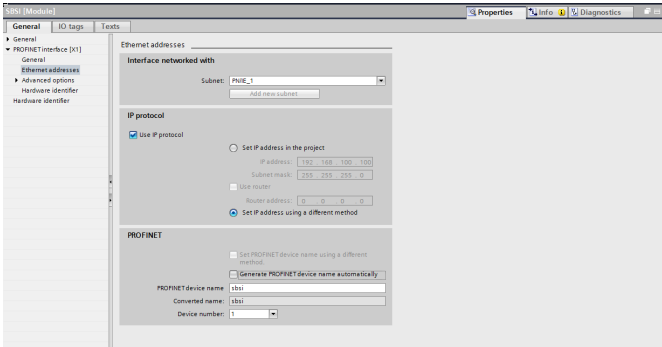
Fig. 309: Set name in project

10.6.3.9 Write name into SBS

In case that the PROFINET name in the SBS has to be updated, it's necessary to write the name into the sensor to establish a communication.

This is done with the tool: Online/Assign PROFINET device name. Select the device in the list (SBS) and with "Assign name" the name is written into the sensor.
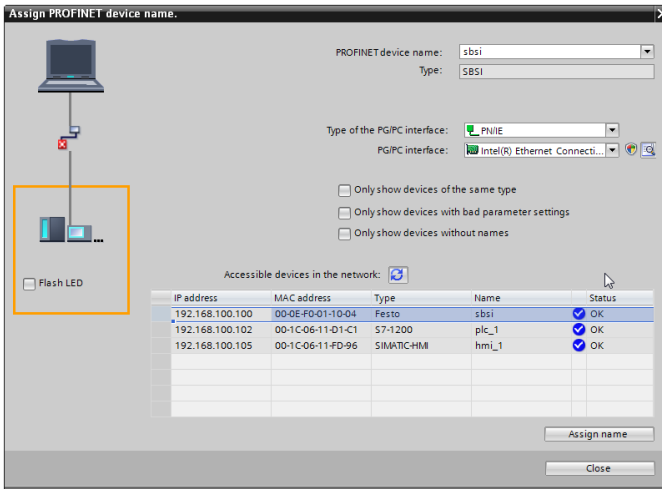
Fig. 310: Write name into SBS

10.6.3.10 Translate project and write to PLC

To finish the configuration and save changes of the project: 1. translate and 2. transfer / write to the PLC

Fig. 311: Translate project and write to PLC

10.6.3.11 Mapping of output data

The mapping of the output data of the vision sensor to the PROFINET protocol can happen like follows:

Step 1) List of variables in "Device overview".

Fig. 312: Device Overview

Step 2) The start address of the input variable is shown in „Device Overview".

Fig. 313: List of variables

Step 3) Set up of output data of sensor in Vision Sensor Device Manager, and protocol format saved as .csv- file.
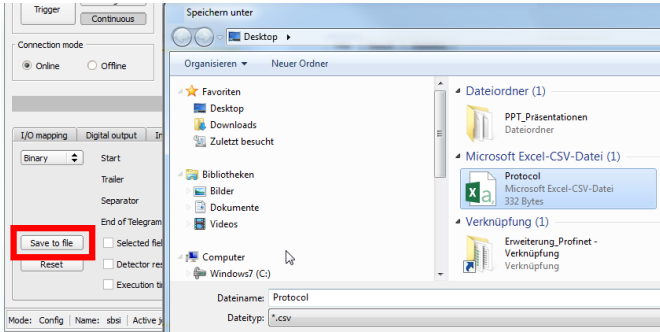
Fig. 314: Output format saved as .csv- file, with "Save to file".

Step 4) Open .csv- file in MS- Excel: Byte format.
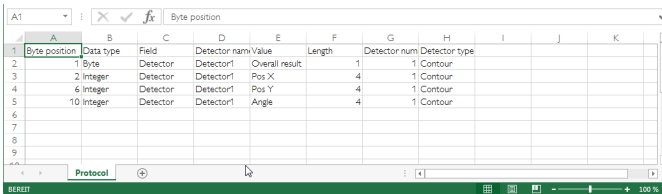
Fig. 315: Output format in MS-Excel.

Description of the format of the PROFINET Data- module s. Module 3: "Data" (From SBS to PLC) (Page 355)

Step 5) Mapping between the input data of the PLC ...:

Fig. 316: Input data PLC

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... and the configured protocol:

Fig. 317: in vision sensor configured protocol

Step 6) Trigger of vision sensor: result data is displayed.

Fig. 318: Result data in Vision Sensor Configuration Studio

Step 7) The following data are received in PLC / TIA:

Fig. 319: Data in SPS / TIA

Conversion of Binary values

All detector-specific data with decimal places are transmitted as whole numbers, multiplied by 1000, and Values are transferred in format "Big-endian".

Use the following formula for the conversion: (Example:"Score" values (Binary protocol)

In Vision Sensor Configuration Studio / Vision Sensor Visualisation Studio "Score" = 35 is displayed.

Over Ethernet there will be received the following four bytes: 000,000,139,115.

Formula for recalculating: (HiWordByte*256 + HiLowByte) *65536 + HiByte*256 + LoByte = Value

Because Big-endian (from Sensor) is sent calculation goes as following:

000 = HiWordByte, 000 = HiLowByte, 139 = HiByte, 115 = LoByte

(0*256 + 0) * 65536 + (139 * 256) + 115 = 35699 / 1000 = 35,699 (real score value)

Angles or other negative values are transferred in two's complement.

As in the list of variables, for e.g. the first position X, the following HEX- values are received:

4	"Data2"	%IB71	Hex	16#00
5	"Data3"	%IB72	Hex	16#03
6	"Data4"	%IB73	Hex	16#98
7	"Data5"	%IB74	Hex	16#C6

Fig. 320: Data output position X

the following is valid:

HiWordByte = 00 = %IB71

HiLowByte = 03 = %IB72

HiByte = 98 = %IB73

LoByte = C6 = %IB74

that means: in HEX simpy the following value would be shown (without above calculation)

000398C6 = 235718 / 1000 = 235,718 (s. screenshot below "Result / statistics")

Fig. 321: Result data of vision sensor

The same for e.g. "angle" in HEX:

12	"Data10"	%IB79	Hex	16#FF
13	"Data11"	%IB80	Hex	16#FF
14	"Data12"	%IB81	Hex	16#FF
15	"Data13"	%IB82	Hex	16#78

Fig. 322: Data output angle

FFFFFF78 = 1111 1111 1111 1111 1111 1111 0111 1000

As with "angle" two's complement is used, it must be inverted, +1, that means:

+ 0000 0000 0000 0000 0000 0000 1000 0111

+ 0000 0000 0000 0000 0000 0000 0000 0001

= 0000 0000 0000 0000 0000 0000 1000 1000 = 136 / 1000 = 0,1°

Important: "MINUS", that means: = - 0,1°

10.6.4 PROFINET - telegram description SBS

10.6.4.1 Module1: "Control" (From PLC to SBS)

Name in PLC "CTRL (3 bytes)"

Byte	Size (bytes)	Name	Data type	Bit No.	Significance
0	3	Reset error	1 Bit	0	Reset Error clears 4bit Errorcode in Module: "Status". Rising edge (low ==› high) clears error code.
		HW Trigger Disable	1 Bit	1	This bit is set to disable triggering via the hardware trigger. Valid for triggered and free-run mode. Low (0): Hardware trigger or free run enabled. High (1): Hardware trigger or free run disabled If the HW-Pin "Trigger enable" is used, both (Digital input "Hardware- Trigger" and "HW Trigger Disable Bit") have to be set on "Enable" to accept triggers.
		Trigger	1 Bit	2	Rising edge (low ==› high) Trigger is executed immediately. If Trigger was not executed, Trigger Ack-Bit stays low and Bitfield "Error" has error code "1: Failure trigger request". S. also Timing diagram, chapter: Case: Trigger not possible (not ready) (Page 359)

Byte	Size (bytes)	Name	Data type	Bit No.	Significance
					.
		Change job	1 Bit	3	Rising edge (low ==› high) indicates, to switch to the job with the number in byte "Jobnumber" in Control Module. This request can be executed delayed. After successful Jobchange, the byte "Jobnumber" in Status Module equals to that in Control Module. If Jobchange could not be executed due to error (e.g. wrong Jobnumber), Bitfield "Error" has error code "2: Failure change job" (and Ready stays low!). S. also Timing diagram, chapter: Case: Jobchange not possible (e.g. wrong job number) (Page 361).
		Switch to run	1 Bit	4	Rising edge (low ==› high) "Switch to Run" is executed. Success or failure of Switch to Run request is signalized with bitfield "Error" (error code "3: Failure Switch to run request") and Bit "Operation Mode". S. also Timing diagram, chapter: Case: Switch to run not possible (Page 362).
		Reserve	1 Bit	5	
		Reserve	1 Bit	6	
		Reserve	1 Bit	7	
1		Reserve	1 Byte		
2		Job number	U8		Number of job to be changed to, on rising edge of Change-job bit. Binary value 1-255 for "Jobnumber Change". 0 indicates no change, even if Change job bit toggles

Example 1.1: Module 1 "Control": Trigger bit set

Must change from 0 to 1, and remain till Trigger ack. is received

Byte 0	Byte 1	Byte 2
Bit 2:Trigger bit = 1 (rest not relevant in this case)	Reserve	Job number

Byte 0								Byte 1								Byte 2							
0.-7	0.-6	0.-5	0.-4	0.-3	0.-2	0.-1	0.-0	1.-7	1.-6	1.-5	1.-4	1.-3	1.-2	1.-1	1.-0	2.-7	2.-6	2.-5	2.-4	2.-3	2.-2	2.-1	2.-0
x	x	x	x	x	1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

Example 1.2: Module 1 "Control": Change Job

Must change from 0 to 1, and remain till Change job ack. is received

Byte 0								Byte 1								Byte 2							
Bit 3: Change job = 1 (rest not relevant in this case)								Reserve								Job number: Binary value e.g. = 10101010 (=170dez)							
0.-7	0.-6	0.-5	0.-4	0.-3	0.-2	0.-1	0.-0	1.-7	1.-6	1.-5	1.-4	1.-3	1.-2	1.-1	1.-0	2.-7	2.-6	2.-5	2.-4	2.-3	2.-2	2.-1	2.-0
x	x	x	x	1	x	x	x	x	x	x	x	x	x	x	x	1	0	1	0	1	0	1	0

10.6.4.2 Module 2: "Status" (From SBS to PLC)

Name in PLC "STAT (6 bytes)"

Byte	Size (bytes)	Name	Data type	Bit No.	Significance
0	6	Ready	1 Bit	0	SBS is ready to receive trigger. Ready = 1. **Attention:** The Ready Bit is reserved to indicate that the SBS vision sensor is ready for the next evaluation cycle. It is not suitable to indicate that a evaluation cycle is finished or the results are valid! (Rising edge of Ready is not equivalent with result valid! The Ready Bit is a replication of the digital Ready- signal and it follows this as fast as possible, but due to the cycle nature of the PROFINET protocol this is not possible hundred per cent.)

Byte	Size (bytes)	Name	Data type	Bit No.	Significance
		Reserve	1 Bit	1	
		Trigger acknowledge	1 Bit	2	Acknowledge for successful trigger request (via Trigger Bit in Control Module). Acknowledge is cleared as a response of clearing the Trigger bit. If trigger was not executed, Trigger Ack-Bit stays low.
		Change job acknowledge	1 Bit	3	Acknowledge for completion of Change job request (via Change Job Bit in Control Module) - independent of success. Acknowledge is cleared as soon as Change job Request bit is cleared. Success or failure of Change job request is signalized with bitfield "Error" (error code "2: Failure change job") and byte "Jobnumber" in Status Module. This Ack-Bit can be delayed due to delayed execution of Job Change.
		Switch to run acknowledge	1 Bit	4	Acknowledge for completion of Switch-to-run request (via Switch to run request Bit in Control Module). Acknowledge is cleared as soon as request bit is cleared. Success or failure of Switch to run request is signalized with bitfield "Error" (error code "3: Failure Switch to run request") and Bit "Operation Mode". Acknowledge is given after Vision Sensor Configuration Studio has been disconnected and job has been reloaded from flash, or a failure is detected.
		Reserve	1 Bit	5	
		Reserve	1 Bit	6	
		Reserve	1 Bit	7	

Byte	Size (bytes)	Name	Data type	Bit No.	Significance
1		Reserve	1 Byte		
2		Digital results (same as in Ethernet Payload, without length)	1 Bit	0	12 RDBU
			1 Bit	1	09 RD
			1 Bit	2	05 PK
			1 Bit	3	06 YE
			1 Bit	4	07 BK
			1 Bit	5	08 GY
		Reserve	1 Bit	6	This byte is filled with results of hardware digital output pins. Bit positions are fix (see column "Significance", same as Ethernet Payload without length information). Value of digital output bit is defined in "Output" - tab "Digital output", column "Logical Expression" in Vision Sensor Configuration Studio. If not selected as result output pin or not having a valid logical expression, value of output bit is 0.
		Reserve	1 Bit	7	
3		Job number	U8		Number of current job: Jobnumber: 1-255
4		Image ID	U8		Image ID (0-255) is incremented with each job execution, independent from trigger source.

Byte	Size (bytes)	Name	Data type	Bit No.	Significance
5		Error	4 Bit		4 bit error code. Used to indicate failures on requests or SBS system error via Control Module. Error is cleared by "Reset error", or overwritten with next error. 0: No error 1: Failure trigger request (sensor not ready) 2: Failure change job 3: Failure switch to run 5: Failure PROFINET not active in job 15: System error
		Trigegr mode	1 Bit	4	1 = Free run 0 = Triggered
		Reserve	1 Bit	5	
		Operation mode	1 Bit	6	1 = Run 0 = Config
		Reserve	1 Bit	7	

Example 2.1: Module 2 "Status": Trigger acknowledge is set

- Trigger acknowledge is set to 1 (Trigger received)
- Ready is set to 0 (Busy)

Byte 0								Byte 1								Byte 2							
Bit 0: Ready = 0 Bit 2: Trigger ack. = 1								Reserve								Digital results							
0.-7	0.-6	0.-5	0.-4	0.-3	0.-2	0.-1	0.-0	1.-7	1.-6	1.-5	1.-4	1.-3	1.-2	1.-1	1.-0	2.-7	2.-6	2.-5	2.-4	2.-3	2.-2	2.-1	2.-0
0	x	1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

Byte 3								Byte 4								Byte 5							
Job number								Image ID								Error 4 bit Trigger mode etc.							
3.-	3.-	3.-	3.-	3.-	3.-	3.-	3.-	4.-	4.-	4.-	4.-	4.-	4.-	4.-	4.-	5.-	5.-	5.-	5.-	5.-	5.-	5.-	5.-

Byte 3								Byte 4								Byte 5							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

Example 2.2: Module 2 "Status": Change job acknowledge is set

- Change job ack. is set to 1 (Change job received)
- Ready is set to 0 (Busy)

Byte 0								Byte 1								Byte 2							
Bit 0: Ready = 0 Bit 2: Trigger ack. = 1								Reserve								Digital results							
0.-7	0.-6	0.-5	0.-4	0.-3	0.-2	0.-1	0.-0	1.-7	1.-6	1.-5	1.-4	1.-3	1.-2	1.-1	1.-0	2.-7	2.-6	2.-5	2.-4	2.-3	2.-2	2.-1	2.-0
0	x	x	1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

Byte 3								Byte 4								Byte 5							
Job number								Image ID								Error 4 bit Trigger mode etc.							
3.-7	3.-6	3.-5	3.-4	3.-3	3.-2	3.-1	3.-0	4.-7	4.-6	4.-5	4.-4	4.-3	4.-2	4.-1	4.-0	5.-7	5.-6	5.-5	5.-4	5.-3	5.-2	5.-1	5.-0
1	0	1	0	1	0	1	0	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

10.6.4.3 Module 3: "Data" (From SBS to PLC)

Name in PLC DATA (2 + 8 / 16 / ... bytes)

Byte-Position in Module	Size in Bytes	Member name	Data type	Bit number	Significance
0	1	Image ID	U8		Image ID (0 - 255) is incremented with each job execution, independent from trigger source.
1	1	Result data	1 Bit	0	Result data has been truncated. 1: Data overrun = truncated

Byte-Position in Module	Size in Bytes	Member name	Data type	Bit number	Significance
		overrun			0: No overrun
		Reserve	7 Bit	1 - 7	Reserve
2	One block of 8, 16, 32, 64, 128 or 256 Bytes	Result data	Byte-array		Data as defined in Vision Sensor Configuration Studio in "Output/Telegram/Payload". In case of PROFINET in tab Telegram "Binary" must be selected.

Example 3.1: Module 3 "Data"

- E.g.: No overrun
- Data Byte 2 ... n as defined in Vision Sensor Configuration Studio "Output/Telegram/Payload"

Byte 0								Byte 1								Byte 2 ... n							
Image ID								Result data overrun Reserve								Result data: as defined in Vision Sensor Configuration Studio "Output/Telegram/Payload" in binary format.							
0.-7	0.-6	0.-5	0.-4	0.-3	0.-2	0.-1	0.-0	1.-7	1.-6	1.-5	1.-4	1.-3	1.-2	1.-1	1.-0	2.7	2.6	2.5	2.4	2.3	2.2	2.1	2.0
x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

10.6.4.4 Module 4: "Request" (From PLC to SBS)

Name in PLC "REQU (4 + 8 / 16 / ... bytes)"

Byte-Position in Module	Size in Bytes	Member name	Data type	Bit number	Significance
0	1	Key	1 Byte		Request key (Request counter)

Byte-Position in Module	Size in Bytes	Member name	Data type	Bit number	Significance
1	1	Reserve	1 Byte		Reserve
2	1	Reserve	1 Byte		Reserve
3	1	Reserve	1 Byte		Reserve
4	One block of 8, 16, 32, 64, 128 or 256 Bytes	Request data	Byte- array		Same data as for TCP requests, see addendum: Serial communication BINARY (Page 501)

10.6.4.5 Module 5: "Response" (From SBS to PLC)

Name in PLC "RESP (4 + 8 / 16 / ... bytes)"

Byte-Position in Module	Size in Bytes	Member name	Data type	Bit number	Significance
0	1	Key	U8		Response key which is mirrored from request
1	1	Result data overrun	1 Bit	0	Response data has been truncated
		Reserve	7 Bit	1-7	Reserve
2	1	Reserve	1 Byte		Reserve
3	1	Reserve	1 Byte		Reserve
4	One block of 8, 16, 32, 64, 128 or 256 Bytes	Result data	Byte-array		Same data as for TCP responses s. addendum: ... Serial communication BINARY (Page 501)

10.6.4.6 Start- / End- criteria per each PROFINET command

Command (Modul "Control")	Start- condition (Modul "Status")	Confirmation of acceptance (Modul "Status")	Confirmation of execution (Modul "Status")
Trigger	Ready = High	Trigger Ack = High	Image ID changed
Change Job	/	Job Change Ack = High	Job Nr. changed
Switch to run	Operation Mode = Low	Switch to run Ack = High	Operation Mode = High

10.6.5 Timing diagrams to the SBS PROFINET communication with a PLC

10.6.5.1 Case: Trigger ok
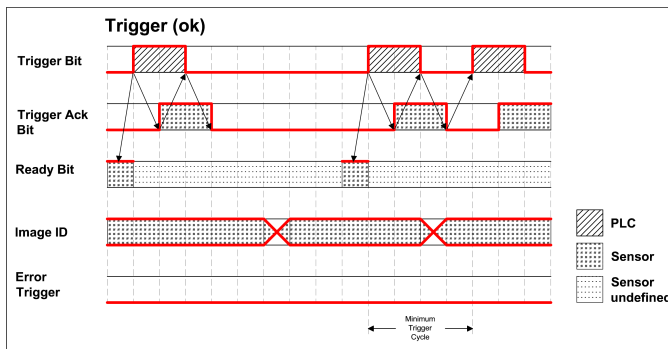
Fig. 323: Timing Trigger ok

10.6.5.2 Case: Trigger not possible (not ready)
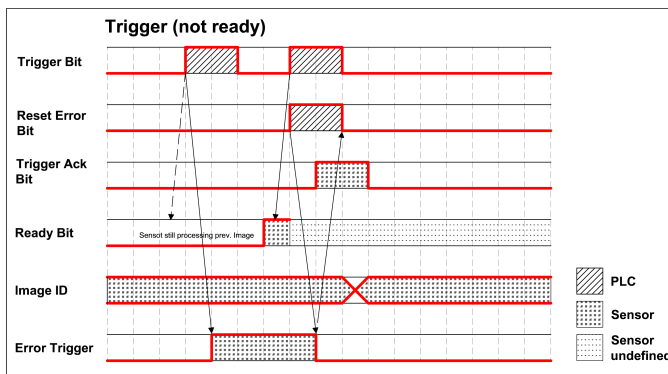
Fig. 324: Timing Trigger not ready

10.6.5.3 Case: Jobchange ok
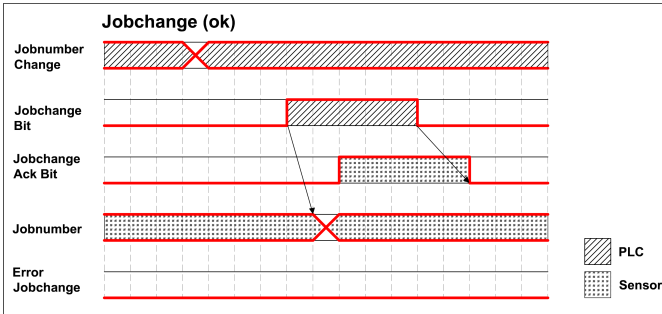
Fig. 325: Timing Jobchange ok

10.6.5.4 Case: Jobchange delayed
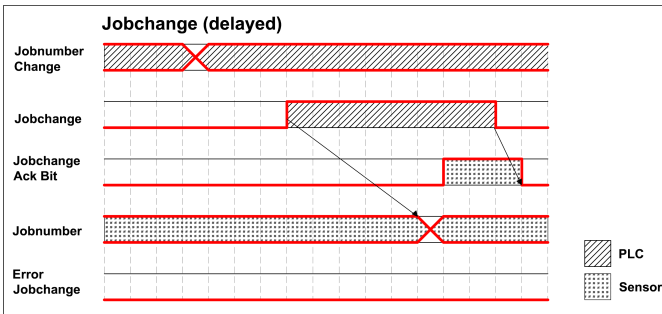
Fig. 326: Timing Job change delayed

10.6.5.5 Case: Jobchange not possible (e.g. wrong job number)
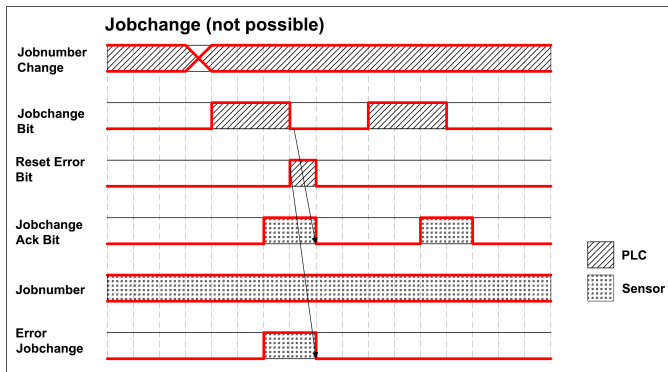
Fig. 327: Timing Jobchange not possible

10.6.5.6 Case: Switch to run ok
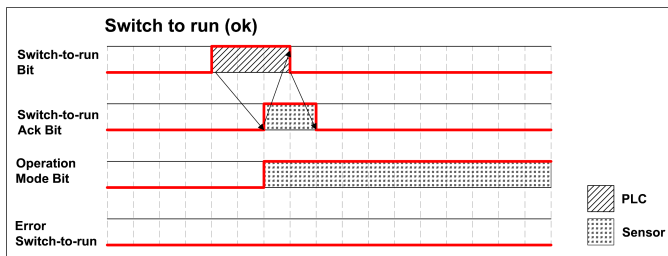
Fig. 328: Timing Switch to run ok

10.6.5.7 Case: Switch to run not possible
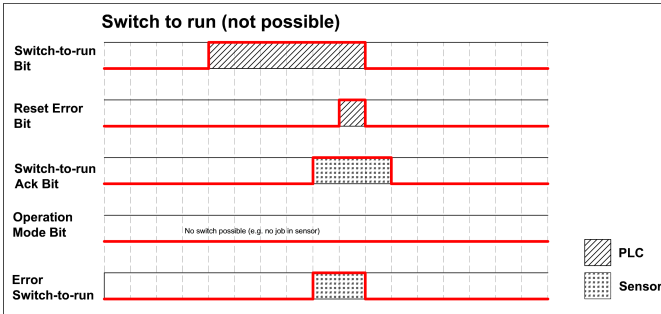
Fig. 329: Switch to run not possible

10.6.5.8 Strong recommendations for PLC programmer

1. Follow the sequence for requests.
2. Wait for completion of an action before sending the next one. Completion of action is given by change in image ID for trigger request and reception of acknowledge bit for other requests.

   Please note:

   That completion of action cannot be safely detected by low-high transition of READY because long exchange rates between PLC and SBS, e.g. 32ms, may result in READY not getting low.

3. READY should be high before sending trigger request.

10.6.5.9 Request sequences

10.6.5.9.1 Accepting / Discarding of Requests of Control Module

1. Request is accepted with rising Ack bit.
2. Request is discarded with error bit.
3. Request is discarded without error and Ack, if sensor is processing previous request and has not given Ack to that request. (Not obeying recommended "Handshake").

10.6.5.9.2 Trigger Request Sequence

1. Check Ready Bit high in Status module.
2. Set Trigger Request Bit high in Control Module.
3. Check Trigger Ack Bit high and Error Bitfield in status Module.

    a.   if Trigger Ack Bit high (Trigger successful), set Trigger Request Bit low (continue with step 4).

    b.   if Trigger Ack Bit low and Error Bitfield has Errorcode "1: Failure trigger request", then set Trigger Request Bit low and set Reset Error Bit high (continue with step 6).

4.   (Case Trigger successful) check Trigger Ack Bit low.

5.   (Case Trigger successful) then check ImageID Byte incremented (value 255 change to 0).

6.   (Case Trigger not successful) Check Error Bitfield going 0, then set Reset Error Bit low.

10.6.5.9.3 Change Job Request Sequence

1.   Set Byte Jobnumber in Control module to desired value.

2.   Check Ready Bit in Status module (in case of previous jobchange failure, ignore Ready).

3.   Set ChangeJob Request Bit high in Control Module.

4.   Wait and Check for ChangeJob Ack Bit high.

5.   Check Error Bitfield in status Module.

    a.   if Error Bitfield has not Errorcode "2: Failure change job", then set ChangeJob Request Bit low (continue with step 6).

    b.   if Error Bitfield has Errorcode "2: Failure change job", then set ChangeJob Request Bit low and set Reset Error Bit high. (continue with step 8)

6.   (Case ChangeJob successful) Check ChangeJob Ack Bit low.

7.   (Case ChangeJob successful) then check Jobnumber Byte in Status module. If jobnumber is correct.

8.   (Case ChangeJob not successful) Check Error Bitfield going 0, then set Reset Error Bit low. Check the correct jobnumber and repeat the request with Step 3 (Ready bit stays low).

10.6.5.9.4 Switch-To-Run Request Sequence

1.   Check Ready Bit high and Operation Mode Bit low (Config mode) in Status module.

2.   Set Switch-to-Run Request Bit high in Control Module.

3.   Wait and Check Switch-to-Run Ack Bit high.

4.   Check Error Bitfield in status Module.

    a.   if Error Bitfield has not Errorcode "3: Failure switch to run request", then set Switch-to-Run Request Bit low (continue with step 5).

    b.   if Error Bitfield has Errorcode "3: Failure switch to run request", then set Switch-to-Run Request Bit low and set Reset Error Bit high (continue with step 6).

5.   (Case Switch-to-Run successful) Check Switch-to-Run Ack Bit low and Operation Mode Bit high (Run mode).

6. (Case Switch-to-Run not successful) Check Switch-to-Run Ack Bit low and Error Bitfield going 0, then set Reset Error Bit low.

10.6.5.9.5 Sequence for requests via request/response module:

1. Request ID and request data is set.
2. Request key is incremented.
3. PLC waits for until request key is mirrored in response key.
4. PLC reads results including error included in results. See TCP payload.

10.6.5.9.6 Error Reset (depicted in UseCase "Jobchange not possible")

1. Reset by "Reset Error Bit"
2. Error bits are overwritten by new error bits.

10.7 SBS vision sensor EtherNet/IP, Introduction

This chapter explains the use of the Vision Sensor with EtherNet/IP.

For data communication between SBS vision sensor and PLC via EtherNet/IP the following topics are explained: electrical connection, settings in SBS vision sensor and PLC (as example for Rockwell RSLogix), available telegrams formats and the telegram timing.

10.7.1 Electrical connection of the SBS vision sensor in the EtherNet/IP network

The SBS vision sensor is connected via an Ethernet TCP/IP and a EtherNet/IP switch to the network.
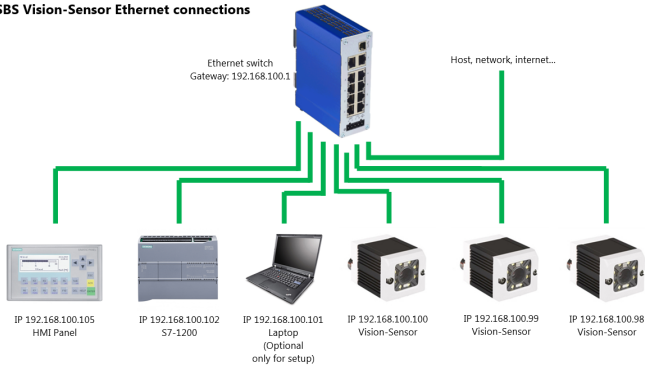
Fig. 330: Connection of Vision Sensor via EtherNet/IP switch

10.7.2 Configuration of SBS vision sensor via EtherNet/IP for the use with

In this example the configuration of the SBS vision sensor is described.

10.7.2.1 Settings in Vision Sensor Device Manager
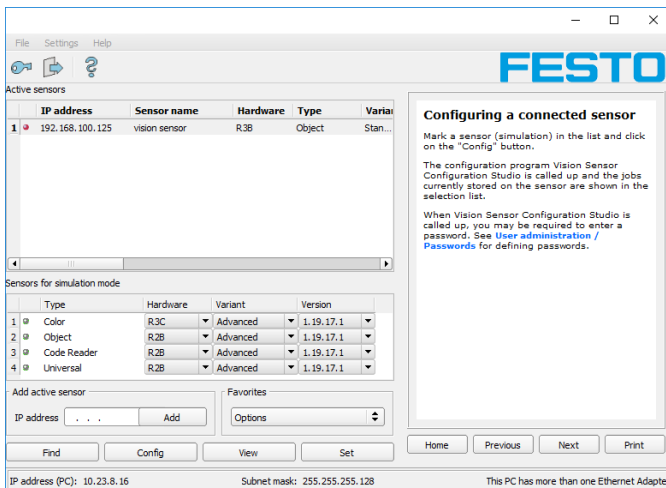
Fig. 331: SBS vision sensor is displayed and selected in Vision Sensor Device Manager.

When Vision Sensor Device Manager launches or by clicking the "Find" button, all active sensors are listed in the upper window called "Active sensors". You can change the IP address, subnet mask and other parameters on the SBS vision sensor by clicking the "Set" button.

10.7.2.2 Setting of IP and name
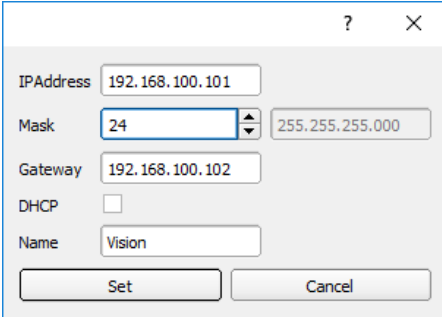
Fig. 332: Setting of IP and name

Here the IP address of the SBS vision sensor and it's name is set.

Important requirements:

For a functioning PROFINET communication, the IP addresses of the SBS and the PLC must correspond (same address space)!

10.7.2.3 Open Vision Sensor Configuration Studio

When the desired SBS vision sensor in Vision Sensor Device Manager is selected, click on "Config". Confirm the following dialog box with "OK" to stop Vision Sensor Device Manager and start the configuration in Vision Sensor Configuration Studio.
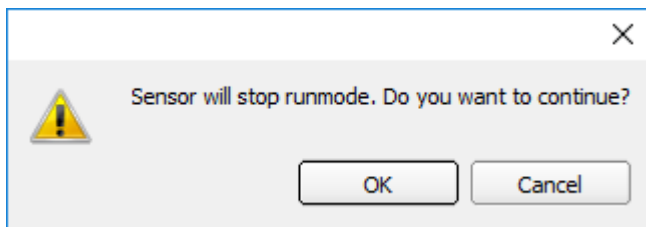
Fig. 333: Open Vision Sensor Configuration Studio

10.7.2.4 Select Interface "EtherNet/IP"

In setup"Output" on the "Interface" tab, the EtherNet/IP checkbox is selected.
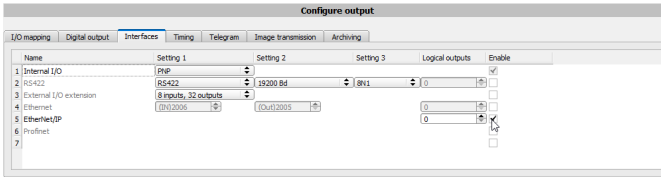
Fig. 334: Activation of EtherNet/IP in Vision Sensor Configuration Studio

10.7.2.5 Definition of the telegram

In the tab "Telegram" the data which should be transferred can be defined completely free. For the use with EtherNet/IP this must be done with format "Binary".

10.7.2.5.1 Definition of the output data

The output data itself are configured identically as the data output via Ethernet TCP/IP or RS422 in: Vision Sensor Configuration Studio/Output/Telegram.

See chapter: Tab Telegram, Data output (Page 243)
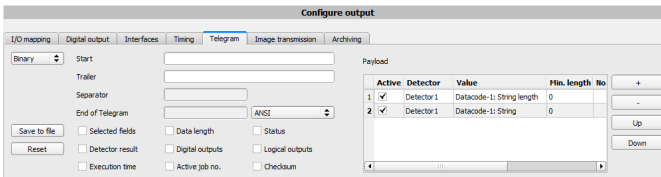
Fig. 335: Data output, protocol: Binary

10.7.2.6 Start sensor, data output

With "Start sensor" the configuration data are transferred to the SBS. The sensor get's started and now the output data are transferred as defined.
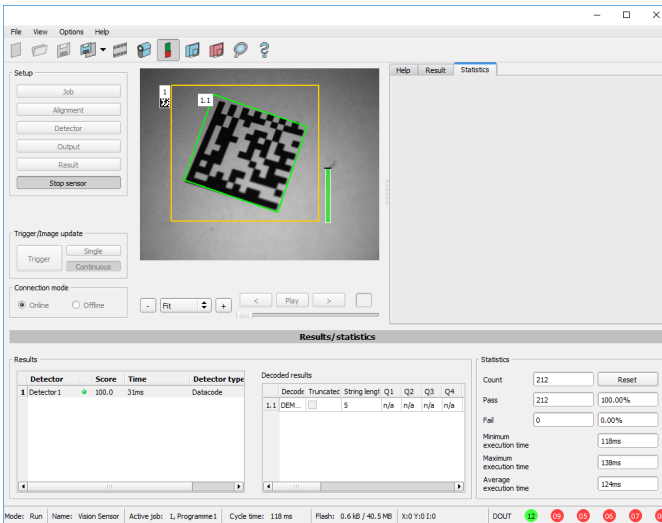
Fig. 336: Start sensor

10.7.3 EtherNet/IP Protokoll

EtherNet/IP has a predefined protocol, consisting oft two assemblies.

- Assembly request (PLC to Sensor, 344 bytes long) and
- Assembly response (Sensor to PLC, 444 bytes long)

10.7.3.1 Assembly request

Request key

Position 0 (Byte 0 and 1) are the request key. Every change in the request key indicates to the sensor that there are new data inside the assembly request available. Changing the request key triggers a command like trigger, job change...

Command configuration

The command configuration starts on position 2 and has a size of 2 bytes (byte 2 and 3).
It is possible with selected code, to choose between: Trigger, Change job and Set reference string.

- **Trigger:** To make a trigger (to take a new picture), the code is: 0x01
- **Change job:** to send the command to change a job, the code is: 0x02

Commands which need further arguments like "change job" need to get the arguments on the correct byte positions : the job number is an integer value to be placed on "pnValueInt" (byte 264), the length of this information is 1 byte long, following Parameter "unNumint" (byte 6) has to be set to "1".

Examples

Trigger

Request structure	Key	ID
Storage	unKey	unId
Byte position	0	2
Request pattern	Count	0x01

Change Job

Request structure	Key	ID	NumInt	Job number
Storage	unKey	unId	NumInt	ValueInt[0]
Byte position	0	2	6	264
Request pattern	Count	0x02	0x01	Job no.

Set reference string permanent

Request structure	Key	ID	Length of string	NumInt	Ref. String	Detector number	Parameter number	Parameter type
Storage	unKey	unId	NumChar	NumInt	Char	Int[0]	Int[1]	Int[2]
Byte position	0	2	4	6	8	264	268	272
Request pattern	Count	0x05	0x01	0x03	0x43	0x01	0x65	0x0A
Explanation			Example 1 character	Constant value	Example string f. "AB" "C"	Example for detector 1	Command set ref. string	Example param. type string

Set reference string temporary

Request structure	Key	ID	Length of string	NumInt	Ref. String	Detector number	Parameter number	Parameter type
Storage	unKey	unId	NumChar	NumInt	Char	Int[0]	Int[1]	Int[2]
Byte position	0	2	4	6	8	264	268	272
Request pattern	Count	0x06	0x02	0x03	0x41 0x42	0x01	0x65	0x0A
Explanation			Example 2 character	Constant value	Example string f. "AB" Example for detector 1	Example for detector 1	Command set ref. string	Example param. type string

10.7.3.1.1 Over hardware IO the offers a "Ready" signal.

Sending a Trigger is allowed only if "Ready" signal is high.

When hardware ready signal is not connected to the PLC it is very easy to find out the ready status just over EtherNet/IP.

After first connection of PLC to sensor the sensor must be in a "ready"-state, otherwise there would have been no EtherNet/IP connection.

Following chart shows the hardware ready signal in relation to the commands over EtherNet/IP at the example of a typical trigger sequence:
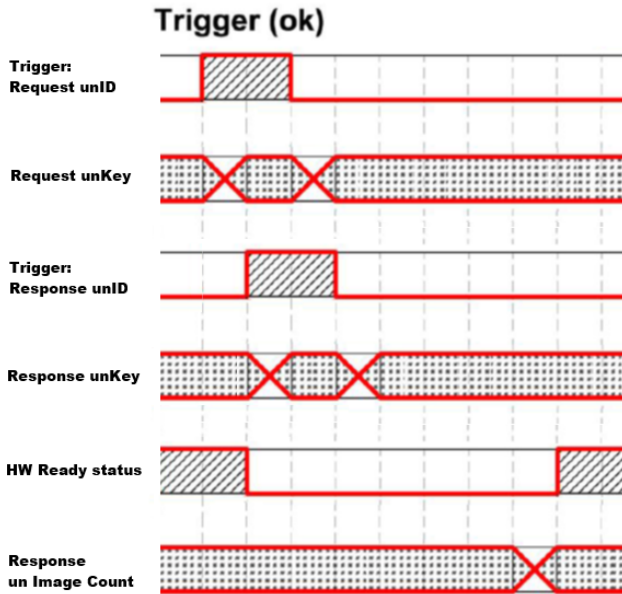
Fig. 337: EtherNet/IP, Sensor ready

10.7.3.2 Assembly response

User defined data output are configured in "Output/Telegram/Payload".
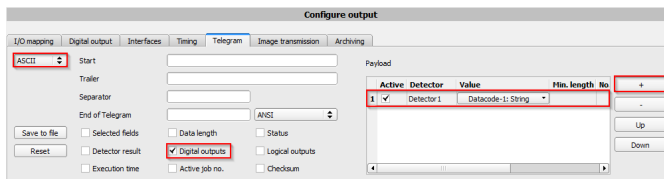
Fig. 338: User defined data output

Depending from kind of output data they can be found in the assembly response at

- Boolean: byte 92 (pucBool)
- String: byte 116 (pcString)
- Integer: byte 244 (pnInt)

Example Trigger Handshake
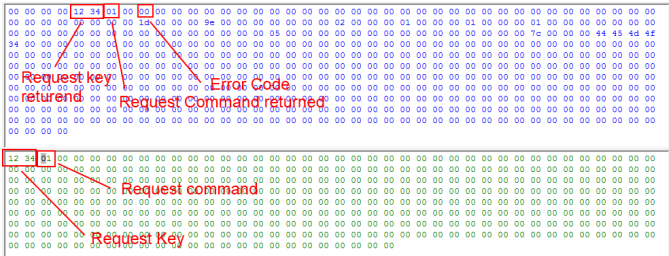
Fig. 339: EtherNet/IP, Trigger Handshake

Response and request bytes
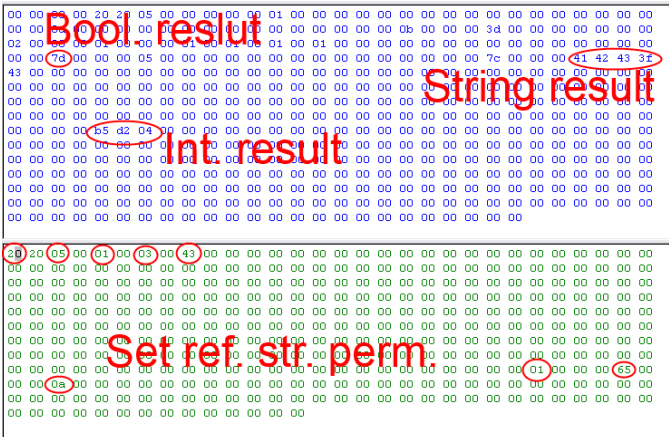
Fig. 340: EtherNet/IP, Response and request bytes

A complete documentation of the assemblies can be found in the end of this chapter.

10.7.4 Implementation of SBS vision sensor into RSLogix

Establish a network-connection between RSLogix and each sensor by adding a Generic Ethernet Module in the Ethernet I/O network for each sensor.

```
□ I/O Configuration
    □ Backplane, 1789-A17/A Virtual Chassis
        [1] 1789-L60 Example
        □ [2] EtherNet/IP Eth1
            □ Ethernet
                EtherNet/IP Eth1
                ETHERNET-MODULE Eth2
```
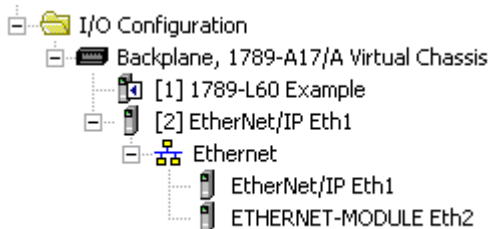
Fig. 341: EtherNet/IP, Ethernet modules

The suitable network adapter which is mounted in side the PLC must be configured.

The Ethernet Card will need to setup as a module on the Ethernet I/O network within the same subnet as the camera(s) you will be communicating with.

In this example the IP adress of RSLogix is 192.168.100.84, this can be configured by click with right mouse button on "EtherNet/IP Eth1" ➔ "New Module":

```
□ Add-On-Defined
⊞ Predefined
⊞ Module-Defined
    Trends
□ I/O Configuration
    □ 1768 Bus
        □ [2] 1768-ENBT/A Ethernet
            □ Ethernet
                17|   New Module...
                ET|
                ET|   Paste        Ctrl+V
        □ [1] 1768-M
            SER.CC    Print         ▶
        [0] 1768-L43 test
    □ 1769 Bus
        [0] 1768-L43 test
```
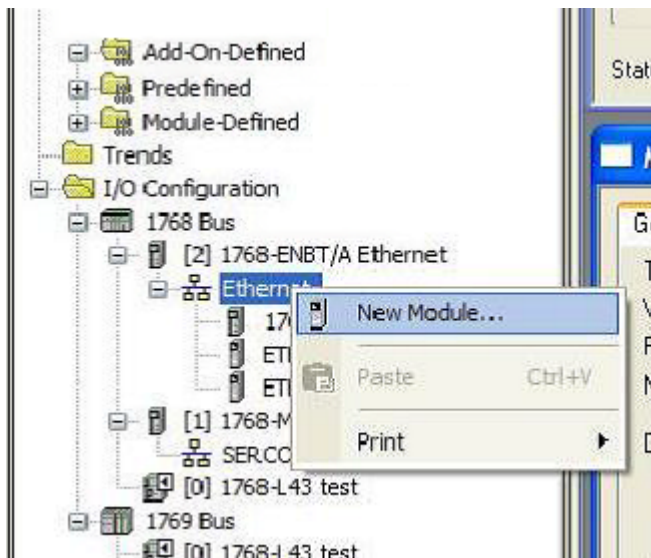
Fig. 342: EtherNet/IP, New Ethernet modules
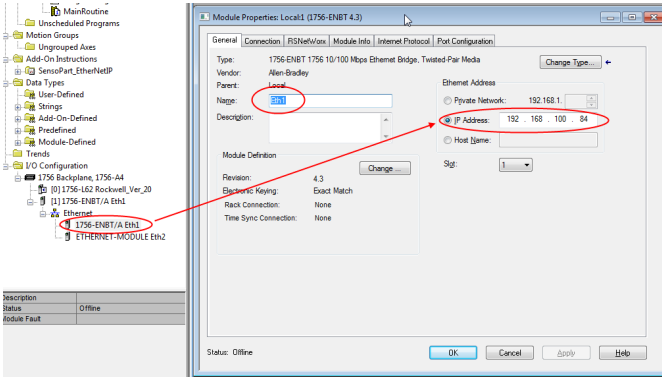
Fig. 343: EtherNet/IP, Adresse

10.7.4.1 Over Generic Profile

Each sensor is added as a "Generic Ethernet Module" as shown in the following two screenshots. Enter IP adress of sensor (as set before with Vision Sensor Device Manager software) and the number of input and output bytes like shown in screenshot:
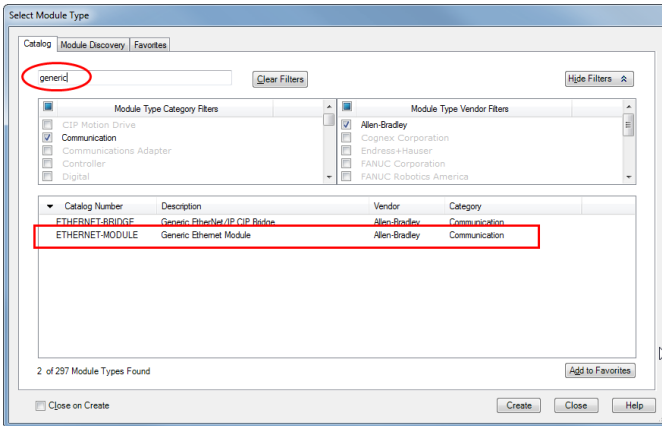
Fig. 344: EtherNet/IP, select Generic Module

Add one Ethernet module for each sensor.
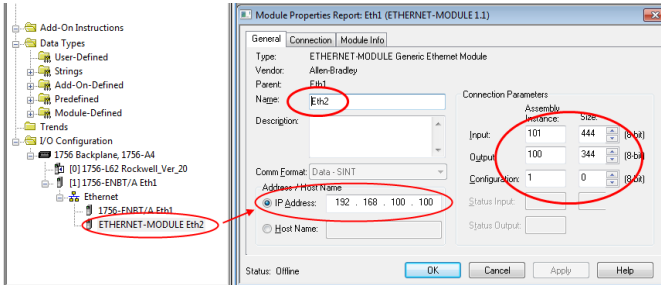
Fig. 345: EtherNet/IP, number of input and output byte

Duplicate this step with different name and IP-address for each sensor, rest of settings the same.

10.7.4.2 Over EDS-File

If an EDS file has been installed before "Festo SBS" can be selected directly inside the list of available modules.

Assembly size and Assembly instance is set automatically in this case. Only IP address of SBS has to be entered.
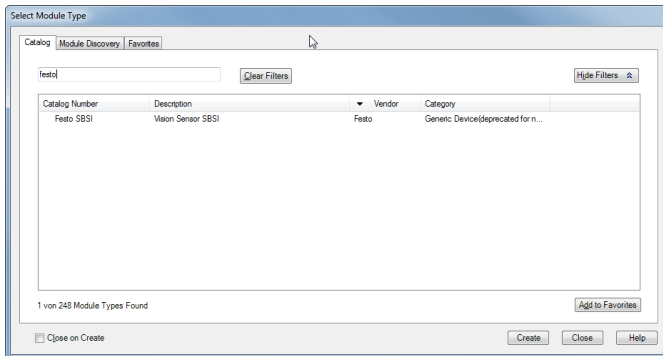
Fig. 346: EtherNet/IP, select Generic Module
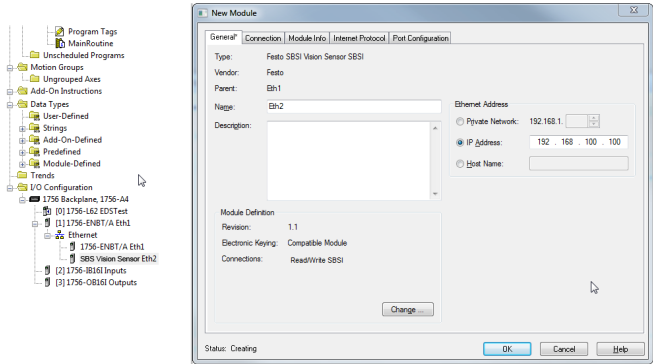
Fig. 347: EtherNet/IP, set IP address, EDS- file

10.7.5 Result data: assembly response

User defined data output to be configured in the result telegram specification:
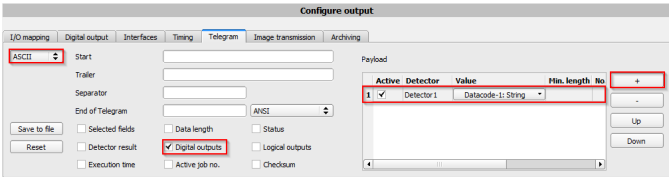
Fig. 348: EtherNet/IP, Result data

Depending on the kind of output data they can be found in the assembly response at

- Boolean: byte 92 (pucBool)
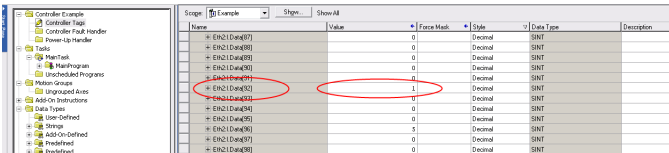
Fig. 349: EtherNet/IP, Output data, Bool

- String: byte 116 (pcString)

Fig. 350: EtherNet/IP, Output data, String

- Integer: byte 244 (pnInt)

Fig. 351: EtherNet/IP, Output data, Int

To see boolean results of Q1 to Q3 you have to activate the transmission in FestoVision Sensor Configuration Studio-Software: Output/Telegram/Digital Outputs

If this setting is correct, you get them on Q1 = Eth2:I.Data[60].01, Q2 = Eth2:I.Data[60].02, Q3 = Eth2:I.Data[60].03

10.7.6 EtherNet/IP, Anhang

10.7.6.1 Assembly Request

Communication settings

Description:	Request posted from PLC to SBS vision sensor
Class:	Class 1
nAssemblyInstance:	100

nType:	AssemblyConsuming
nLength (bytes):	344
szAssemblyName:	AssemblyRequest

Assembly Request

The SBS vision sensor receives a data frame of 344 bytes.

To release commands to the sensor, proceed as follow:

Each byte corresponds to values which are sent from the PLC to the sensor. The position defines the byte to use and the size defines the length of this command.

Position	Size (bytes)	Member	Data type	Description
0	2	unKey	U16	request key, eg. a request counter
2	2	unId	U16	request ID, eg. for requests "trigger", "change job"
4	2	unNumChar	U16	no. of valid char parameters
6	2	unNumInt	U16	no. of valid int parameters
8	256	pcValueChar[RQST_NUM_CHAR]	I8	char parameters for request, member may only hold one string
264	80	16 int parameters for request	I16	int parameters for request

The request key:

The position 0 (Byte 0) with a size of 2 bytes, corresponds to the request key. It valid the modification of parameters sent. For that, you need to increment the request key bytes with a value of your choice to release a command.

Example:

Make a trigger on the SBS vision sensor. The default code of the request key is 0x0 0x0. After Trigger configuration (description follows), increment the request key to engage the trigger. The request key code is now: 0x0 0x2.

Position 0:

Byte 1	Byte 0

Always 0	0000 0010

Command configuration:

The request key has a size of 2 bytes (at position 0 and 1). The command configuration will start on position 2 and has a size of 2 bytes. It is possible to choose a command called Request ID between: Trigger, Change job, statistics reset, auto shutter, permanent or temporary teach.

Position 2:

Byte 3	Byte 2
Always 0	0000 0001

Change job: to send the change job command, the code is 0x0 0x2 in position 2. Set the LSB of position 6 to "1" (Standard version: job 1 or job 2; Advanced versions: 255 jobs available). Write the job number (4 bytes) to position / byte 264. To validate the request, increment the request key. To change the job make a trigger to change the job (don't forget to set the LSB of position 6 to "0").

Position 2:

Byte 3	Byte 2
Always 0	0000 0010

Position 6:

Byte 7	Byte 6
Always 0	0000 0001

Position 264:

Byte 265	Byte 264
Always 0	0000 0010

Byte 3	Byte 2
Always 0	0000 0100

Auto Shutter: For function auto shutter you have to write the code: 0x0 0x7 on position 2.

Position 2:

Byte 3	Byte 2
Always 0	0000 0111

Permanent teach: The permanent teach allows to teach a new reference pattern / contour etc. with same tools and same settings. These teach is permanent, it means the new reference pattern / contour etc. is stored permanently in the sensor memory, even if the sensor is reset. The code is: 0x0 0x8 on position 2. Set trigger to execute command and increment request key.

Position 2:

Byte 3	Byte 2
Always 0	0000 1000

Temporary teach: The temporary teach allows a new reference pattern / contour etc. with same tools and same setting. These teach is temporary, it means the reference pattern / contour etc. is not available after a reset of the sensor. The code is: 0x0 0x9 on position 2. Set trigger to execute command and increment request key.

Position 2:

Byte 3	Byte 2
Always on 0	0000 1001

Summary of available commands:

Commands	Position	Size	Code
Trigger	2	2	0x0 0x1
Change job	2	2	0x0 0x2
Job number	264	4	Job number
Statistics reset	2	2	0x0 0x4
Auto shutter	2	2	0x0 0x7
Permanent teach	2	2	0x0 0x8
Temporary teach	2	2	0x0 0x9

Example: To make a trigger, write the code 0x0 0x1 on position 2. Modify request key on position 0: 0x0 0x2 => 0x0 0x4. The SBS vision sensor take a new picture.

Attention: Don't forget to increment the request key to valid the commands.

10.7.6.2 Assembly Response

Communication settings

Description:	Response returned from SBS vision sensor to PLC
Class:	Class 1
nAssemblyInstance:	101
nType:	AssemblyProducing
nLength (bytes):	444
szAssemblyName:	AssemblyResponse

Assembly Response

Assembly responses are data sent by the sensor after made some commands by the PLC or by the software.

For the commands by PLC, please see Ethernet / IP request file.

After PLC configuration and Vision Sensor Configuration Studio configuration, the size of the frame assembly response is of 444 Bytes. Each of them corresponds to some values describe as follow.

Position	Size (bytes)	Member	Data type	Description				
0	4	unFault	U32	member is standard in Rockwell RSLogix				
4	2	unKey	U16	Request key is returned in response				
6	2	unId	U16	Request ID is returned in response. (Trigger, Change job, Statistics reset...)				
8	2	unError	U16	Error code of response				
10	4	unNumChar	U32	Responses values for requests like job change, teach ...				
					Byte 13	Byte 12	Byte 11	Byte 10

Positio-n	Size (byte-s)	Member	Dat-a type	Description				
				Trigger	Always 0	Always 0	Always 0	0000 0001
				Change job	Always 0	Always 0	Always 0	0000 0010
				Permanent teach	Always 0	Always 0	Always 0	0000 1000
14	2			RESERVED				
16	16	pcValueChar [RPNS_NUM_ CHAR]	18	char parameters for response, member may only hold one string				
32	16	pnValueInt[RPNS_ NUM_INT]	U32	int parameters for response				
48	4	unImageCount	U32	Number of images taken by the SBS vision sensor.				
52	4	unExecutionTime	U32	Average execution time of last processed image. (To active this data, select in Vision Sensor Configuration Studio: Execution time)				
56	4	pucStatus[RPNS_ IMPL_NUM_BYTE_ STATUS]	U32	Status : SBS vision sensor mode (To active this data, select in Vision Sensor Configuration Studio: Status) Free run: The sensor takes a new picture when the processing is finished. Trigger: The sensor wait an external signal to take a new picture. Example Byte 56, bit "0" and "1":				
					Byte 59	Byte 58	Byte 57	Byte 56
				Freerun	Always 0	Always 0	0000 000X	0000 0X01
				Trigger	Always	Always	0000	0000

Position	Size (bytes)	Member	Data type	Description

Description
mode   0   0   000X   0X10

Additional data for 1.7.10.1 version or more
Configuration : The sensor is connected to a PC for configuration

Example Byte 56, bit "2":

	Byte 59	Byte 58	Byte 57	Byte 56
Configuration	Always 0	Always 0	0000 000X	0000 00X-X
Run	Always 0	Always 0	0000 000X	0000 01X-X

Run : The job is downloaded in the SBS vision sensor memory. The sensor works stand alone.

Byte "57", bit "0" shows the sensor ready status

	Byte 59	Byte 58	Byte 57	Byte 56
Sensor ready	Always 0	Always 0	0000 0001	0000 0XXX
Sensor not ready	Always 0	Always 0	0000 0000	0000 0XXX

Position	Size (bytes)	Member	Data type	Description
60	2	unActiveJob	U16	Active job : Value of job number
62	2			RESERVED
64	2	unNumDigital	U16	Number of active digital outputs (assigned to one tool) (To active this data, select in Vision Sensor Configuration Studio: Digital outputs)

Positio-n	Size (byte-s)	Member	Dat-a type	Description
				According to: Byte 1 and 2, of "Digital outputs", in "Serial communication / Data output Binary"
66	2	unNumLogic	U16	Number of active logical outputs (assigned to one tool) (To active this data, select in Vision Sensor Configuration Studio: Logical outputs) According to: Byte 1 and 2, of "Logical outputs", in "Serial communication / Data output Binary"
68	2	unNumDetector	U16	Number of selected tools (It is a default value) According to: Byte 2 and 3, of "Detector result", in "Serial communication / Data output Binary"
70	2	unNumBool	U16	no. of valid boolean parameters
72	2	unNumString	U16	no. of strings included in pcValueChar
74	2	unNumInt	U16	Number of received payload (To active this data, select a data in Vision Sensor Configuration Studio: Payload)
76	2	pucDigital[RPNS_IMPL_NUM_BYTE_DIGITAL]	U8	Digital outputs results: result according to the order of the outputs. LSB =› first output. MSB =› Last output. Example: 4 active outputs (12, 09, 05, 06). Status of outputs : 12 = OK; 09 = NOK; 05 = OK; 06 = OK. The code will be : table below (To active this data, select in Vision Sensor Configuration Studio : Digital outputs) According to: Byte 3 ... n, of "Digitaloutputs",

	Byte 79	Byte 78	Byte 77	Byte 76
Result	0000 0000	0000 0000	0000 0000	0000 1101

Positio-n	Size (byte-s)	Member	Dat-a type	Description
				in "Serial communication / Data output Binary"
80	8	pucLogic[RPNS_IMPL_NUM_BYTE_LOGIC]	U8	Logical outputs results: result according to the order of the outputs. LSB =› first output. MSB =› Last output. Example: 4 active outputs (12, 09, 05, 06). Status of outputs : 12 = OK; 09 = NOK; 05 = OK; 06 = OK. The code will be : 1011 _see table below_ (To active this data, select in Vision Sensor Configuration Studio: Logical outputs) According to: Byte 3 ... n, of "Logical outputs", in "Serial communication / Data output Binary"
88	1	pucDetector [RPNS_IMPL_ NUM_BYTE_ DETECTOR]	U8	Global result (Only available on Vision Sensor Configuration Studio and Vision Sensor Visualisation Studio): Only coded on the third LSB bits. Bit0 = Global result status (0 : OK ; 1 : NOK) Bit1 = Status of the case « Detector result » in Optional field during the data configuration. Bit2 = Indicate if one of tools is NOK even if result global is OK =› 0 Example 1: We select Detector result case; Tool1 OK; Tool 2 OK; Global result on tool1 and on Tool 2 =› OK, the bit2 will be on 1. _see table below_ Example 2: We select Detector result case; Tool1 OK; Tool2 NOK; Global result on tool1 =› OK, the bit2 will be on 0.

Logical outputs table (Position 80):

	Byte 83..87	Byte 82	Byte 81	Byte 80
Result	0000 0000	0000 0000	0000 0000	0000 1011

Detector table (Position 88):

	Byte 88
Result	0000 0111

Positio-n	Size (byte-s)	Member	Dat-a type	Description
				<table><tr><td></td><td>Byte 88</td></tr><tr><td>Result</td><td>0000 0011</td></tr></table> Other bits always on 0. (To active this data, select in Vision Sensor Configuration Studio: Detector results) According to: Byte 1, of "Detector result", in "Serial communication / Data output Binary"
89	3	pucDetector [RPNS_IMPL_ NUM_BYTE_ DETECTOR]	U8	Detector result: Each bit corresponds to a tool. Only on 1Byte: Bit1 = tool1; bit2 = tool2; bit3 = tool3... until 8 bits. Other bytes, always on 0. Future Applications, coded on 3 bytes. (To active this data, select in Vision Sensor Configuration Studio: Detector results) According to: Byte 4 ... n, of "Detector result", in "Serial communication / Data output Binary"
92	4	pucBool[RPNS_ IMPL_NUM_BYTE_ BOOL]	U8	boolean results (bitwise) as configured in HMI (listbox)
96	16	punStringLength [RPNS_IMPL_ NUM_STRING]	U16	lengths of strings included in pcValueChar
112	2	pucStringTruncat-ed[RPNS_IMPL_ NUM_BYTE_ STRING_ TRUNCATED]	U8	indicates for each string whether it has been truncated (bitwise)
114	2			RESERVED
116	128	pcString[RPNS_ IMPL_NUM_BYTE_ STRING]	I8	char result as configured in HMI (listbox), member may hold multiple strings
244	200	pnInt[RPNS_	U32	Results of payload configured on Vision Sensor

Positio-n	Size (byte-s)	Member	Dat-a type	Description
		IMPL_NUM_INT]		Configuration Studio in tab « frame ». All data on payload are describe as follow:

10.8 Rescue

The utility "Rescue" is used to reset SBS vision sensors, which no longer can be found by Vision Sensor Device Manager, to a default status to be able to be accessed via Vision Sensor Device Manager and Vision Sensor Configuration Studio again.

1. Start Rescue (leave empty field "Mac address of Sensor").
2. Reset SBS, Power off / on or Vision Sensor Device Manager/File (SBS must be connected via Ethernet and be located in the same network as the PC).
3. In the field below "Received Data" now all settings of the SBS vision sensor are displayed.
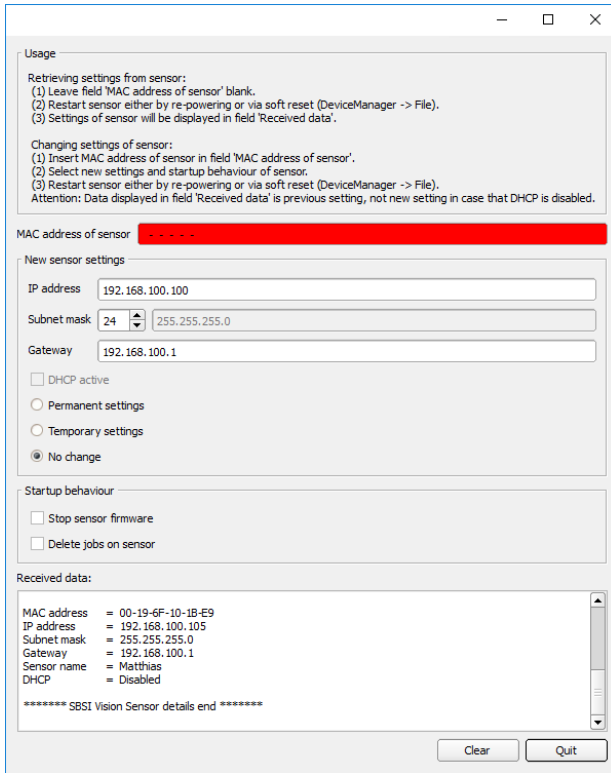
Fig. 352: Rescue/1

4. Now the below shown Mac address can be entered into the field "Mac address of Sensor".

5. Into the lines below, all the network settings like, IP address, Subnet Mask etc., which the SBS should have after the next Restart (Power off/on), can be entered.
Restart SBS.

Please note:
The data displayed in the lower field will not be updated on restart.
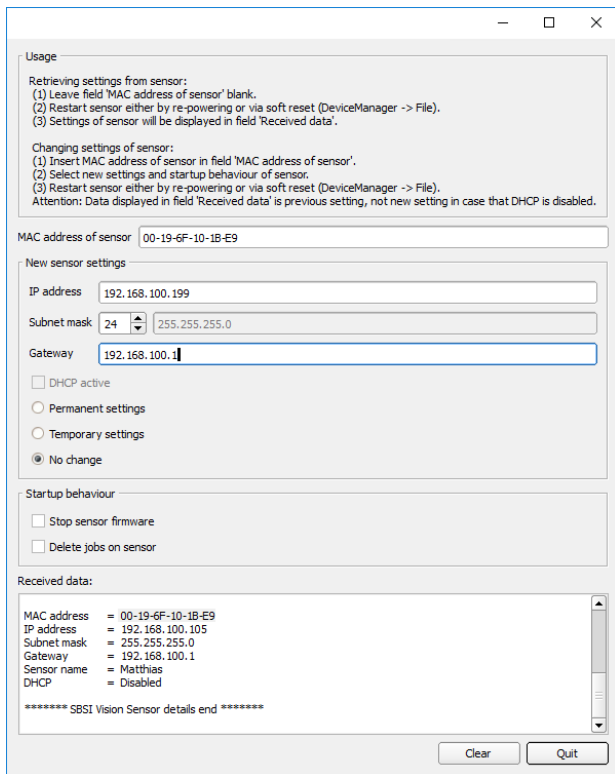
Fig. 353: Rescue/ 2

11 Image settings and accessories

11.1 Good images

To achieve good images follow these steps:

- Align the sensor to the desired field of view. Take care for stable mounting.
- For high contrast images adjust angles and illumination as described in chapter The most important types of illumination are: Bright field, Dark field and Diffuse illumination.
- Adjust a sharp image with the focus screw at the backside of the sensor housing.
- Adjust the brightness of the image with the parameter "Shutter speed" in Vision Sensor Configuration Studio/Job/Image acquisition. (Do not use parameter "Gain", not until you are not able to achieve desired brightness via "Shutter speed").

11.2 Environmental light, shrouding, IR- version

Mechanical shrouding

In most cases it´s much simpler and highly cost effective to protect the scene against disturbing light or sun beams, which e.g. shine temporary at a certain time of day or season from windows or roof lights, by mechanical shrouding like metal plates, than to create illumination conditions, e.g. by additional illumination which is strong enough not to be disturbed in any situation.

Version with Infrared illumination

A further elegant way to get independent from the environmental light is to use the according SBS version with Infrared illumination. Here the scene get´s illuminated with the built in powerful IR- illumination. The receiver is equipped with the according filter. That means the sensor works in a narrow range of this specific wavelength, and for that as far as possible with its own light only.

Another advantage of the infrared light is, that the light flashes are not visible and do not disturb any human workers which are near the plant.

11.3 External illumination

For the SBS a large range of accessories is available. It includes a big range of external illuminations, which can be used additionally or instead of the internal illumination.

The both types SBAL-C6-A xxx and SBAL-C6-R xxx can be connected directly to the sensor.

Wiring
Connection ring light with sensor
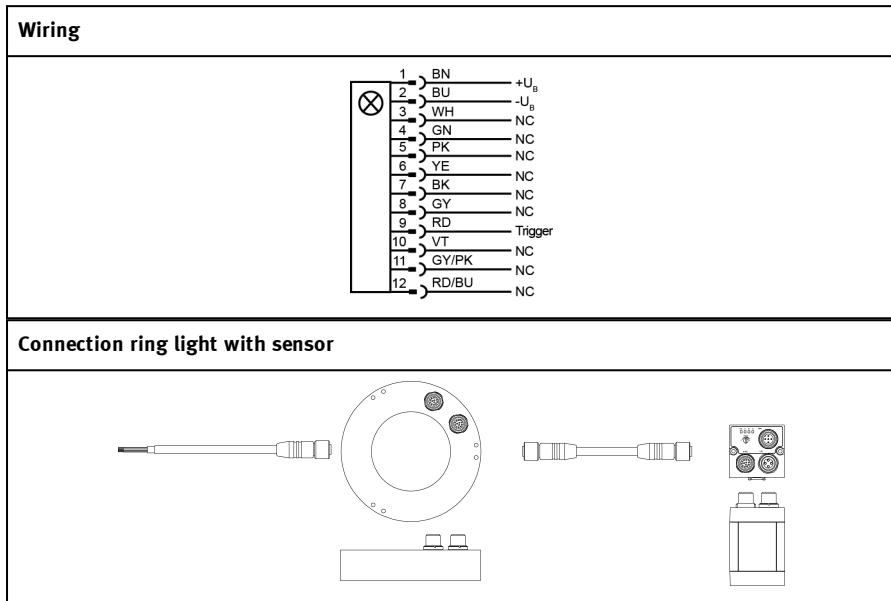
Fig. 354: Connection of external illumination SBAL-C6-A xxx and SBAL-C6-R xxx

11.4 The most important types of illumination are: Bright field, Dark field and Diffuse illumination.

11.4.1 Bright field illumination

Bright field internal / Bright field external
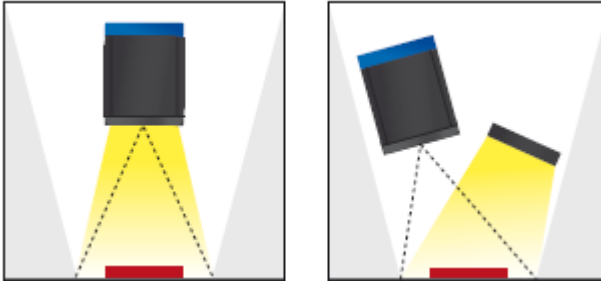
Fig. 355: Bright field illumination

With bright field lighting, the lighting, sensor and object are arranged so that the object's surface reflects the light directly into the sensor. The smooth surface of the object appears as a bright area and each indentation, bump or defect, such as e.g. scratches, are a dark edge.

Attention:
With bright field lighting, the angle of alignment between the lighting, object and sensor and the object's surface is critical as direct reflection by the object's surface only works when the angle and surface characteristics (shiny, mat, oily ....) are constant!

With Bright field / With Dark field
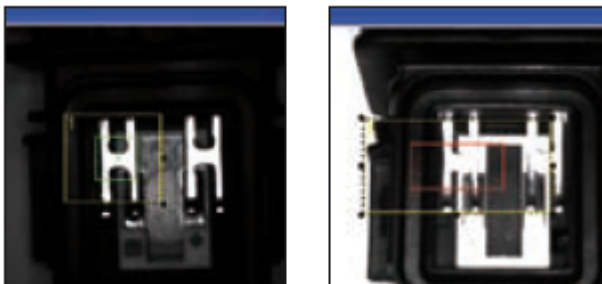
Fig. 356: Example Bright field illumination

By the direct reflection of the highly reflective (shiny) metal part, even before a white background, this is possible to be recognized with Bright field illumination! With Dark field illumination it's not possible to distinguish between shiny metal part and white background.

11.4.2 Dark field illumination

Dark field internal / Dark field external
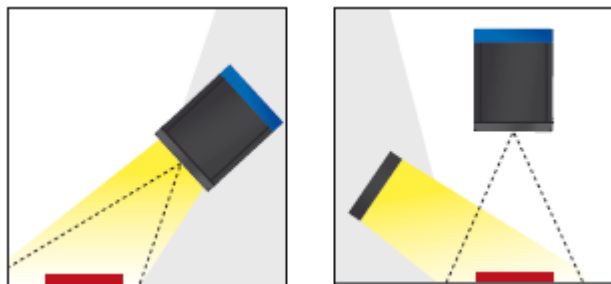
Fig. 357: Dark field illumination

With dark field illumination, the lighting, sensor and object are arranged so that the smooth surface of the object does not reflect the light directly into the sensor. Object edges (indentations and bumps) appear as bright areas, smooth object surfaces however are dark. This type of illumination functions with wide angle ranges and depends little on the object's surface.

With Bright field / With Dark field
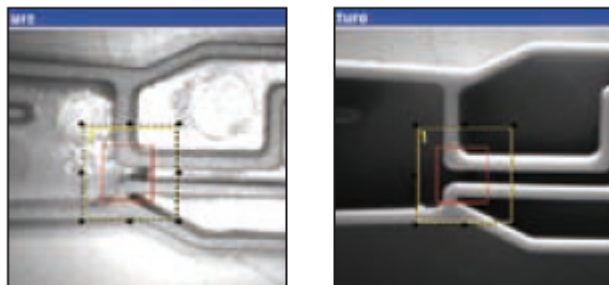
Fig. 358: Example, Dark field

Edges are clearly accentuated with Dark field illumination.

11.4.3 Diffuse illumination (external only)

Diffuse external
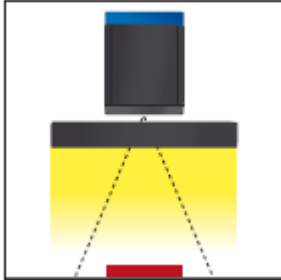
Fig. 359: Diffuse illumination

Diffuse lighting is used everywhere where highly-reflective, curved and above all irregularly-shaped object surfaces are concerned (e.g. aluminium foil on blister packs etc.). Such objects cannot be illuminated with spot-shaped lighting, but only with diffuse lighting (i.e. even lighting from all directions). Diffuse lighting is also known as "cloudy day" illumination, i.e. uniform light from behind the cover of clouds rather than from direct sunlight.

Spot illumination / Diffuse illumination
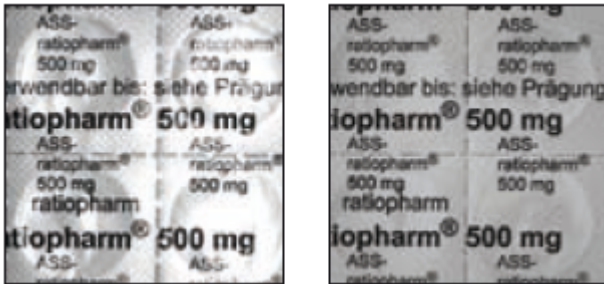
Fig. 360: Diffuse illumination

That means: clear homogeneous image with diffuse illumination! With any spot illumination the reflections of the aluminum foil from one part to another are always different.

12 Technical Data

Electrical data	
Operating Voltage U_B	UB 24 V DC , -25 % / +10 %
Residual ripple	‹ 5 Vss
Current consumption (no I/O)	≤ 200 mA
All inputs	PNP / NPN High › UB - 1 V, Low ‹ 3 V
Input resistance	› 20 kOhm
Encoder input	High › 4 V, max. 18 kHz
Outputs	PNP / NPN
Maximum output current (per output)	50 mA, Ejector (Pin 12 / RDBU) 100 mA
Short-circuit protection (all outputs)	Yes
Inductive load	typ.: Relays 17K / 2H, pneumatic valve 1.4 K / 190 mH
Protection against inverse polarity	Yes
Interfaces SBS-XX-Standard Interfaces SBS-XX-Advanced	Ethernet (LAN) Ethernet (LAN), RS422 / RS232
Readiness delay	typ. 13 s after power on

Optical data		
Number of pixels , chip size, pixel size	SBS - R3B...: 736 (H) x 480 (V), 1/3", 6,0 um square SBS - R2B...: 1280 (H) x 1024 (V), 1/1.8", 5,3 um square	
Technology	CMOS (mono / color)	
Integrated scan illumination	8 LEDs (except C-Mount)	
Integrated lens, focal length	6, 12 or 25 mm, adjustable focus	

Optical data				
	R3B	R3B	R3B	R2B
Lens (adjustable to infinity)	6	12	25	12
Min. scan distance	6	30	140	30
Min. field of view X x Y	5 x 4	8 x 6	18 x 14	16 x 13

Mechanical data	
Length x width x height	65 x 45 x 45 mm (without plug)
Weight	approx. 160 g
Vibration / shock	EN 60947-5-2
Ambient air temperature: operation	0 ºC .... 50 ºC (80 % humidity, non-condensing)
Ambient air temperature: storage	-20 ºC ... 60 ºC (80 % humidity, non-condensing)
Protective system	IP 65/67
Plug connection	24 V DC and I/O M12 12-pin, LAN M12 4-pin, Data M12 5-pin
Housing material	aluminium, plastic

Typical cycle time	
Monochrome detectors	typ. 20 ms Pattern matching typ. 30 ms Contour typ. 8 ms Caliper typ. 30 ms BLOB typ. 2 ms Brightness typ. 2 ms Contrast typ. 2 ms Gray level typ. 30 ms Barcode typ. 40 ms Datacode typ. 15 ms per character OCR

Typical cycle time	
Color detectors	typ. 2 ms Color value typ. 30 ms Color area typ. 2 ms Color list

13 Field of view / Depth of view

Field of view R3B 6mm lens, internal

Focal length: 6mm
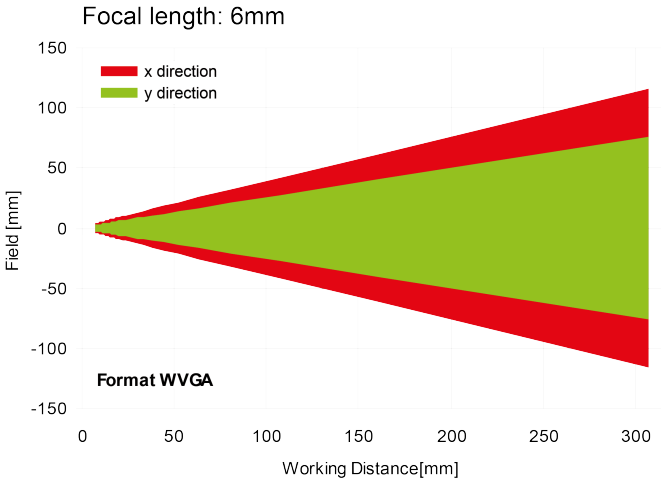
Fig. 361: Field of view 6mm lens, internal

Field of view R3B 12mm lens, internal

Focal length: 12mm
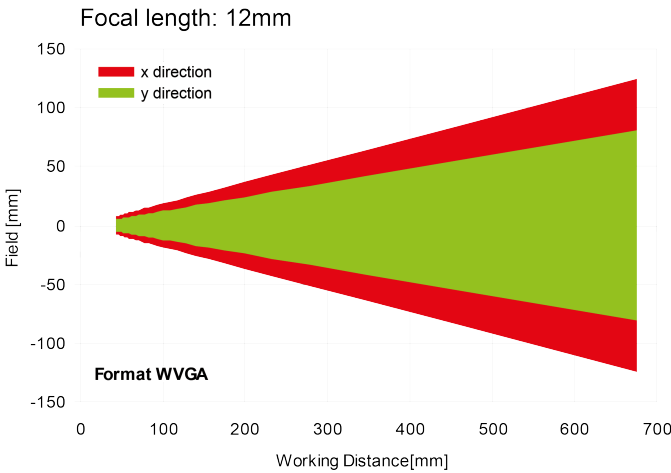
Fig. 362: Field of view 12mm lens, internal

Field of view R2B 12mm lens, internal
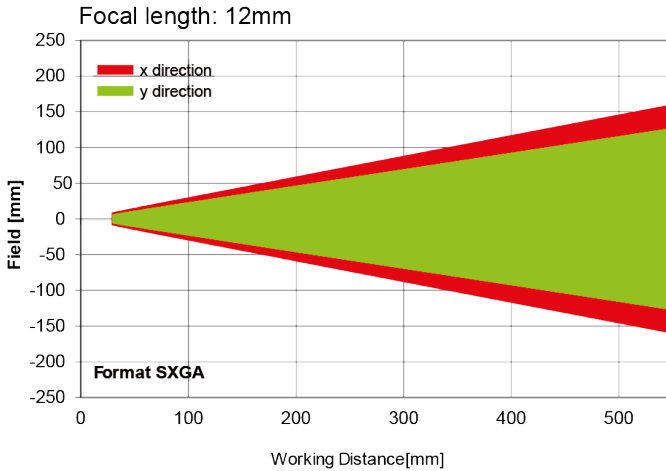
Fig. 363: Field of view R2B 12mm lens, internal

Depth of view R3B 6mm lens internal, normal
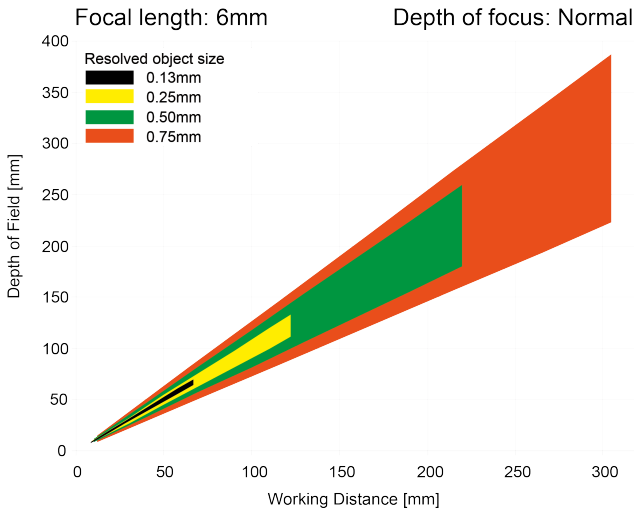
Fig. 364: Depth of view 6mm lens internal, normal

Depth of view R3B 6mm lens internal, enhanced
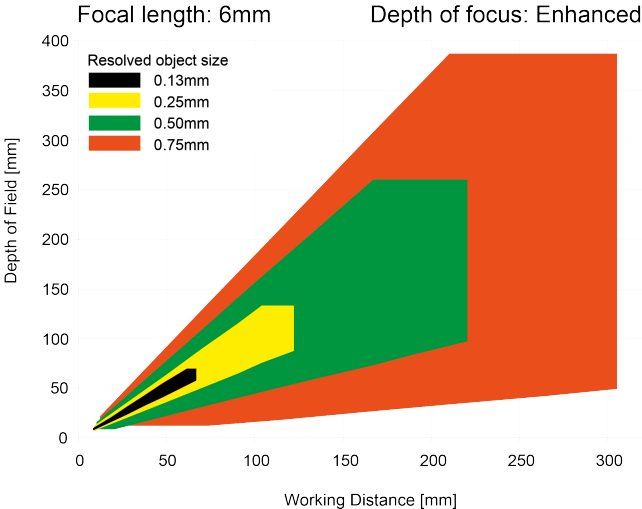
Fig. 365: Depth of view 6mm lens internal, enhanced

Depth of view R3B 12mm lens internal, normal
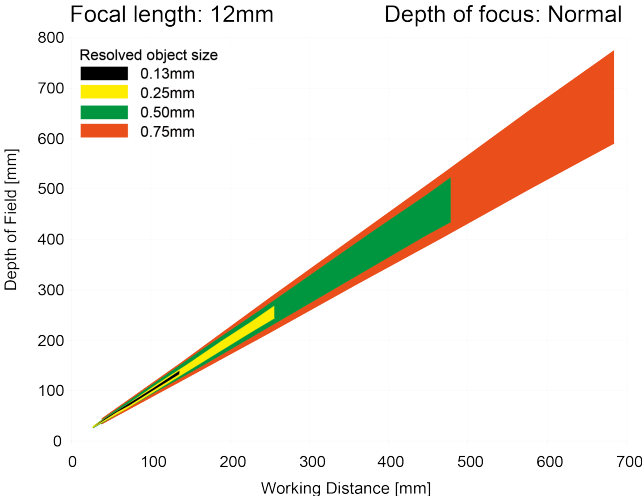
Fig. 366: Depth of view 12mm lens internal, normal

Depth of view R3B 12mm lens internal, enhanced
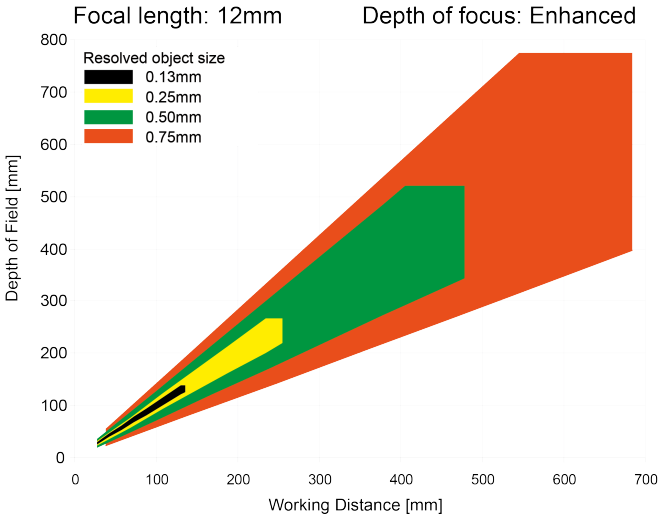
Fig. 367: Depth of view 12mm lens internal, enhanced

Depth of view R2B 12mm lens internal, normal
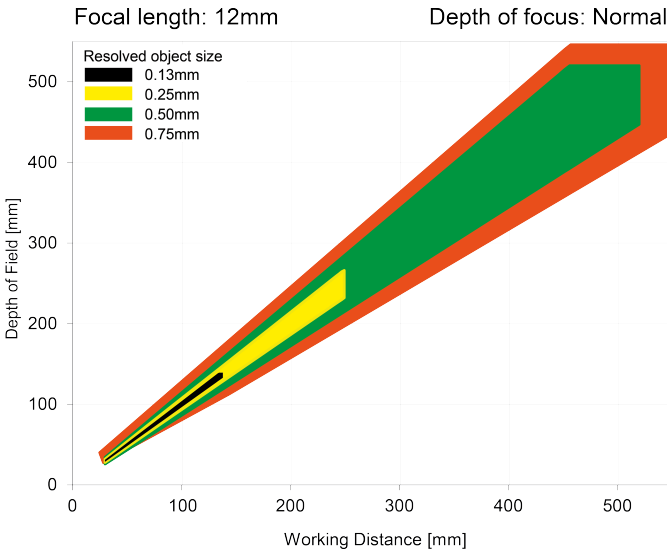
Fig. 368: Depth of view R2B 12mm lens internal, normal

14 Sensor types

14.1 Universal

R3B Universal

Advanced					
Part no.	Type	Focal length	Depth of focus	Min. operating distance / mm	Min. Field of view mm x mm
C-Mount					
8058737	SBSC-U-AF-R3B [1]	C-Mount		lens dependent	lens dependent

R2B Universal

Advanced					
Part no.	Type	Focal length	Depth of focus	Min. operating distance / mm	Min. Field of view mm x mm
C-Mount					
8058736	SBSC-U-AF-R2B [1]	C-Mount		lens dependent	lens dependent

[1] When using the C-Mount-version of the SBS vision sensor, a C-Mount lens with a 5 mm intermediate ring (delivered separately) or a C-Mount protective case is required.

Please note:

For longer operating distances (from approx. 200 mm) external illumination may be necessary.
External IR illumination is only possible with IR sensors or C-Mount sensors.C-Mount

14.2 Color

R3C Color

Advanced					
Part no.	Type	Focal length	Depth of focus	Min. operating distance / mm	Min. Field of view mm x mm
Internal illumination White					
8058733	SBSI-F-AF-R3C-F6-W	6	Normal	6	5 x 4
8058734	SBSI-F-AF-R3C-F12-W	12	Normal	30	8 x 6
C-Mount					
8058735	SBSC-F-AF-R3C [1]	C-Mount		lens dependent	lens dependent

Standard					
Part no.	Type	Focal length	Depth of focus	Min. operating distance / mm	Min. Field of view mm x mm
Internal illumination White					
8058731	SBSI-F-R3C-F6-W	6	Normal	6	5 x 4
8058732	SBSI-F-R3C-F12-W	12	Normal	30	8 x 6

[1] When using the C-Mount-version of the SBS vision sensor, a C-Mount lens with a 5 mm intermediate ring (delivered separately) or a C-Mount protective case is required.

Please note:

For longer operating distances (from approx. 200 mm) external illumination may be necessary.
External IR illumination is only possible with IR sensors or C-Mount sensors.C-Mount

14.3 Object

R3B Object

Advanced					
Part no.	Type	Focal length	Depth of focus	Min. operating distance / mm	Min. Field of view mm x mm
Internal illumination White					
8058724	SBSI-Q-AF-R3B-F6-W	6	Normal	6	5 x 4
8058725	SBSI-Q-AF-R3B-F12-W	12	Normal	30	8 x 6
Internal illumination Infrared					
8058726	SBSI-Q-AF-R3B-F6-NR	6	Normal	6	5 x 4
8058727	SBSI-Q-AF-R3B-F12-NR	12	Normal	30	8 x 6
C-Mount					
8058728	SBSC-Q-AF-R3B [1]	C-Mount		lens dependent	lens dependent

Standard					
Part no.	Type	Focal length	Depth of focus	Min. operating distance / mm	Min. Field of view mm x mm
Internal illumination White					
2942261	SBSI-Q-R3B-F6-W	6	Normal	6	5 x 4
2942262	SBSI-Q-R3B-F12-W	12	Normal	30	8 x 6
Internal illumination Infrared					

Standard

Part no.	Type	Focal length	Depth of focus	Min. operating distance / mm	Min. Field of view mm x mm
2942265	SBSI-Q-R3B-F6-NR	6	Normal	6	5 x 4
2942266	SBSI-Q-R3B-F12-NR	12	Normal	30	8 x 6

R2B Object

Advanced					
Part no.	Type	Focal length	Depth of focus	Min. operating distance / mm	Min. Field of view mm x mm
Internal illumination White					
8058730	SBSI-Q-AF-R2B-F12-W	12	Normal	30	16 x 13

*1 When using the C-Mount-version of the SBS vision sensor, a C-Mount lens with a 5 mm intermediate ring (delivered separately) or a C-Mount protective case is required.

Please note:
For longer operating distances (from approx. 200 mm) external illumination may be necessary.
External IR illumination is only possible with IR sensors or C-Mount sensors.C-Mount

14.4 Code Reader

R3B Code Reader

Advanced					
Part no.	Type	Focal length	Depth of focus	Min. operating distance / mm	Min. Field of view mm x mm
Internal illumination White					
8058715	SBSI-B-AF-R3B-F6-W	6	Normal	6	5 x 4
8058716	SBSI-B-AF-R3B-F12-W	12	Normal	30	8 x 6
Internal illumination Red					
8058717	SBSI-B-AF-R3B-F6-R	6	Normal	6	5 x 4
8058718	SBSI-B-AF-R3B-F12-R	12	Normal	30	8 x 6
Internal illumination Infrared					
8058719	SBSI-B-AF-R3B-F6-NR	6	Normal	6	5 x 4
8058720	SBSI-B-AF-R3B-F12-NR	12	Normal	30	8 x 6
C-Mount					
8058721	SBSC-B-AF-R3B [*1]	C-Mount		lens dependent	lens dependent

Standard					
Part no.	Type	Focal length	Depth of focus	Min. operating distance / mm	Min. Field of view mm x mm
Internal illumination White					

Standard					
Part no.	Type	Focal length	Depth of focus	Min. operating distance / mm	Min. Field of view mm x mm
2930232	SBSI-B-R3B-F6-W	6	Normal	6	5 x 4
2930233	SBSI-B-R3B-F12-W	12	Normal	30	8 x 6
2930242	SBSI-B-R3B-F6-W-D	6	Enhanced	6	5 x 4
2930243	SBSI-B-R3B-F12-W-D	12	Enhanced	30	8 x 6
Internal illumination Red					
2930234	SBSI-B-R3B-F6-R	6	Normal	6	5 x 4
2930235	SBSI-B-R3B-F12-R	12	Normal	30	8 x 6
2930236	SBSI-B-R3B-F6-R-D	6	Enhanced	6	5 x 4
2930237	SBSI-B-R3B-F12-R-D	12	Enhanced	30	8 x 6
Internal illumination Infrared					
2930238	SBSI-B-R3B-F6-NR	6	Normal	6	5 x 4
2930239	SBSI-B-R3B-F12-NR	12	Normal	30	8 x 6
2930240	SBSI-B-R3B-F6-NR-D	6	Enhanced	6	5 x 4
2930241	SBSI-B-R3B-F12-NR-D	12	Enhanced	30	8 x 6

R2B Code Reader

Advanced

Part no.	Type	Focal length	Depth of focus	Min. operating distance / mm	Min. Field of view mm x mm
Internal illumination Red					
8058723	SBSI-B-AF-R2B-F12-R	12	Normal	30	16 x 13
C-Mount					
8058722	SBSC-B-AF-R2B [*1]	C-Mount		lens dependent	lens dependent

*1 When using the C-Mount-version of the SBS vision sensor, a C-Mount lens with a 5 mm intermediate ring (delivered separately) or a C-Mount protective case is required.

Please note:

For longer operating distances (from approx. 200 mm) external illumination may be necessary.
External IR illumination is only possible with IR sensors or C-Mount sensors.C-Mount

15 Type key

| SBS | I | - | B | - | (AF) | - | R3 | B | - | F6 | - | W | - | D |

SBS	S = Sensors, B = image control system, S = Vision Sensor
I	Integral illumination/ optic
C	CS-Mount / C-Mount optic
Q	Object Sensor
B	Code Reader
F	Color Sensor
U	Universal Sensor
AF	Extended (at functional range)
R3	Resolution 736 x 480 pixel
R2	Resolution 1280 x1024 pixel
B	Monochrom („black & white")
C	Color
F6	6mm optic
F12	12mm optic
W	Illumination white
R	Illumination red
NR	Illumination infrared
D	Enhanced depth of focus

16 Cleaning

The SBS vision sensor is to be cleaned with a clean, dry cloth.

Dirt on the front panel is to be cleaned with a soft cloth and a small amount of plastic cleaner if necessary.

Attention:

- Never use aggressive detergents such as solvents or benzine.
- Never use sharp objects. Do not scratch!

17 Addendum

17.1 Telegram, Data output

This topic describes the telegrams available for the SBS vision sensor. These telegrams can be sent to SBS vision sensor via different interfaces.

- Serial interface RS422 / RS232
- Ethernet TCP/IP
- PROFINET (request / response modul)

The telegrams are available in ASCII and Binary format. The format can be selected in the module "Vision Sensor Configuration Studio", in tab "data output" of the setup "Output".

The following settings are possible:

Communication	TCP / IP	RS422 / RS232	EtherNet/IP	PROFINET
Telegram format	ASCII / Binary	ASCII / Binary	Binary	Binary

17.1.1 Overview telegram

17.1.1.1 SBS in general

- **Reset statistic** (ASCII / Binary)
  With the telegram "Reset statistic" the internal statistic counter of the SBS vision sensor can be reset.

17.1.1.2 SBS control

- **Trigger** (ASCII / Binary)
  With the telegram "Trigger" an image acquisition will be started. Some commands need an additional image acquisition. The result data of the image are transferred via the "Out" port.
- **Extended Trigger** (ASCII/ Binary)
  This telegram is an enhancement to the "trigger" telegram. Besides the result data there is also the option to assign an ID or to receive information about the operating mode (run / config). Unlike the "trigger" telegram the result data of "Extended trigger" telegram are also transferred via the "In" port.
- **Change job** (ASCII / Binary)
  With the telegram "Change job" a job change on the SBS vision sensor is initiated.

- **Change job permanent** (ASCII / Binary)
  With the telegram "Change job permanent" a permanent job change on the SBS vision sensor is initiated. The job runs again after restarting.

17.1.1.3 SBS job settings

- **Set shutter speed** (ASCII / Binary)
  With the telegram "Set shutter speed" the shutter speed of the job can be changed. The telegram can be used for e.g. brightness compensation.
- **Get shutter speed** (ASCII / Binary)
  With the telegram "Get shutter speed" the set shutter speed of the job can be read.
- **Set gain** (ASCII / Binary)
  With the telegram "Set gain" the gain of the job can be changed. The telegram can be used for e.g. brightness compensation.
- **Get gain** (ASCII/ Binary)
  With the telegram "Get gain" the set gain of the job can be read.
- **Set parameter** (ASCII / Binary)
  With the telegram "Set parameter" the detector parameters can be adjusted, e.g. reference strings, detector thresholds.
- **Get parameter** (ASCII / Binary)
  With the telegram "Get parameter" the set parameters of the detector can be read.
- **Set ROI** (ASCII / Binary)
  With the telegram "Set ROI" the position of the selected detector can be changed.
- **Get ROI** (ASCII/ Binary)
  With the telegram "Get ROI" the position of the selected detector can be read.
- **Get job list** (ASCII/ Binary)
  With the telegram "Get job list" a list of all available jobs on the SBS vision sensor will be displayed.
- **Get detector list** (ASCII / Binary)
  With the telegram "Get detector list " a list of all detectors in the current job will be displayed.
- **Teach detector** (ASCII / Binary)
  With the telegram "Teach detector" the selected detector is re-taught (only for pattern matching and contour detection).
- **Set trigger delay** (ASCII / Binary)
  With the telegram "Set trigger delay" a delay for starting a trigger can be set (in time (ms) or encoder steps).
- **Get trigger delay** (ASCII / Binary)
  With the telegram "Get trigger delay" the delay for starting a trigger can be read.

17.1.1.4 SBS calibration

- **Calibration: Clear point list** (ASCII / Binary)
  With the telegram "Calibration: Clear point list" the point list will be initialized.

- **Calibration: Add world point** (ASCII/ Binary)
  With the telegram "Calibration: Add world point" a point (fiducial or point pair) is added to the point list. The telegram can be used for the calibration method Point pair list (Robotics) and Calibration plate (Robotics).

- **Calibration: Add point** (ASCII/ Binary) - *Discontinued*
  With the telegram "Calibration: Add point" a point is added to the point list.

- **Calibration: Calibrate by point list** (ASCII / Binary)
  With the telegram "Calibration: Calibrate by point list" the calibration is carried out using the point list in the current job.

- **Calibration: Validate point list** (ASCII / Binary)
  With the telegram "Calibration: Validate point list" the calibration is validated using the point list.

- **Calibration: Calibrate by plate** (ASCII / Binary)
  With the telegram "Calibration: Calibrate by plate" the calibration is carried out using the calibration plate.

- **Calibration: Copy calibration** (ASCII / Binary)
  With the telegram "Calibration: Copy calibration" the calibration of the current job will be copied to the selected destination.

- **Calibration: Set parameter** (ASCII / Binary)
  With the telegram "Calibration: Set parameter" the parameter values for the calibration can be set.

- **Calibration: Get parameter** (ASCII / Binary)
  With the telegram "Calibration: Get parameter" the parameter values of the calibration can be read.

17.1.1.5 SBS visualization

- **Get image** (ASCII/ Binary)
  With the telegram "Get image" the image from SBS vision sensor will be received.

17.1.1.6 SBS Service

- **Update visualization results** (ASCII)
  With the telegram "Update visualization results" the visualization results, e.g. image, detector information and results are updated.

- **Get sensor identity** (ASCII)

  With the telegram "Get sensor identity" the current firmware status as well as the hardware type can be queried.

- **Update firmware** (ASCII)

  With the telegram "Update firmware" the firmware updates are started. Previously the firmware file must be loaded onto the SBS vision sensor.

- **Set jobset** (ASCII)

  With the telegram "Set jobset" the jobset of the SBS vision sensor can be changed. Previously the jobset file must be loaded onto the SBS.

- **Get jobset** (ASCII)

  With the telegram "Get jobset" the jobset of the SBS vision sensor can be read.

17.1.1.7 Data output

(ASCII / Binary)

This section provides information about the data output. Especially, which format the individual results receive.

17.1.2 Telegrams: Availability and supported interfaces

Telegram	U Advanced	OB Standard	OB Advanced	CR Standard	CR Advanced	CO Standard	CO Advanced	Ethernet TCP IN (2006)	PROFINET	Seriell	EtherNet/IP	Service Port (1998)	From version
In general													
Reset statistic	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		1.18.
Control													
Trigger	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		1.0.
Extended trigger	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		1.6.
Change job	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		1.0.
Change job permanent	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		1.18.
Job settings													
Set shutter speed	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		1.0.
Get shutter speed	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		1.0.
Set gain	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		1.6.
Get gain	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		1.6.
Set parameter	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		1.0.
Get parameter	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		1.0.
Set ROI	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		1.0.
Get ROI	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		1.0.
Get job list	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		1.18.
Get detector list	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		1.18.
Teach detector	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		1.0.
Set trigger delay	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			1.22.
Get trigger delay	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			1.22.

Telegram	U Advanced	U Standard	OB Advanced	OB Standard	CR Advanced	CR Standard	CO Advanced	Ethernet TCP IN (2006)	PROFINET	Seriell	EtherNet/IP	Service Port (1998)	From version
Calibration													
Clear point list	✓		✓				✓	✓	✓	✓			1.18.
Add world point	✓		✓				✓	✓	✓	✓			1.22.
Add point	✓		✓				✓	✓	✓	✓			1.18.
Calibrate by point list	✓		✓				✓	✓	✓	✓			1.18.
Validate calibration	✓		✓				✓	✓	✓	✓			1.18.
Calibrate by calibration plate								✓	✓	✓			1.19.
Set fiducials								✓	✓	✓			1.22.
Copy calibration								✓	✓	✓			1.19.
Set parameter								✓	✓	✓			1.22.
Get parameter								✓	✓	✓			1.22.
Visualization													
Get image	✓	✓	✓	✓	✓	✓	✓	✓		✓			1.0.
Service													
Update visualization data	✓		✓		✓		✓					✓	1.22.
Get sensor identity	✓		✓		✓		✓					✓	1.19.
Update Firmware	✓		✓		✓		✓					✓	1.19.
Set jobset	✓		✓		✓		✓					✓	1.19.
Get jobset	✓		✓		✓		✓					✓	1.19.

17.1.3 Error codes

Error code	Description
000	Success

Error code	Description
001	Error
00	Insufficient parameter data
005	Invalid telegram
006	Input parameters with invalid size or invalid value
007	File does not exist
008	Recorder off
009	No matching image of requested type
010	Invalid name or length
011	Invalid data length
012	Not allowed due to jobset mismatch
013	Failed to start new job from jobset
016	Firmware version mismatch
018	Calibration plate data not available
020	More than one vis-file present
021	Sensor type does not match for vis-file
030	Calibration not enabled
031	Calibration copy error
032	Mismatched input conditions for destination Job
033	Calibrate / Validate error
034	Invalid number of points
035	Calibration add point error, e.g. last job result fail
036	Invalid fiducial
037	Error: Protect job set. Job change "permanent" is not allowed.
038	Parameter values are not available for write / read.
039	Sensor is in configuration mode. The telegram is rejected.

Error code	Description
040	Error during parameter value read / write.

17.1.4 Serial Communication ASCII

Reset statistic (ASCII)

Overview telegram SBS in general

Telegrams: Availability and supported interfaces (Page 415)

Reset statistic (ASCII) Request string to sensor		
Byte No.	Content	Significance
1	R	Reset statistic
2	S	
3	T	
Example:	RST	
Reset statistic (ASCII) Response string from sensor		
Byte No.	Content	Significance
1	R	Reset statistic
2	S	
3	T	
4	P F	P Pass F Fail
Example:	RSTP	
Additional information:		
Accepted in run mode:	Yes	
Accepted in config mode:	No	
Accepted when Ready is Low:	Yes	
Status of Ready signal during processing:	Not altered	
Supported interfaces:	Telegrams: Availability and supported interfaces (Page	

	415)
End of telegram:	Max. 4 byte (option)

Trigger (ASCII)

Overview telegram SBS control

Telegrams: Availability and supported interfaces (Page 415)

Trigger (ASCII) Request string to sensor		
Byte No.	Content	Significance
1	T	Trigger, (simple trigger without index, in-port)
2	R	
3	G	
Example:	TRG	
Trigger (ASCII) Response string from sensor		
Byte No.	Content	Significance
1	T	Trigger, (response to trigger without index, via port 2006. If defined: result data without index via port 2005)
2	R	
3	G	
4	P F	P Pass F Fail
Example:	TRGP	
Additional information:		
Accepted in run mode:		Yes
Accepted in config mode:		Yes
Accepted when Ready is Low:		No
Status of Ready signal during processing:		Low
Supported interfaces:		Telegrams: Availability and supported interfaces (Page 415)
End of telegram:		Max. 4 byte (option)

Extended trigger (ASCII)

Overview telegram SBS control

Telegrams: Availability and supported interfaces (Page 415)

Extended trigger (ASCII) Request string to sensor		
Byte No.	Content	Significance
1	T	Extended Trigger command, (trigger with index for correlation of trigger to the correponding result data, via port 2006)
2	R	
3	X	
4 - 5	X	Length of following data (n)
6 ... n	X	Data
Example:	TRX06MyPart	
Extended trigger (ASCII) Response string from sensor		
Byte No.	Content	Significance
1	T	Extended Trigger command, (response to trigger with index and result data, via port 2006, for correlation of trigger to corresponding result. Result data without index, via port 2005 also)
2	R	
3	X	
4	P F	P Pass F Fail
5 - 6	X	Length of following data (n)
7 ... n	X	Data of request command
n+1	C R	C = Config R = Run
n+2 ... n+9	X	Length of following data (n)
n+9 ... m	X	Result data

Example:	TRX06MyPartR00000000	
Additional information:		
Accepted in run mode:	Yes	
Accepted in config mode:	Yes	
Accepted when Ready is Low:	No	
Status of Ready signal during processing:	Low	
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)	
End of telegram:	Max. 4 byte (option)	

Change job (ASCII)

Overview telegram SBS control

Telegrams: Availability and supported interfaces (Page 415)

Change job (ASCII) Request string to sensor		
Byte No.	Content	Significance
1	C	Change job
2	J	
3	B	
4 - 6	X	Job number
Example:	CJB005	
Change job (ASCII) Response string from sensor		
Byte No.	Content	Significance
1	C	Change job
2	J	
3	B	
4	P F	P Pass F Fail
5	T F	Triggered Freerun
6 - 8	X	Job number
Example 1: Example 2:	CJBPT005 CJBFF005	
Additional information:		
Accepted in run mode:		Yes
Accepted in config mode:		No
Accepted when Ready is Low:		Yes

Status of Ready signal during processing:	Low
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)
End of telegram:	Max. 4 byte (option)

Please note:
If an error occurs during the job change, it is possible to change to job 1.

Change job permanent (ASCII)

Overview telegram SBS control

Telegrams: Availability and supported interfaces (Page 415)

Change job permanent (ASCII) Request string to sensor		
Byte No.	Content	Significance
1	C	Change job permanent
2	J	
3	P	
4 - 6	X	Job number
Example:	CJP005	
Change job permanent (ASCII) Response string from sensor		
Byte No.	Content	Significance
1	C	Change job permanent
2	J	
3	P	
4	P F	P Pass F Fail
5	T F	Triggered Freerun
6 - 8	X	Job number
Example 1: Example 2:	CJPPT005 CJPFF005	
Additional information:		
Accepted in run mode:	Yes	
Accepted in config mode:	No	
Accepted when Ready is Low:	Yes	
Status of Ready signal during	Low	

processing:	
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)
End of telegram:	Max. 4 byte (option)

Please note:
If an error occurs during the job change, it is possible to change to job 1.

Set shutter speed (ASCII)

Overview telegram SBS job settings

Telegrams: Availability and supported interfaces (Page 415)

Set shutter speed (ASCII) Request string to sensor		
Byte No.	Content	Significance
1	S	Set shutter speed
2	S	
3	P T	P = Permanent Temporary Permanent change affect all parameters, including those that have only been changed temporarily.
4 - 5	X	Number of chars of shutter value, e.g. 04
6 - 9	X	New shutter value in microseconds, e.g. 8000 = 8 ms
Example:	SSP048000	
Set shutter speed (ASCII) Response string from sensor		
Byte No.	Content	Significance
1	S	Set shutter speed
2	S	
3	P T	P = Permanent Temporary Permanent change affect all parameters, including those that have only been changed temporarily.
4	P F	P Pass F Fail
Example:	SSPP	
Additional information:		
Accepted in run mode:	Yes	

Accepted in config mode:	No
Accepted when Ready is Low:	Yes
Status of Ready signal during processing:	Low
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)
End of telegram:	Max. 4 byte (option)

Get shutter speed (ASCII)

Overview telegram SBS job settings

Telegrams: Availability and supported interfaces (Page 415)

Get shutter speed (ASCII) Request string to sensor		
Byte No.	Content	Significance
1	G	Get shutter speed (from active job)
2	S	
3	H	
Example:	GSH	
Get shutter speed (ASCII) Response string from sensor		
Byte No.	Content	Significance
1	G	Get shutter speed
2	S	
3	H	
4	P F	P Pass F Fail
5	X	Shutter value length
6 … n	X	Shutter value
Beispiel Run Mode: Example configuration mode:	GSHP41200 GSHF0	
Additional information:		
Accepted in run mode:	Yes	
Accepted in config mode:	No	
Accepted when Ready is Low:	Yes	
Status of Ready signal during processing:	Not altered	
Supported interfaces:	Telegrams: Availability and supported interfaces	

	(Page 415)
End of telegram:	Max. 4 byte (option)

Set gain (ASCII)

Overview telegram SBS job settings

Telegrams: Availability and supported interfaces (Page 415)

Set gain (ASCII) Request string to sensor		
Byte No.	Content	Significance
1	S	Set Gain
2	G	
3	A	
4	0 1	0: Temporary 1: Permanent Permanent change affect all parameters, including those that have only been changed temporarily.
5 - 9	X	New gain value (in value * 1000), e.g. 2.0 = 02000
Example:	SGA102000	
Set gain (ASCII) Response string from sensor		
Byte No.	Content	Significance
1	S	Set Gain
2	G	
3	A	
4	P F	P Pass F Fail
5 - 9	X	Current gain
Example:	SGAP02000	
Additional information:		
Accepted in run mode:	Yes	
Accepted in config mode:	No	
Accepted when Ready is	Yes	

Low:	
Status of Ready signal during processing:	Not altered
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)
End of telegram:	Max. 4 byte (option)

Get gain (ASCII)

Overview telegram SBS job settings

Get gain (ASCII) Request string to sensor		
Byte No.	Content	Significance
1	G	
2	G	Get Gain
3	A	
Example:	GGA	
Get gain (ASCII) Response string from sensor		
Byte No.	Content	Significance
1	G	
2	G	Get Gain
3	A	
4	P F	P Pass F Fail
5 - 9	X	Current gain value (value *1000), e.g. 1,0 = 01000
Example:	GGAP01000	
Additional information:		
Accepted in run mode:	Yes	
Accepted in config mode:	No	
Accepted when Ready is Low:	Yes	
Status of Ready signal during processing:	Not altered	
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)	
End of telegram:	Max. 4 byte (option)	

Set parameter (ASCII)

Overview telegram SBS job settings

Telegrams: Availability and supported interfaces (Page 415)

Set parameter (ASCII) Request string to sensor		
Byte No.	Content	Significance
1	S	Set parameter
2	P	
3	P T	P Permanent T Temporary Permanent change affect all parameters, including those that have only been changed temporarily.
4 - 6	X	Detector number
7 - 9	X	Command reference string / Set value *1), see below !
10 - 14	X	Length of reference string / value in Bytes (n)
15 ... n	X	Reference string / value
Example:	SPP0010010044196	
Set parameter (ASCII) Response string from sensor		
Byte No.	Content	Significance
1	S	Set parameter
2	P	
3	P T	P Permanent T Temporary Permanent change affect all parameters, including those that have only been changed temporarily.
4	P F	P Pass F Fail

5	S	SI08 - Signed Integer 08 UI08 - Unsigned Integer 08 SI16 - Signed Integer 16 UI16 - Unsigned Integer 16
6	T	SI32 - Signed Integer 32 UI32 - Unsigned Integer 32 SI40 - Signed Integer 40 UI40 - Unsigned Integer 40
7	R	FLOT - Float DOBL - Double STRG - String BOOL - Boolean
8	G	SP08 - Special Signed 8 UDEF - Undefined IARR - Integer Array ZERO - Default Zero Parameter
Example:	SPPPSTRG	
Additional information:		
Accepted in run mode:	Yes	
Accepted in config mode:	No	
Accepted when Ready is Low:	Yes	
Status of Ready signal during processing:	Low	
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)	
End of telegram:	Max. 4 byte (option)	

*1) Byte No. 7: Command: set reference string / value:

Detector	Function	Command
Alignment Pattern matching	Threshold Min Threshold Max ResultOffsetPos_X	001 002 031

Detector	Function	Command
	ResultOffsetPos_Y ResultOffsetAngle	032 033
Alignment Contour detection	Threshold Min Threshold Max ResultOffsetPos_X ResultOffsetPos_Y ResultOffsetAngle	001 002 031 032 033
Alignment Edge detector	Transition probe 1 Transition probe 2 Transition probe 3 Score min probe 1 Score min probe 2 Score min probe 3	101 102 103 104 105 106
Pattern matching	Threshold Min Threshold Max ResultOffsetPos_X ResultOffsetPos_Y ResultOffsetAngle	001 002 031 032 033
Contour	Threshold Min Threshold Max ResultOffsetPos_X ResultOffsetPos_Y ResultOffsetAngle	001 002 031 032 033
Gray level	Threshold Min Threshold Max GrayMin GrayMax GreyInvert	001 002 101 102 103
Contrast	Threshold Min Threshold Max	001 002
Brightness	Threshold Min Threshold Max	001 002
Barcode	Reference String	101
Datacode	Reference String	101
OCR	Reference String	101
Color value	ColorMinChannel1	101

Detector	Function	Command
	ColorMaxChannel1	102
	ColorInvertChannel1	103
	ColorMinChannel2	104
	ColorMaxChannel2	105
	ColorInvertChannel2	106
	ColorMinChannel3	107
	ColorMaxChannel3	108
	ColorInvertChannel3	109
Color area	ColorMinChannel1	101
	ColorMaxChannel1	102
	ColorInvertChannel1	103
	ColorMinChannel2	104
	ColorMaxChannel2	105
	ColorInvertChannel2	106
	ColorMinChannel3	107
	ColorMaxChannel3	108
	ColorInvertChannel3	109
BLOB	GrayAbsoluteMin	101
	GrayAbsoluteMax	102
	GrayAbsoluteInvert	103

Get parameter (ASCII)

Get parameter (ASCII) Request string to sensor		
Byte No.	Content	Significance
1	G	
2	P	Get parameter
3	A	
4 - 6	X	Detector number e.g. 001
7 - 9	X	Command: Set reference string / value *1), see below !
Example:	GPA001001	
Get parameter (ASCII) Response string from sensor		
Byte No.	Content	Significance
1	G	
2	P	Get parameter
3	A	
4	P F	P Pass F Fail

5	S	SI08 - Signed Integer 08 UI08 - Unsigned Integer 08 SI16 - Signed Integer 16 UI16 - Unsigned Integer 16
6	T	SI32 - Signed Integer 32 UI32 - Unsigned Integer 32 SI40 - Signed Integer 40 UI40 - Unsigned Integer 40
7	R	FLOT - Float DOBL - Double STRG - String BOOL - Boolean
8	G	SP08 - Special Signed 8 UDEF - Undefined IARR - Integer Array ZERO - Default Zero Parameter
9 - 13	X	Length of Reference strings / value (n) e.g. 00005
14 … n	X	Reference string / value
Example:	GPAPSTRG00005Test1	
Additional information:		
Accepted in run mode:	Yes	
Accepted in config mode:	No	
Accepted when Ready is Low:	Yes	
Status of Ready signal during processing:	Not altered	
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)	
End of telegram:	Max. 4 byte (option)	

*1) Byte No.. 7: Command: Get reference string / value:

Detector	Function	Command
Alignment Pattern matching	Threshold Min Threshold Max ResultOffsetPos_X ResultOffsetPos_Y ResultOffsetAngle	001 002 031 032 033
Alignment Contour detection	Threshold Min Threshold Max ResultOffsetPos_X ResultOffsetPos_Y ResultOffsetAngle	001 002 031 032 033
Alignment Contour detection	Transition probe 1 Transition probe 2 Transition probe 3 Score min probe 1 Score min probe 2 Score min probe 3	101 102 103 104 105 106
Pattern matching	Threshold Min Threshold Max ResultOffsetPos_X ResultOffsetPos_Y ResultOffsetAngle	001 002 031 032 033
Contour	Threshold Min Threshold Max ResultOffsetPos_X ResultOffsetPos_Y ResultOffsetAngle	001 002 031 032 033
Gray level	Threshold Min Threshold Max GrayMin GrayMax GreyInvert	001 002 101 102 103
Contrast	Threshold Min Threshold Max	001 002
Brightness	Threshold Min Threshold Max	001 002
Barcode	Reference String	101

Detector	Function	Command
Datacode	Reference String	101
OCR	Reference String	101
Color value	ColorMinChannel1 ColorMaxChannel1 ColorInvertChannel1 ColorMinChannel2 ColorMaxChannel2 ColorInvertChannel2 ColorMinChannel3 ColorMaxChannel3 ColorInvertChannel3	101 102 103 104 105 106 107 108 109
Color area	ColorMinChannel1 ColorMaxChannel1 ColorInvertChannel1 ColorMinChannel2 ColorMaxChannel2 ColorInvertChannel2 ColorMinChannel3 ColorMaxChannel3 ColorInvertChannel3	101 102 103 104 105 106 107 108 109
BLOB	GrayAbsoluteMin GrayAbsoluteMax GrayAbsoluteInvert	101 102 103

Set ROI (ASCII)

Overview telegram SBS job settings

Telegrams: Availability and supported interfaces (Page 415)

Set ROI (ASCII) Request string to sensor		
Byte No.	Content	Significance
1	S	Set ROI
2	R	
3	P T	P = Permanent T = Temporary Permanent change affect all parameters, including those that have only been changed temporarily.
4 - 11	X	ROI Info length in bytes from Byte 4 to end e.g. 00000055
12 - 14	X	Detector No. e.g. 001
15 - 16	X	ROI Index = 00 for yellow ROI = 01 for red ROI = 02 for position control
17 - 18	X	ROI shape 01=circle 02=rectangle 03=ellipse 04=free shape
19 - 26	X	Center X (value in pixel * 1000), e.g. 160 pixel = 00160000
27 - 34	X	Center Y (value in pixel * 1000), e.g. 120 pixel = 00120000
35 - 42	X	Half width / X-radius (in pixels * 1000), e.g. 80 Pixel = 00080000

43 - 50	X	Half height / Y-radius (in pixels * 1000), e.g. 40 Pixel = 00040000
51 - 58	X	Angle (not at circle / ellipse) (in ° * 1000), e.g. 180° = 00180000
Example:	SRP00000055001000200160000001200000008000000040000001800000 Length 55, Detector=1, yellow ROI, rectangle, center X=160, center Y=120, half width= 80, half height=40	

Set ROI (ASCII) Response string from sensor		
Byte No.	Content	Significance
1	S	Set ROI
2	R	
3	P T	P = Permanent Temporary Permanent change affect all parameters, including those that have only been changed temporarily.
4	P F	P Pass F Fail
Example:	SRPP	
Additional information:		
Accepted in run mode:		Yes
Accepted in config mode:		No
Accepted when Ready is Low:		Yes
Status of Ready signal during processing:		Low
Supported interfaces:		Telegrams: Availability and supported interfaces (Page 415)
End of telegram:		Max. 4 byte (option)
Parameter:		The parameter are given in alignment frames and not in image frames.

Get ROI (ASCII)

Overview telegram SBS job settings

Telegrams: Availability and supported interfaces (Page 415)

Get ROI (ASCII) Request string to sensor		
Byte No.	Content	Significance
1	G	
2	R	Get ROI
3	I	
4 - 6	X	Detector No. e.g. 001
7 - 8	X	ROI Index = 00 for yellow ROI = 01 for red ROI = 02 for position control
Example:	GRI00100	
Get ROI (ASCII) Response string from sensor		
Byte No.	Content	Significance
1	G	
2	R	Get ROI
3	I	
4	P F	P Pass F Fail
5 - 12	X	ROI Info Länge in Bytes, ab Byte 5 bis Ende String
13 - 15	X	Detector No. e.g. 001
16 - 17	X	ROI Index = 00 for yellow ROI

		= 01 for red ROI = 02 for position control
18 - 19	X	ROI shape 01=circle 02=rectangle 03=ellipse 04=free shape
20 - 27	X	Centre X (value in pixels * 1000)
28 - 35	X	Centre Y (value in pixels * 1000)
36 - 43	X	Half width /X-radius (value in pixels * 1000)
44 - 51	X	Half height /Y-radius (value in pixels * 1000)
52 - 59	X	Angle (not at circle / ellipse) (valuein ° * 1000)
Example:		GRIP0000005500100020016000000120000000800000004000000090000 (Length= 55, detector 1, search region, rectangle, Centre X=160, Centre Y=120, half width =80, half height =40, angle = 90)
Additional information:		
Accepted in run mode:		Yes
Accepted in config mode:		No
Accepted when Ready is Low:		Yes
Status of Ready signal during processing:		Low
Supported interfaces:		Telegrams: Availability and supported interfaces (Page 415)
End of telegram:		Max. 4 byte (option)

Get job list (ASCII)

Overview telegram SBS job settings

Telegrams: Availability and supported interfaces (Page 415)

Get job list (ASCII) Request string to sensor		
Byte No.	Content	Significance
1	G	
2	J	Get Job List
3	L	
Example:	GJL	
Get job list (ASCII) Response string from sensor		
Byte No.	Content	Significance
1	G	
2	J	Get Job List
3	L	
4	P F	P Pass F Fail
5 - 7	X	Response version
8 - 10	X	Number of jobs
11 - 13	X	Active job number
	ⓘ	**Please note:** The following byte sequence is repeated for each job from 1 to "Number of jobs". The byte numbers shift accordingly.
14 - 16	X	Number of characters for the job name. This can be used to specify a unique name for job n.
17 ... n	X	From this position, the name for job n follows in the specified length.
n+1 ... n +	X	Number of subsequent bytes. A description

3		for the job n can be specified.
n + 4 ... m	X	From this position, the description for job n follows in the specified length.
m + 1 ... m + 3	X	Number of subsequent bytes. This can be used to specify a unique name for the author of job n.
m + 4 ... k	X	From this position, the name for the author of job n follows in the specified length.
k + 1 ... k + 8	X	Date of creation of job n.
k + 9 ... k + 16	X	Date of last change of job n.
Example:	GJLP001001001007testjob010DefaultJob004Test2014112720141128	
Additional information:		
Accepted in run mode:	Yes	
Accepted in config mode:	No	
Accepted when Ready is Low:	Yes	
Status of Ready signal during processing:	Not altered	
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)	
End of telegram:	Max. 4 byte (option)	

Get detector list (ASCII)

Overview telegram SBS job settings

Telegrams: Availability and supported interfaces (Page 415)

Get detector list (ASCII) Request string to sensor		
Byte No.	Content	Significance
1	G	Get Detector List
2	D	
3	L	
Example:	GDL	
Get detector list (ASCII) Response string from sensor		
Byte No.	Content	Significance
1	G	Get Detector List
2	D	
3	L	
4	P F	P Pass F Fail
5 - 7	X	Job number of the current job
8 - 10	X	Number of detectors in the current job
	ⓘ	**Please note:** The following byte sequence is repeated for each detector in the job. The byte numbers shift accordingly.
11 - 13	X	Number of subsequent bytes. This allows a unique name for the detector n to be specified.
14 ... n	X	From this position, the name for detector n follows, in the given length.
n + 1 ... n+ 5	X	001 - Pattern matching 004 - Contour 005 - Gray level 006 - Contrast

		007 - Brightness 011 - OCR 013 - Datacode 014 - Barcode 018 - Color value 019 - Color area 020 - Color list 021 - Caliper 022 - BLOB
Example:	GDLP001001012testdetector00005	
Additional information:		
Accepted in run mode:	Yes	
Accepted in config mode:	No	
Accepted when Ready is Low:	Yes	
Status of Ready signal during processing:	Not altered	
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)	
End of telegram:	Max. 4 byte (option)	

Teach detector (ASCII)

Overview telegram SBS job settings

Telegrams: Availability and supported interfaces (Page 415)

Teach detector (ASCII) Request string to sensor		
Byte No.	Content	Significance
1	T	Teach detector
2	E	
3	D	
4 - 6	X	0 = Alignment >= 1 Detectors
7	X	0: Temporary 1: Permanent Permanent change affect all parameters, including those that have only been changed temporarily.
8	X	0 = no trigger 1 = Trigger
Example:	TED00111	
Teach detector (ASCII) Response string from sensor		
Byte No.	Content	Significance
1	T	Teach detector
2	E	
3	D	
4	P F	P Pass F Fail
Example:	TEDP	
Additional information:		
Accepted in run mode:	Yes	
Accepted in config mode:	No	

Accepted when Ready is Low:	Yes
Status of Ready signal during processing:	Low
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)
End of telegram:	Max. 4 byte (option)

Set trigger delay (ASCII)

Set trigger delay V1 (ASCII) Request string to sensor		
Byte No.	Content	Significance
1	S	Set Trigger Delay
2	T	
3	D	
4	1	Request version
5	X	0: Temporary 1: Permanent
6 - 13	X	Trigger delay in msec (max. 3000 msec) in encoder steps (max. 65535 steps)
Example:	STD1100001000	
Set trigger delay V1 (ASCII) Response string from sensor		
Byte No.	Content	Significance
1	S	Set Trigger Delay
2	T	
3	D	
4	P F	P Pass F Fail
5 - 7	X	Error codes (Page 416)
Example:	STDP000	
Additional information:		
Accepted in run mode:	Yes	
Accepted in config mode:	No	
Accepted when Ready is Low:	Yes	

Status of Ready signal during processing:		Not altered
Supported interfaces:		Telegrams: Availability and supported interfaces (Page 415)
End of telegram:		Max. 4 byte (option)

Get trigger delay (ASCII)

Overview telegram SBS job settings

Telegrams: Availability and supported interfaces (Page 415)

Get trigger delay V1 (ASCII) Request string to sensor		
Byte No.	Content	Significance
1	G	Get Trigger Delay
2	T	
3	D	
4	1	Request version
Example:	GTD1	

Get trigger delay V1 (ASCII) Response string from sensor		
Byte No.	Content	Significance
1	G	Get Trigger Delay
2	T	
3	D	
4	P F	P Pass F Fail
5 - 7	X	Error code
8 - 15	X	Trigger delay in msec (max. 3000 msec) in encoder steps (max. 65535 steps)
Example:	GTDP00000001000	
Additional information:		
Accepted in run mode:	Yes	
Accepted in config mode:	No	
Accepted when Ready is Low:	Yes	
Status of Ready signal during	Not altered	

processing:		
Supported interfaces:		Telegrams: Availability and supported interfaces (Page 415)
End of telegram:		Max. 4 byte (option)

Calibration: Clear point list (ASCII)

Overview telegram SBS calibration

Clear point list (ASCII) Request string to sensor		
Byte No.	Content	Significance
1	C	Calibration: Clear Data
2	C	
3	D	
Example:	CCD	
Clear point list (ASCII) Response string from sensor		
Byte No.	Content	Significance
1	C	Calibration: Clear Data
2	C	
3	D	
4	P F	P Pass F Fail
Example:	CCDP	
Additional information:		
Accepted in run mode:	Yes	
Accepted in config mode:	No	
Accepted when Ready is Low:	Yes	
Status of Ready signal during processing:	Not altered	
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)	
End of telegram:	Max. 4 byte (option)	

Calibration: Add world point (ASCII)

Overview telegram SBS calibration

Telegrams: Availability and supported interfaces (Page 415)

Calibration: Add world point V1 (ASCII) Request string to sensor		
Byte No.	Content	Significance
1	C	
2	A	Calibration: Add World Point
3	W	
4	1	Request version
5	X	1: Only fiducials Calibration plate (Robotics) 4: World point and image point Point pair list (Robotics)
6 - 10	0	Constant (5 Bytes)
11 - 18	X	World-X (in mm *1000)
19 - 26	X	World-Y (in mm *1000)
27 - 34	0	Constant (8 Byte)
Example:	CAW100001001000000200000000000000 (World X=100mm; World Y=200mm)	
Calibration: Add world point V1 (ASCII) Response string from sensor		
Byte No.	Content	Significance
1	C	
2	A	Calibration: Add World Point
3	W	
4	P F	P Pass F Fail
5 - 7	X	Error codes (Page 416)
8 - 12	X	Current number of points

13 - 20	X	Image point X
21 - 28	X	Image point Y
Example:	CAWP000000010028800000566000 (Fiducial 1; Image X=288; Image Y=566)	
Additional information:		
Accepted in run mode:	Yes	
Accepted in config mode:	No	
Accepted when Ready is Low:	Yes	
Status of Ready signal during processing:	Not altered	
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)	
End of telegram:	Max. 4 byte (option)	

Calibration: Add point (ASCII) - *Discontinued*

Overview telegram SBS calibration

Telegrams: Availability and supported interfaces (Page 415)

Calibration: Add point (ASCII) Request string to sensor		
Byte No.	Content	Significance
1	C	
2	A	Calibration: Add Point
3	P	
4 - 8	0	Constant
9 - 16	X	World-X (in mm *1000)
17 - 24	X	World-Y (in mm *1000)
Example:	CAP000000010000000200000 (World-X = 100 mm; World-Y = 200 mm)	
Calibration: Add point (ASCII) Response string from sensor		
Byte No.	Content	Significance
1	C	
2	A	Calibration: Add Point
3	P	
4	P	P Pass
	F	F Fail
5 - 9	X	Current number of points in the list
10 - 17	X	Image point X
18 - 25	X	Image-Y
Example:	CAPP000010064000000512000 (Index 1; Image-X = 640; Image-Y = 512)	
Additional information:		
Accepted in run mode:	Yes	
Accepted in config mode:	No	

Accepted when Ready is Low:	Yes
Status of Ready signal during processing:	Not altered
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)
End of telegram:	Max. 4 byte (option)
Necessary settings in requesting job:	In "Output/Telegram/Payload" as first and second value the X- and Y- value of the finding position must be set.

Please note:
This telegram "Calibration: Add point" is discontinued.
Alternatively the telegram "Calibration: Add world point (ASCII) (Page 458)" is available.

Calibration: Calibrate by Point List (ASCII)

Overview telegram SBS calibration

Telegrams: Availability and supported interfaces (Page 415)

Calibration: Calibrate by Point List (ASCII) Request string to sensor		
Byte No.	Content	Significance
1	C	Calibration: Calibrate by Point List
2	C	
3	L	
4	X	0: Temporary 1: Permanent
Example:	CCL1	
Calibration: Point list (ASCII) Response string from sensor		
Byte No.	Content	Significance
1	C	Calibration: Calibrate by Point List
2	C	
3	L	
4	P F	P Pass F Fail
5 - 9	X	Current highest point pair index
10 - 17	X	Deviation calibration, RMSE (Root Mean Square Error)
18 - 25	X	Deviation calibration, mean
26 - 33	X	Deviation calibration, max
34 - 41	X	Deviation calibration, min
Example:	CCLP000101234567812345678123456781234 5678	
Additional information:		

Accepted in run mode:	Yes
Accepted in config mode:	No
Accepted when Ready is Low:	Yes
Status of Ready signal during processing:	Not altered
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)
End of telegram:	Max. 4 byte (option)

Calibration: Validate by Point List (ASCII)

Overview telegram SBS calibration

Calibration: Validate by Point List (ASCII) Request string to sensor		
Byte No.	Content	Significance
1	C	
2	V	Calibration: Validate by Point List
3	L	
Example:	CVL	
Calibration: Validate by Point List (ASCII) Response string from sensor		
Byte No.	Content	Significance
1	C	
2	V	Calibration: Validate by Point List
3	L	
4	P F	P Pass F Fail
5 - 9	X	Current highest point pair index
10 - 17	X	Deviation calibration, RMSE (Root Mean Square Error)
18 - 25	X	Deviation calibration, mean
26 - 33	X	Deviation calibration, max
34 - 41	X	Deviation calibration, min
Example:	CVLP0001012345678123456781234567812345678	
Additional information:		
Accepted in run mode:	Yes	
Accepted in config mode:	No	

Accepted when Ready is Low:	Yes
Status of Ready signal during processing:	Not altered
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)
End of telegram:	Max. 4 byte (option)

Calibration: Calibrate by plate (ASCII)

Overview telegram SBS calibration

Telegrams: Availability and supported interfaces (Page 415)

Calibration: Calibrate by plate (ASCII) Request string to sensor		
Byte No.	Content	Significance
1	C	Calibration: Calibrate by Plate
2	C	
3	P	
4	1	Request version
5	X	0: Temporary 1: Permanent Permanent change affect all parameters, including those that have only been changed temporarily.
6	X	0: No fiducials are used. The origin of the measurement coordinate system is identical to the origin of the calibration coordinate system. 1: No fiducials are used. Measurement coordinate system is identical to the device coordinate system. 2: World system is used, fiducial job 3: World system is used, fiducial command CAW
7	X	0: Calibration internal and external sensor parameters 1: Validate calibration 2: Calibration internal sensor parameters 5: Calibration transformation measurement coordinate system
Example:	CCP1110	
Calibration: Calibrate by plate (ASCII) Response string from sensor		
Byte No.	Content	Significance

1	C	Calibration: Calibrate by Plate
2	C	
3	P	
4	P F	P Pass F Fail
5 - 7	X	Error codes (Page 416)
8 - 12	X	Current number of detected
13 - 20	X	Deviation calibration, RMSE (Root Mean Square Error)
21 - 28	X	Deviation calibration, mean
29 - 36	X	Deviation calibration, max
37 - 44	X	Deviation calibration, min
45 - 52	X	Delta X (in user unit * 1000)
53 - 60	X	Delta Y (in user unit * 1000)
61 - 68	0	Reserved
69 - 76	0	Reserved
77 - 84	0	Reserved
85 - 92	X	Delta Gamma (in degrees *1000)
93 - 100	X	Deviation fiducials; mean
101 - 108	X	Deviation fiducials, max
109 - 116	X	Deviation fiducials, min
Example:	CCPP000000120000100100002002000030030000400400 0050050000600600007007000080080000900900001001	
Additional information:		
Accepted in run mode:	Yes	
Accepted in config mode:	No	

Accepted when Ready is Low:	Yes
Status of Ready signal during processing:	Not altered
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)
End of telegram:	Max. 4 byte (option)

Calibration: Set fiducial (ASCII)

Kalibrierung: Referenzmarke setzen V1 (ASCII) Request string to sensor		
Byte No.	Content	Significance
1	C	
2	S	Calibration: Set Fiducial
3	F	
4	1	Request version
5	X	0: Temporary 1: Permanent
Example:	CSF11	
Kalibrierung: Referenzmarke setzen V1 (ASCII) Response string from sensor		
Byte No.	Content	Significance
1	C	
2	S	Calibration: Set Fiducial
3	F	
4	P F	P Pass F Fail
5 - 7	X	Error codes (Page 416)
8 - 15	X	X value
16 - 23	X	Y value
24 - 31	X	Z value
32 - 39	X	Rot. X value
40 - 47	X	Rot. Y value
48 - 55	X	Rot. Z value
55 - 63	X	Deviation fiducials; mean

64 - 71	X	Deviation fiducials, max
72 - 79	X	Deviation fiducials, min
Example:	CSFP 000 00001001 00002002 00003003 00004004 00005005 00006006 00001001 0000202 00003003	
Additional information:		
Accepted in run mode:	Yes	
Accepted in config mode:	No	
Accepted when Ready is Low:	Yes	
Status of Ready signal during processing:	Not altered	
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)	
End of telegram:	Max. 4 byte (option)	

Calibration: Copy Calibration (ASCII)

Overview telegram SBS calibration

Telegrams: Availability and supported interfaces (Page 415)

Calibration: Copy Calibration (ASCII) Request string to sensor		
Byte No.	Content	Significance
1	C	Calibration: Copy Calibration
2	C	
3	C	
4	1	Request version
5	1	Constant
6 - 8	X	Destination 0 : To all Jobs from Jobset ›0: To specified Job only
9	X	0: Always copy when the calibration is active. 1: Only copy if the calibration method is the same.
Example:	CCC110021	
Calibration: Copy Calibration (ASCII) Response string from sensor		
Byte No.	Content	Significance
1	C	Calibration: Copy Calibration
2	C	
3	C	
4	P F	P Pass F Fail
5 - 7	X	Error codes (Page 416)
8 - 10	X	Job Number at which error occurred. 00: Success ›0 : Job number at which error occurred.
Example:	CCCP000000	

Additional information:		
Accepted in run mode:		Yes
Accepted in config mode:		No
Accepted when Ready is Low:		Yes
Status of Ready signal during processing:		Not altered
Supported interfaces:		Telegrams: Availability and supported interfaces (Page 415)
End of telegram:		Max. 4 byte (option)

Calibration: Set parameter (ASCII)

Calibration: Set parameter V1 (ASCII) Request string to sensor		
Byte No.	Content	Significance
1	C	
2	S	Calibration: Set Parameter
3	P	
4	1	Request version
5	X	0: Temporary 1: Permanent
6 - 8	X	Parameter number (Page 474)
9 - 16	X	Length of following data
17 ... n	X	Parameter value
Example:	CSP11002000000019	
Calibration: Set parameter V1 (ASCII) Response string from sensor		
Byte No.	Content	Significance
1	C	
2	S	Calibration: Set Parameter
3	P	
4	P F	P Pass F Fail
5 - 7	X	Error codes (Page 416)
Example:	CSPP000	
Additional information:		
Accepted in run mode:	Yes	

Accepted in config mode:	No
Accepted when Ready is Low:	Yes
Status of Ready signal during processing:	Not altered
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)
End of telegram:	Max. 4 byte (option)

Parameter name	Parameter number	Parameter value	Length	Format	Status
Unit (user unit)	004	0: mm 1: cm 2: m 3: inch 4: au	1 Byte	Characters	no change
Z-Offset	021	(in user unit * 1000)	8 Byte	Signed Integer	no change
Focal length	022	(in mm *1000)	8 Byte	Signed Integer	invalid
Fiducial 1	024	in each case: 0: X value (in user unit * 1000) 1: Y value (in user unit * 1000) 2: Z value (in user unit * 1000)	Per value 8 bytes	Signed Integer	no change
Fiducial 2	025				
Fiducial 3	026				
Fiducial 4	027				

Calibration: Get parameter (ASCII)

Overview telegram SBS calibration

Telegrams: Availability and supported interfaces (Page 415)

Calibration: Get parameter V1 (ASCII) Request string to sensor		
Byte No.	Content	Significance
1	C	
2	G	Calibration: Get Parameter
3	P	
4	1	Request version
5 - 7	X	Parameter number (Page 476)
Example:	CGP1001	
Calibration: Get parameter V1 (ASCII) Response string from sensor		
Byte No.	Content	Significance
1	C	
2	G	Calibration: Get Parameter
3	P	
4	P F	P Pass F Fail
5 - 7	X	Error codes (Page 416)
8 - 10	X	Parameter number (Page 476)
11 - 18	X	Length of the following data
19 ... n	X	Parameter values, depending on the selected parameter
Example:	CGPP000001000000011	
Additional information:		
Accepted in run mode:	Yes	
Accepted in config mode:	No	

Accepted when Ready is Low:	Yes
Status of Ready signal during processing:	Not altered
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)
End of telegram:	Max. 4 byte (option)

Parameter name	Parameter number	Value	Length	Format
Status calibration	001	0: Invalid 1: Valid	1 Byte	Signed Integer
Calibration method	002	0: None 1: Scaling (Measurement) 2: Point pair list (Robotics) 3: Calibration plate (Measurement) 4: Calibration plate (Robotics)	1 Byte	Characters
Unit (user unit)	004	0: mm 1: cm 2: m 3: inch 4: au	1 Byte	Characters
Internal sensor parameter	010	0: Focal length (in mm *1000) 1: Kappa value (*1000) 2: Pixel pitch X (in µm * 1000) 3: Pixel pitch Y (in µm * 1000) Principal point X (in pixel * 1000) Principal point Y (in pixel * 1000) 6: Image size X (Pixel) 7: Image size Y (Pixel)	Per value 8 bytes	Signed Integer

Parameter name	Parameter number	Value	Length	Format
External parameters	011	0: Shift X axis (in user unit * 1000) 1: Shift Y axis (in user unit * 1000) 2: Shift Z axis (in user unit * 1000) 3: Rotation X (in degree * 1000) 4: Rotation Y (in degree * 1000) 5: Rotation Z (in degree * 1000)	Per value 8 bytes	Signed Integer
Transformation calibration coordinate system	012	0: Shift X axis (in user unit * 1000) 1: Shift Y axis (in user unit * 1000) 2: Shift Z axis (in user unit * 1000) 3: Rotation X (in degree * 1000) 4: Rotation Y (in degree * 1000) 5: Rotation Z (in degree * 1000)	Per value 8 bytes	Signed Integer
Transformation measurement coordinate system	014	0: Shift X axis (in user unit * 1000) 1: Shift Y axis (in user unit * 1000) 2: Shift Z axis (in user unit * 1000) 3: Rotation X (in degree * 1000) 4: Rotation Y (in degree * 1000) 5: Rotation Z (in degree * 1000)	Per value 8 bytes	Signed Integer
Z-Offset	021	Value in customer unit (see unit * 1000)	8 Byte	Signed Integer
Focal length	022	(in mm *1000)	8 Byte	Signed

Parameter name	Parameter number	Value	Length	Format
				Integer
Fiducial 1	024	in each case: 0: X value (in user unit * 1000) 1: Y value (in user unit * 1000) 2: Constant 0	Per value 8 bytes	Signed Integer
Fiducial 2	025			
Fiducial 3	026			
Fiducial 4	027			

Get image (ASCII)

Get image (ASCII) Request string to sensor		
Byte No.	Content	Significance
1	G	
2	I	Get Image
3	M	
4	X	0 – Last Image 1 – Last Failed Image 2 – Last Good Image
Example:	GIM1	
Get image (ASCII) Response string from sensor		
Byte No.	Content	Significance
1	G	
2	I	Get Image
3	M	
4	P F	P Pass F Fail
5	X	Error codes (Page 416)
6	X	Image type 0 - Grayscale 3 – COLOR_BAYER_BG At conversion of the image from Bayer into RGB, the appropriate image type must be considered. Pre-processing filters of the category "arrangement" have an influence on the Bayer type. Bayer Pattern begins with blue - green.
7	X	Image result 1 - good image

		0 - failed image
8 - 11	X	No. of rows e.g. 0480 / 0200
12 - 15	X	No. of columns e.g. 0640 / 0320
16 - 19	X	End of message string
20 ... n	X	Binary image data (rows * columns)
Example:	GIMP0004800640...	
Additional information:		
Accepted in run mode:	Yes	
Accepted in config mode:	No	
Accepted when Ready is Low:	Yes	
Status of Ready signal during processing:	Low	
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)	
End of telegram:	Max. 4 byte (option)	

Update visualization results (ASCII)

Overview telegram SBS Service

Telegrams: Availability and supported interfaces (Page 415)

Update visualization results V1 (ASCII) Request string to sensor		
Byte No.	Content	Significance
1	U	
2	V	Update Visualization Results
3	R	
4	1	Request version
5	X	Image: 0 - No image will be created 1 - Gray value image / RGB image will be created 2 - Gray value image / Bayerpattern will be created
6	X	Result XML: 0 - Result file will not be created 1 - Result file will be created
7	X	Statistic XML: 0 - Statistic file will not be created 1 - Statistic file will be created
8	X	Image type 0 - Last image (Any) 1 - Last fail image (Fail) 2 - Last pass image (Pass) 3 - Next image (Any) 4 - Next fail image (Fail) 5 - Next pass image (Pass)
9 - 11	X	Directory number 000: visu000
Example:	UVR11110000	
Update visualization results V1 (ASCII) Response string from sensor		
Byte No.	Content	Significance

1	U	Update Visualization Results
2	V	
3	R	
4	P F	P Pass F Fail
5 - 7	X	Error codes (Page 416)
8	X	Data available: 0: New data available, when ready.txt is written 1: No new data available
9 - 11	X	Directory number 000: visu000
Example:	UVRP0000000	
Additional information:		
Accepted in run mode:	Yes	
Accepted in config mode:	No	
Accepted when Ready is Low:	Yes	
Status of Ready signal during processing:	Not altered	
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)	
End of telegram:	Max. 4 byte (option)	

The created files are available for download in the directory /tmp/[Directory number].

- image.bmp
- overlay.xml

With the file "overlay.xml" all relevant information for the creation of the overlay can be obtained. The file is created in XML format. The most important elements are described in the table below

Name		Value	Description
detector	type	pattern_matching	Detector type

Name		Value	Description
		contour contrast brightness grey caliper blob ocr datacode barcode	
	number	Integer	Position in detector list
	name	String	Name of the detector defined in the configuration
roi	purpose	search teach position_control result	Type of overlay element. The different types have different colors.
	shape	rectangle rectangle_mask ellipse	Shape of the overlay element
center	x	Float	Center position in x (pixel)
	y	Float	Center position in y (pixel)
size	half_width	Float	Half width of overlay element (pixel)
	half_hight	Float	Half height of overlay element (pixel)
angle	angle	Float	Angle of overlay element (degree)
number	value	Float	Number of element types in this detector
line	x1	Float	Start point X line 1 (pixel)
	y1	Float	Start point Y line 1 (pixel)
	x2	Float	Start point X line 2 (pixel)
	y2	Float	Start point Y line 2 (pixel)

Depending on the detector type (detector → type), there are different elements that can be displayed. The following table indicates which element can be displayed on which detector.

Detector	search	teach	position_control	result
Pattern matching	Yes	Yes	Yes	1
Contour	Yes	Yes	Yes	200
Contrast	Yes	No	No	0
Brightness	Yes	No	No	0
Gray level	Yes	No	No	0
Caliper	Yes	No	No	0
BLOB	Yes	No	No	1000
OCR	Yes	No	No	1
Datacode	Yes	No	No	5
Barcode	Yes	No	No	5

Get sensor identity (ASCII)

Overview telegram SBS Service

Telegrams: Availability and supported interfaces (Page 415)

Get sensor identity V1 (ASCII) Request string to sensor		
Byte No.	Content	Significance
1	G	
2	S	Get sensor identity
3	I	
4	1	Request version
Example:	GSI1	
Get sensor identity V1 (ASCII) Response string from sensor		
Byte No.	Content	Significance
1	G	
2	S	Get sensor identity
3	I	
4	P F	P Pass F Fail
5 - 7	X	Error codes (Page 416)
8 - 10	X	Length of the following data
11 ... n	X	Version of the firmware as well as information about the hardware. Areas are clearly separated by a separator.
Example:	GSIP0000221.19.3.2; SBSI-Q-AF-R2B-F12-W	
Additional information:		
Accepted in run mode:	Yes	
Accepted in config mode:	No	
Accepted when Ready is	Yes	

Low:	
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)
End of telegram:	Max. 4 byte (option)

Update firmware (ASCII)

Update firmware V1 (ASCII) Request string to sensor		
Byte No.	Content	Significance
1	U	Update firmware
2	F	
3	W	
4	1	Request version
Example:	UFW1	
Update firmware V1 (ASCII) Response string from sensor		
Byte No.	Content	Significance
1	U	Update firmware
2	F	
3	W	
4	P F	P Pass F Fail
5 - 7	X	Error codes (Page 416)
Example:	UFWP000	
Additional information:		
Accepted in run mode:	Yes	
Accepted in config mode:	No	
Accepted when Ready is Low:	Yes	
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)	
End of telegram:	Max. 4 byte (option)	

After sending the command, a valid firmware file is checked in the /tmp/ directory on the SBS vision sensor. The name must correspond to the typical name allocation (for example, as after the download from the home page).Festo The end is reached as soon as the camera signal is ready (pin 4 GN) again. Alternatively, the telegram "GSI1" can be used to check whether a valid response is sent.

Please note:
The voltage supply must be ensured during the firmware update. An update may take up to 10 minutes.

Set job set (ASCII)

Overview telegram SBS Service

Set job set V1 (ASCII) Request string to sensor		
Byte No.	Content	Significance
1	S	Set jobset
2	J	
3	S	
4	1	Request version
5 - 7	X	Length of the subsequent file name. Maximum length 250 characters.
8 … n	X	Optional file name. If no file name is specified, the default name "Jobset.bjs" is set.
Example:	SJS1012myjobset.bjs	
Set job set V1 (ASCII) Response string from sensor		
Byte No.	Content	Significance
1	S	Set jobset
2	J	
3	S	
4	P F	P Pass F Fail
5 - 7	X	Error codes (Page 416)
8 - 10	X	Active job number in the loaded jobset
Example:	SJSP000001	
Additional information:		
Accepted in run mode:	Yes	
Accepted in config mode:	No	

Accepted when Ready is Low:	No
Status of Ready signal during processing:	Low
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)
End of telegram:	Max. 4 byte (option)

The jobset with the specified name is searched in the /tmp/ directory on the SBS vision sensor. If the file exists, this job record is activated. The file is then removed. If the file exists, this job record is activated. The file is then removed.

Get job set (ASCII)

Get job set V1 (ASCII) Request string to sensor		
Byte No.	Content	Significance
1	G	Get jobset
2	J	
3	S	
4	1	Request version
5 - 7	X	Length of the subsequent file name. Maximum length 250 characters.
8 ... n	X	Optional file name. If no file name is specified, the default name "Jobset.bjs" is set.
Example:	GJS1012myjobset.bjs	
Get job set V1 (ASCII) Response string from sensor		
Byte No.	Content	Significance
1	G	Get jobset
2	J	
3	S	
4	P F	P Pass F Fail
5 - 7	X	Error codes (Page 416)
Example:	GJSP000	
Additional information:		
Accepted in run mode:	Yes	
Accepted in config mode:	No	
Accepted when Ready is	Yes	

Low:	
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)
End of telegram:	Max. 4 byte (option)

The get jobset file is now available for download in the /tmp/ directory under the specified name.

Data output in ASCII

Overview telegram Data output

Telegrams: Availability and supported interfaces (Page 415)

Output data (ASCII), dynamically composed from user settings in the software. For detailed information to the file format see also: Tab Telegram, Data output (Page 243)

Basic String Construction:

‹START› ((((‹OPTIONAL FIELDS› ‹SEPARATOR› ‹PAYLOAD›))) ‹CHKSUM› ‹TRAILER›

Output data (ASCII):

‹OPTIONAL FIELDS›			
Name	Number of bytes	Binary contents / example	Significance / Comments
Header	1 - max. 8	User defined, max. 8 characters	Start string (Header)
Selected Fields	16	1 Byte per field	by this field output of all active checkboxes "byte-wise" can be activated - Output order is from left to right and from top to down. - For each checkbox there is one byte beginning with LSB = low significant bit. - Checkbox "Selected fields" is not part of the output! P = logical output set F = logical output not set 0 = logical output not active
Separator	1 - 5	User defined, max. 5 characters (per separator)	Separator from: "after first optional field", or "after first detector spec. date"
Data length	n	One byte per figure of decimal number e.g. 102 "1"; "0"; "2"	Length of telegram in bytes
Status	3	"110" triggered mode or	

‹OPTIONAL FIELDS›			
Name	Number of bytes	Binary contents / example	Significance / Comments
		"101" free-run mode	
Detector result	n	Byte 1 = AND conjunction of all detectors Byte 2 = Boolean result of alignment Byte 3 = global result of the active job Following Bytes: number of detectors Following Bytes: Detector results, "P" = Pass, "F" = Fail, last byte is first detector Length: 4 Byte + 1 Byte per each used detector	
Digital outputs	n	First Bytes: number of active outputs Following Bytes: digital outputs	P = logical output set F = logical output not set 0 = logical output not active
Logical outputs	n	First Bytes: number of active logical outputs Following Bytes: logical outputs	Example: 18 logical outputs are configured, but only output1, 2 and 9 are linked to functions (are active): 3PP000000P 2 bytes number of active outputs, all results bit-coded ... In this example there are needed 2 bytes because of output 9.... P = logical output set F = logical output not set 0 = logical output not active
Total execution time	n		Current (job) cycle time in [ms]

‹OPTIONAL FIELDS›			
Name	Number of bytes	Binary contents / example	Significance / Comments
Active job no.	1 - 3		Active job no. (1 ... 255)

‹PAYLOAD›				
Payload				
Name	**Number of bytes**	**ASCII contents / example**	**Significance / Comments**	**For detector:**
Detector result	1	P = Pass F = Fail	Boolean detector result	All detectors
Score value 1 ... n	n		Score (0 ... 100 %)	All detectors
Execution time	n		Execution time of individual detector in [msec].	All detectors
Distance	n		Calculated distance, [1/1000] *1)	Caliper
Position X 1 ... n	n	e.g.: X = 180 (pix) = (in ASCII) "180000" = 6 Byte	Position found X (x-coordinate). [1/1000] *1)	Pattern matching Contour Edge detector Caliper Datacode Barcode OCR
Position Y 1 ... n	n		Position found Y (y-coordinate). [1/1000] *1)	Pattern matching Contour Edge detector Caliper Datacode Barcode

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‹PAYLOAD›				
Payload				
Name	**Number of bytes**	**ASCII contents / example**	**Significance / Comments**	**For detector:**
				OCR
DeltaPos X	n		Delta position X between object taught and object found [1/1000] *1)	Pattern matching Contour Edge detector
DeltaPos Y	n		Delta position X between object taught and object found [1/1000] *1)	Pattern matching Contour Edge detector
Angle	n		Orientation of object found (0° ... 360°) [1/1000] *1)	Pattern matching Contour Edge detector Datacode Barcode OCR
Delta Angle	n		Angle between object taught and object found (0° ... 360°) [1/1000] *1)	Pattern matching Contour Edge detector
Scaling	n		Only with contour (0.5 ... 2) [1/1000] *1)	Contour
R(ed) G(reen) B(lue)	n		Value for color parameter, signed integer [1/1000] *1)	Color value Color list
H(ue) S(aturation) V(alue)	n		Value for color parameter, signed integer [1/1000] *1)	Color value Color list

‹PAYLOAD›				
Payload				
Name	**Number of bytes**	**ASCII contents / example**	**Significance / Comments**	**For detector:**
L(uminanz) A B	n		Value for color parameter, signed integer [1/1000] *1)	Color value Color list
Result index	n		Index in list, signed integer [1/1000] *1)	Color list
Color distance	n		Distance between taught and current color, signed integer [1/1000] *1)	Color list
Area	n		Area of the BLOB, without holes, in pixels, signed integer [1/1000] *1)	BLOB
Area (incl. holes)	n		Area of the BLOB, including holes, in pixels, signed integer [1/1000] *1)	BLOB
Contour length	n		Number of pixels of outer contour, signed integer [1/1000] *1)	BLOB
Compactness	n		Compactness of BLOB (Circle = 1, all other ›1). The stronger the shape of the BLOB deviates from circle the larger the value of compactness will be. Signed integer [1/1000] *1)	BLOB
Center of gravity X	n		X- coordinate of center of gravity of BLOB, signed integer [1/1000] *1)	BLOB
Center of gravity Y	n		Y- coordinate of center of gravity of BLOB, signed integer [1/1000] *1)	BLOB
Center X	n		X- coordinate of fitted, geometric element (rectangle, ellipse), signed integer [1/1000] *1)	BLOB
Center Y	n		Y- coordinate of fitted, geometric element (rectangle, ellipse), signed integer [1/1000] *1)	BLOB

‹PAYLOAD›				
Payload				
Name	Number of bytes	ASCII contents / example	Significance / Comments	For detector:
Width	n		Width of geometric element (rectangle / ellipse). Width ›= 0, width ›= height, negative value indicates failure, signed integer [1/1000] *1)	BLOB
Height	n		Height of geometric element (rectangle / ellipse). Heigth ›= 0, height ‹= width, negative value indicates failure, signed integer [1/1000] *1)	BLOB
Angle (360)	n		Orientation of width of object in degree (range: -180 ... +180°, 0° = east, counterclockwise), signed integer [1/1000] *1)	BLOB
Eccentricity	n		Eccentricity numerical (range 0,0 ... 1,0), signed integer [1/1000] *1)	BLOB
Face up / down, area	n		Face up / down discrimination, based on area, indicated by sign, signed integer [1/1000] *1)	BLOB
String	n	Maximum length 127 !!	Contents of Code. Depending from code string length may change. If a fix string length is needed, parameters minimum string length (detector specific data output) and maximum string length (detector parameters) have to be used.	Datacode Barcode OCR
String length	n		Length of Code in Bytes	Datacode Barcode OCR
Truncated	1	F = Code complete, P = Code truncated	Code truncated	Datacode Barcode OCR

‹PAYLOAD›				
Payload				
Name	**Number of bytes**	**ASCII contents / example**	**Significance / Comments**	**For detector:**
Compare result	1		Result of string comparison	Datacode Barcode OCR
Quality parameter	n		Output of quality parameters according to selection	Datacode Barcode
Contrast	n		Contrast of the code (0 - 100 %)	Barcode
Correction	n		Number of modules corrected by error corrections	Barcode
Module height	n		Height of modules in pixels	Datacode
Module width	n		Width of modules in pixels	Datacode
Confidence	5 ... n		Output of the confidence values of the individual characters	OCR
Result	n		Degree of similarity between the read string and the reference string from 0 to 100 %	OCR
Min. Quality	1		Minimum required quality was achieved	OCR

‹CHKSUM›			
Name	Number of bytes	ASCII contents / example	Significance / Comments
Checksum	1		XOR checksum of all bytes in telegram

‹TRAILER›			
Name	Number of bytes	ASCII contents / example	Significance / Comments
Trailer	1 - max. 8	User defined, max. 8 characters	End of string (Trailer)

*1) All detector-specific data with decimal places are transmitted as integers (multiplied by 1000) and must therefore be divided by 1000 after data reception.

17.1.5 Serial communication BINARY

Reset statistic (BINARY)

Overview telegram SBS in general

Telegrams: Availability and supported interfaces (Page 415)

Reset statistic (BINARY) Request string to sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0x05	Length of telegram
5	Unsigned Char	0x04	Reset statistic
Reset statistic (BINARY) Response string from sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0x07	Length of telegram
5	Unsigned Char	0x04	Reset statistic
6 - 7	Unsigned short	0xXX	Error codes (Page 416)

Additional information:	
Accepted in run mode:	Yes
Accepted in config mode:	No
Accepted when Ready is Low:	Yes
Status of Ready signal during processing:	Low
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)

Trigger (BINARY)

Overview telegram SBS control

Telegrams: Availability and supported interfaces (Page 415)

Trigger (BINARY) Request string to sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0x05	Length of telegram
5	Unsigned Char	0x01	Trigger, (simple trigger without index, via port 2006)
Trigger (BINARY) Response string from sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0x07	Length of telegram
5	Unsigned Char	0x01	Trigger, (response to trigger without index, via port 2006. If defined: result data without index via port 2005)
6 - 7	Unsigned short	0xXX	Error codes (Page 416)
Additional information:			
Accepted in run mode:		Yes	
Accepted in config mode:		Yes	
Accepted when Ready is Low:		No	
Status of Ready signal during processing:		Low	
Supported interfaces:		Telegrams: Availability and supported interfaces (Page 415)	

Extended trigger (BINARY)

Overview telegram SBS control

Telegrams: Availability and supported interfaces (Page 415)

Extended trigger (BINARY) Request string to sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0xXX	Length of telegram
5	Unsigned Char	0x13	Extended Trigger command, (trigger with index for correlation of trigger to the correponding result data, via port 2006)
6	Unsigned Char	0xXX	Length of following data (n)
7 ... n	Unsigned Char	0xXX	Data
Extended trigger (BINARY) Response string from sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0xXX	Length of telegram
5	Unsigned Char	0x13	Extended Trigger command, (response to trigger with index and result data, via port 2006, for correlation of trigger to corresponding result, Result data without index, via port 2005 also)
6 - 7	Unsigned short	0xXX	Error codes (Page 416)
8	Unsigned Char	0xXX	Length of following data (n)
9 ... n	Unsigned Char	0xXX	Data of request command
n + 1	Unsigned Char	0xXX	Operating mode 0 = Config mode 1 = Run mode

n + 2 ... n + 5	Unsigned Int	0xXX	Length of following result data (m)
n + 6 ... m	Unsigned Char	0xXX	Result data

Additional information:	
Accepted in run mode:	Yes
Accepted in config mode:	Yes
Accepted when Ready is Low:	No
Status of Ready signal during processing:	Low
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)

Change job (BINARY)

Overview telegram SBS control

Telegrams: Availability and supported interfaces (Page 415)

Change job (BINARY) Request string to sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0x06	Length of telegram
5	Unsigned Char	0x02	Change job
6	Unsigned Char	0xXX	Job no. XX = 1 - n
Change job (BINARY) Response string from sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0x09	Length of telegram
5	Unsigned Char	0x02	Change job
6 - 7	Unsigned short	0xXX	Error codes (Page 416)
8	Unsigned Char	0xXX	Trigger mode 0 = triggered 1 = Free run
9	Unsigned Char	0xXX	Job no. XX = 1 - n
Additional information:			
Accepted in run mode:	Yes		
Accepted in config mode:	No		
Accepted when Ready is Low:	Yes		
Status of Ready signal during processing:	Low		
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)		

Please note:
If an error occurs during the job change, it is possible to change to job 1.

Change job permanent (BINARY)

Overview telegram SBS control

Telegrams: Availability and supported interfaces (Page 415)

Change job permanent (BINARY) Request string to sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0x06	Length of telegram
5	Unsigned Char	0x22	Change job permanent
6	Unsigned Char	0xXX	Job no. XX = 1 - n
Change job permanent (BINARY) Response string from sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0x09	Length of telegram
5	Unsigned Char	0x22	Change job permanent
6 - 7	Unsigned short	0xXX	Error codes (Page 416)
8	Unsigned Char	0xXX	Trigger mode 0 = triggered 1 = Free run
9	Unsigned Char	0xXX	Job no. XX = 1 - n
Additional information:			
Accepted in run mode:	Yes		
Accepted in config mode:	No		
Accepted when Ready is Low:	Yes		
Status of Ready signal during processing:	Low		
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)		

Please note:
If an error occurs during the job change, it is possible to change to job 1.

Set shutter speed (BINARY)

Overview telegram SBS job settings

Telegrams: Availability and supported interfaces (Page 415)

Set shutter speed (BINARY) Request string to sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0x09	Length of telegram
5	Unsigned Char	0x0E 0x0F	Set shutter speed temporary Set shutter speed permanent Permanent change affect all parameters, including those that have only been changed temporarily.
6 - 9	Unsigned Int	0xXX	Shutter value
Set shutter speed (BINARY) Response string from sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0x07	Length of telegram
5	Unsigned Char	0x0E 0x0F	Set shutter speed temporary Set shutter speed permanent Permanent change affect all parameters, including those that have only been changed temporarily.
6 - 7	Unsigned short	0xXX	Error codes (Page 416)
Additional information:			
Accepted in run mode:	Yes		
Accepted in config mode:	No		
Accepted when Ready is Low:	Yes		
Status of Ready signal during	Low		

processing:	
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)

Get shutter speed (BINARY)

Overview telegram SBS job settings

Telegrams: Availability and supported interfaces (Page 415)

Get shutter speed (BINARY) Request string to sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0x05	Length of telegram
5	Unsigned Char	0x17	Get shutter speed
Get shutter speed (BINARY) Response string from sensor			
1 - 4	Unsigned Int	0x0B	Length of telegram
5	Unsigned Char	0x17	Get shutter speed
6 - 7	Unsigned short	0xXX	Error codes (Page 416)
8 - 11	Unsigned Int	0xXX	Shutter value
Additional information:			
Accepted in run mode:		Yes	
Accepted in config mode::		No	
Accepted when Ready is Low:		Yes	
Status of Ready signal during processing:		Not altered	
Supported interfaces:		Telegrams: Availability and supported interfaces (Page 415)	

Set gain (BINARY)

Overview telegram SBS job settings

Telegrams: Availability and supported interfaces (Page 415)

Set gain (BINARY) Request string to sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0x0A	Length of telegram
5	Unsigned Char	0x1B	Set gain
6	Unsigned Char	0xXX	0: Temporary 1: Permanent Permanent change affect all parameters, including those that have only been changed temporarily.
7 - 10	Unsigned Int	0xXX	Gain value
Set gain (BINARY) Response string from sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0x0B	Length of telegram
5	Unsigned Char	0x1B	Set gain
6 - 7	Unsigned short	0xXX	Error codes (Page 416)
8 - 11	Unsigned Int	0xXX	Current gain value (value *1000)
Additional information:			
Accepted in run mode:		Yes	
Accepted in config mode:		No	
Accepted when Ready is Low:		Yes	
Status of Ready signal during processing:		Not altered	
Supported interfaces:		Telegrams: Availability and supported interfaces (Page 415)	

Get gain (BINARY)

Overview telegram SBS job settings

Telegrams: Availability and supported interfaces (Page 415)

Get gain (BINARY) Request string to sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0x05	Length of telegram
5	Unsigned Char	0x1C	Get gain
Get gain (BINARY) Response string from sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0x0B	Length of telegram
5	Unsigned Char	0x1C	Get gain
6	Unsigned short	0xXX	Error codes (Page 416)
7		0xXX	
8 - 11	Unsigned Int	0xXX	Current gain (in value * 1000), e.g. 1,0 = 01000
Additional information:			
Accepted in run mode:	Yes		
Accepted in config mode:	No		
Accepted when Ready is Low:	Yes		
Status of Ready signal during processing:	Not altered		
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)		

Set parameter (BINARY)

Overview telegram SBS job settings

Telegrams: Availability and supported interfaces (Page 415)

Set parameter (BINARY) Request string to sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0xXX	Length of telegram = 9 Bytes + Length of string (n)
5	Unsigned Char	0x05 0x06	Set parameter permanent Set parameter temporary Permanent change affect all parameters, including those that have only been changed temporarily.
6	Unsigned Char	0xXX	Detector no., XX = 1- n
7	Unsigned Char	0xXX	Command reference string / Set value *1), see below !
8 - 9	Unsigned short	0xXX	Length new reference string / value (n)
10 ... n	Unsigned Char	0xXX	Reference string / value
Set Parameter (Binary) Response string from sensor (may be 4-5 Seconds delayed)			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0x08	Length of telegram
5	Unsigned Char	0x05 0x06	Set parameter permanent Set parameter temporary Permanent change affect all parameters, including those that have only been changed temporarily.
6 - 7	Unsigned short	0xXX	Error codes (Page 416)
8	Unsigned Char	0xXX	Parameter type string

Additional information:	
Accepted in run mode:	Yes
Accepted in config mode:	No
Accepted when Ready is Low:	Yes
Status of Ready signal during processing:	Low
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)

*1) Byte No. 7: Command: set reference string / value:

Detector	Function	Command	Length of following data
Alignment Pattern matching	Threshold Min	1	4
	Threshold Max	2	4
	ResultOffsetPos_X	31	5
	ResultOffsetPos_Y	32	5
	ResultOffsetAngle	33	5
Alignment Contour detection	Threshold Min	1	4
	Threshold Max	2	4
	ResultOffsetPos_X	31	5
	ResultOffsetPos_Y	32	5
	ResultOffsetAngle	33	5
Alignment Edge detector	Transition probe 1	101	4
	Transition probe 2	102	4
	Transition probe 3	103	4
	Score min probe 1	104	4
	Score min probe 2	105	4
	Score min probe 3	106	4
Pattern matching	Threshold Min	1	4
	Threshold Max	2	4

Detector	Function	Command	Length of following data
	ResultOffsetPos_X	31	5
	ResultOffsetPos_Y	32	5
	ResultOffsetAngle	33	5
Contour	Threshold Min	1	4
	Threshold Max	2	4
	ResultOffsetPos_X	31	5
	ResultOffsetPos_Y	32	5
	ResultOffsetAngle	33	5
Gray level	Threshold Min	1	4
	Threshold Max	2	4
	GrayMin	101	4
	GrayMax	102	4
	GreyInvert	103	1
Contrast	Threshold Min	1	4
	Threshold Max	2	4
Barcode	Reference String	101	n
Datacode	Reference String	101	n
OCR	Reference String	101	n
Color value	ColorMinChannel1	101	4
	ColorMaxChannel1	102	4
	ColorInvertChannel1	103	4
	ColorMinChannel2	104	4
	ColorMaxChannel2	105	4
	ColorInvertChannel2	106	4
	ColorMinChannel3	107	4
	ColorMaxChannel3	108	4
	ColorInvertChannel3	109	4
Color area	ColorMinChannel1	101	4
	ColorMaxChannel1	102	4
	ColorInvertChannel1	103	4
	ColorMinChannel2	104	4
	ColorMaxChannel2	105	4
	ColorInvertChannel2	106	4
	ColorMinChannel3	107	4

Detector	Function	Command	Length of following data
	ColorMaxChannel3 ColorInvertChannel3	108 109	4 4
BLOB	GrayAbsoluteMin GrayAbsoluteMax GrayAbsoluteInvert	101 102 103	4 4 1

Get parameter (BINARY)

Overview telegram SBS job settings

Telegrams: Availability and supported interfaces (Page 415)

Get parameter (BINARY) Request string to sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0x07	Length of telegram
5	Unsigned Char	0x0A	Get parameter
6	Unsigned Char	0xXX	Detector no., XX = 1- n
7	Unsigned Char	0xXX	Command: Set reference string / value *1), see below !
Get Parameter (Binary) Response string from sensor (may be 4-5 Seconds delayed)			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0xXX	Length of telegram = 10 Bytes + Length of string (n)
5	Unsigned Char	0x0A	Get parameter
6 - 7	Unsigned short	0xXX	Error codes (Page 416)
8	Unsigned Char	0xXX	Parameter type string
9 - 10	Unsigned short	0xXX	Length of parameter (n)
11 ... n + n	Unsigned Char	0xXX	Reference string / value
Additional information:			
Accepted in run mode:		Yes	
Accepted in config mode:		No	

Accepted when Ready is Low:	Yes
Status of Ready signal during processing:	Not altered
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)

*1) Byte No.. 7: Command: Get reference string / value:

Detector	Function	Command	**Length of following data**
Alignment Pattern matching	Threshold Min Threshold Max ResultOffsetPos_X ResultOffsetPos_Y ResultOffsetAngle	1 2 31 32 33	4 4 5 5 5
Alignment Contour detection	Threshold Min Threshold Max ResultOffsetPos_X ResultOffsetPos_Y ResultOffsetAngle	1 2 31 32 33	4 4 5 5 5
Alignment Edge detector	Transition probe 1 Transition probe 2 Transition probe 3 Score min probe 1 Score min probe 2 Score min probe 3	101 102 103 104 105 106	4 4 4 4 4 4
Pattern matching	Threshold Min Threshold Max ResultOffsetPos_X ResultOffsetPos_Y ResultOffsetAngle	1 2 31 32 33	4 4 5 5 5
Contour	Threshold Min Threshold Max ResultOffsetPos_X	1 2 31	4 4 5

Detector	Function	Command	**Length of following data**
	ResultOffsetPos_Y	32	5
	ResultOffsetAngle	33	5
Gray level	Threshold Min	1	4
	Threshold Max	2	4
	GrayMin	101	4
	GrayMax	102	4
	GreyInvert	103	1
Contrast	Threshold Min	1	4
	Threshold Max	2	4
Barcode	Reference String	101	n
Datacode	Reference String	101	n
OCR	Reference String	101	n
Color value	ColorMinChannel1	101	4
	ColorMaxChannel1	102	4
	ColorInvertChannel1	103	4
	ColorMinChannel2	104	4
	ColorMaxChannel2	105	4
	ColorInvertChannel2	106	4
	ColorMinChannel3	107	4
	ColorMaxChannel3	108	4
	ColorInvertChannel3	109	4
Color area	ColorMinChannel1	101	4
	ColorMaxChannel1	102	4
	ColorInvertChannel1	103	4
	ColorMinChannel2	104	4
	ColorMaxChannel2	105	4
	ColorInvertChannel2	106	4
	ColorMinChannel3	107	4
	ColorMaxChannel3	108	4
	ColorInvertChannel3	109	4
BLOB	GrayAbsoluteMin	101	4
	GrayAbsoluteMax	102	4
	GrayAbsoluteInvert	103	1

Set ROI (BINARY)

Overview telegram SBS job settings

Telegrams: Availability and supported interfaces (Page 415)

Set ROI (BINARY) Request string to sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0x18 0x20	Length of telegram 0x18 circle 0x20 rectangle / free shape / ellipse
5	Unsigned Char	0x10 0x11	Set ROI temporary Set ROI permanent Permanent change affect all parameters, including those that have only been changed temporarily.
6 - 9	Unsigned Int	0xXX	ROI Info Length in Bytes from Byte 6 to end
10	Unsigned Char	0xXX	Detector No.
11	Unsigned Char	0x00	ROI Index 00 = yellow ROI 01 = Teach 02 = Position control
12	Unsigned Char	0xXX	ROI shape 01=circle 02=rectangle 03=ellipse 04=free shape
13 - 16	Unsigned Int	0xXX	ROI Parameter: center X (in Pixels * 1000)
17 - 20	Unsigned Int	0xXX	ROI Parameter: center Y (in Pixels * 1000)
21 - 24	Unsigned	0xXX	ROI Parameter: width / radius X (in Pixels* 1000)

	Int		
	Only ellipse / rectangle:		
25 - 28	Unsigned Int	0xXX	ROI Parameter: width / radius Y (in Pixels* 1000)
29 - 32	Unsigned Int	0xXX	ROI Parameter: Angle in ° (in ° * 1000)

Set ROI (BINARY) Response string from sensor			
Byte No.	Data type	Content	Significance
1	Unsigned Int	0x07	Length of telegram
5	Unsigned Char	0x10 0x11	Set ROI temporary Set ROI permanent Permanent change affect all parameters, including those that have only been changed temporarily.
6 - 7	Unsigned short	0xXX	Error codes (Page 416)

Additional information:	
Accepted in run mode:	Yes
Accepted in config mode:	No
Accepted when Ready is Low:	Yes
Status of Ready signal during processing:	Low
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)
Parameter:	The parameter are given in alignment frames and not in image frames.

Get ROI (BINARY)

Overview telegram SBS job settings

Telegrams: Availability and supported interfaces (Page 415)

Get ROI (BINARY) Request string to sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0x07	Length of telegram
5	Unsigned Char	0x12	Get ROI
6	Unsigned Char	0xXX	Detector No.
7	Unsigned Char	0xXX	ROI Index 00 = yellow ROI 01 = Teach 02 = Position control
Get ROI (BINARY) Response string from sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0xXX	Length of telegram
5	Unsigned Char	0x12	Get ROI
6 - 7	Unsigned short	0xXX	Error codes (Page 416)
8 - 11	Unsigned Int	0xXX	ROI Info Length in Bytes from Byte 8 to end
12	Unsigned Char	0xXX	Detector No.
13	Unsigned Char	0x00	ROI Index 00 = yellow ROI 01 = Teach 02 = Position control
14	Unsigned Char	0xXX	ROI shape 01=circle

			02=rectangle 03=ellipse 04=free shape
15 - 18	Unsigned Int	0xXX	ROI Parameter: center X (in Pixels * 1000)
19 - 22	Unsigned Int	0xXX	ROI Parameter: center Y (in Pixels * 1000)
23 -26	Unsigned Int	0xXX	ROI Parameter: width / radius X (in Pixels* 1000)
	Only ellipse / rectangle:		
27 - 30	Unsigned Int	0xXX	ROI Parameter: width / radius Y (in Pixels* 1000)
31 - 34	Unsigned Int	0xXX	ROI Parameter: Angle in ° (in ° * 1000)

Additional information:	
Accepted in run mode:	Yes
Accepted in config mode:	No
Accepted when Ready is Low:	Yes
Status of Ready signal during processing:	Low
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)

Get job list (BINARY)

Overview telegram SBS job settings

Get job list (BINARY) Request string to sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0x05	Length of telegram
5	Unsigned Char	0x14	Get job list
Get job list (BINARY) Response string from sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0xXX	Length of telegram
5	Unsigned Char	0x14	Get job list
6	Unsigned short	0xXX	Error codes (Page 416)
8	Unsigned Char	0x01	Constant
9	Unsigned Char	0xXX	Number of jobs
10	Unsigned Char	0xXX	Active job number
	ⓘ	**Please note:** The following byte sequence is repeated for each job from 1 to "Number of jobs". The byte numbers shift accordingly.	
11	Unsigned Char	0xXX	Number of following bytes. This can be used to specify a unique name for job n.
11 ... n	Char	0xXX	From this position, the name for job n follows in the specified length.

n + 1 … n + 3	Unsigned Char	0xXX	Number of following bytes. A description for the job n can be specified.
n + 4 … m	Char	0xXX	From this position, the description for job 1 follows in the specified length.
m + 1 … m+ 3	Unsigned Char	0xXX	Number of following bytes. This can be used to specify a unique name for the author of job n.
m + 4 … k	Char	0xXX	From this position, the name for the author of job n follows in the specified length.
k + 1 … k + 8	Unsigned Int	0xXX	Date of creation of job n.
k + 9 … k + 16	Unsigned Int	0xXX	Date of last change of job n.

Additional information:	
Accepted in run mode:	Yes
Accepted in config mode:	No
Accepted when Ready is Low:	Yes
Status of Ready signal during processing:	Not altered
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)

Get detector list (BINARY)

Overview telegram SBS job settings

Telegrams: Availability and supported interfaces (Page 415)

Get detector list (BINARY) Request string to sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0x05	Length of telegram
5	Unsigned Char	0x15	Get Detector List
Get detector list (BINARY) Response string from sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0xXX	Length of telegram
5	Unsigned Char	0x18	Get Detector List
6	Unsigned short	0xXX	Error codes (Page 416)
8	Unsigned Char	0xXX	Job number of the current job
9	Unsigned Char	0xXX	Number of detectors in the current job
		Please note: The following byte sequence is repeated for each detector in the job. The byte numbers shift accordingly.	
10	Unsigned Char	0xXX	Number of subsequent bytes. This allows a unique name for the detector n to be specified.
11 ... n	Unsigned Char	0xXX	From this position, the name for detector n follows, in the given length.
n + 1 ... n + 3	Unsigned Char	0xXX	001 - Pattern matching 004 - Contour 005 - Gray level

			006 - Contrast 007 - Brightness 011 - OCR 013 - Datacode 014 - Barcode 018 - Color value 019 - Color area 020 - Color list 021 - Caliper 022 - BLOB
Additional information:			
Accepted in run mode:			Yes
Accepted in config mode:			No
Accepted when Ready is Low:			Yes
Status of Ready signal during processing:			Not altered
Supported interfaces:			Telegrams: Availability and supported interfaces (Page 415)

Teach detector (BINARY)

Overview telegram SBS job settings

Teach detector (BINARY) Request string to sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0x08	Length of telegram
5	Unsigned Char	0x18	Teach detector
6	Unsigned Char	0xXX	0 = Alignment ›= 1 Detectors
7	Unsigned Char	0xXX	0: Temporary 1: Permanent
8	Unsigned Char	0xXX	0 = no trigger 1 = Trigger
Teach detector (BINARY) Response string from sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0x00	Length of telegram
5	Unsigned Char	0x18	Teach detector
6 - 7	Unsigned short	0xXX	Error codes (Page 416)
Additional information:			
Accepted in run mode:	Yes		
Accepted in config mode:	No		
Accepted when Ready is Low:	Yes		
Status of Ready signal during processing:	Not altered		
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)		

Set trigger delay (BINARY)

Overview telegram SBS job settings

Telegrams: Availability and supported interfaces (Page 415)

Set trigger delay V1 (BINARY) Request string to sensor			
Byte No..	Data type	Content	Significance
1 - 4	Unsigned Int	0xB	Length of telegram
5	Unsigned Char	0x27	Set trigger delay
6	Unsigned Char	0xXX	Request version
7	Unsigned Char	0xXX	0: Temporary 1: Permanent
8 - 11	Unsigned Int	0xXX	Trigger delay in msec (max. 3000 msec) in encoder steps (max. 65535 steps)
Set trigger delay V1 (BINARY) Response string from sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0x07	Length of telegram
5	Unsigned Char	0x1A	Set trigger delay
6 - 7	Unsigned short	0xXX	Error codes (Page 416)
Additional information:			
Accepted in run mode:		Yes	
Accepted in config mode:		No	
Accepted when Ready is Low:		Yes	
Status of Ready signal during processing:		Low	
Supported interfaces:		Telegrams: Availability and supported interfaces (Page 415)	

Get trigger delay (BINARY)

Overview telegram SBS job settings

Telegrams: Availability and supported interfaces (Page 415)

Get trigger delay V1 (BINARY) Request string to sensor			
Byte No..	Data type	Content	Significance
1 - 4	Unsigned Int	0x6	Length of telegram
5	Unsigned Char	0x28	Get trigger delay
6	Unsigned Char	0xXX	Request version
Get trigger delay V1 (BINARY) Response string from sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0xB	Length of telegram
5	Unsigned Char	0x28	Get trigger delay
6 - 7	Unsigned short	0xXX	Error codes (Page 416)
8 - 11	Unsigned Int	0xXX	Trigger delay in msec (max. 3000 msec) in encoder steps (max. 65535 steps)
Additional information:			
Accepted in run mode:	Yes		
Accepted in config mode:	No		
Accepted when Ready is Low:	Yes		
Status of Ready signal during processing:	Not altered		
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)		

Calibration: Clear point list (BINARY)

Overview telegram SBS calibration

Clear point list (BINARY) Request string to sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0x05	Length of telegram
5	Unsigned Char	0x1F	Calibration: Clear Data
Clear point list (BINARY) Response string from sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0x07	Length of telegram
5	Unsigned Char	0x1F	Calibration: Clear Data
6 - 7	Unsigned short	0xXX	Error codes (Page 416)
Additional information:			
Accepted in run mode:		Yes	
Accepted in config mode:		No	
Accepted when Ready is Low:		Yes	
Status of Ready signal during processing:		Not altered	
Supported interfaces:		Telegrams: Availability and supported interfaces (Page 415)	

Calibration: Add world point (BINARY)

Overview telegram SBS calibration

Calibration: Add world point V1 (BINARY) Request string to sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0x0F	Length of telegram
5	Unsigned Char	0x26	Calibration: Add World Point (CAW)
6	Unsigned Char	0xXX	Request version
7	Unsigned Char	0xXX	1: Only fiducials Calibration plate (Robotics) 4: World point and image point Point pair list (Robotics)
9 - 10	Unsigned short	0xXX	Constant (5 Bytes)
11 - 14	Unsigned Int	0xXX	World X (in mm *1000)
15 - 18	Unsigned Int	0xXX	World Y (in mm *1000)
19 - 22	Unsigned Char	0xXX	Constant (8 Byte)
Calibration: Add world point V1 (BINARY) Response string from sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0x11	Length of telegram
5	Unsigned Char	0x26	Calibration: Add World Point (CAW)
6 - 7	Unsigned short	0xXX	Error codes (Page 416)
8 - 9	Unsigned short	0xXX	Current number of points

10 -13	Unsigned Int	0xXX	Image point X
14 - 17	Unsigned Int	0xXX	Image point Y
Additional information:			
Accepted in run mode:			Yes
Accepted in config mode:			No
Accepted when Ready is Low:			Yes
Status of Ready signal during processing:			Not altered
Supported interfaces:			Telegrams: Availability and supported interfaces (Page 415)

Calibration: Add point (BINARY)

Overview telegram SBS calibration

Telegrams: Availability and supported interfaces (Page 415)

Calibration: Add point (BINARY) Request string to sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0x0F	Length of telegram
5	Unsigned Char	0x1D	Calibration: Add Point
6 - 7	Unsigned short	0xXX	Constant
8 - 11	Unsigned Int	0xXX	World X (in mm *1000)
12 - 15	Unsigned Int	0xXX	World Y (in mm *1000)
Calibration: Add point (BINARY) Response string from sensor			
Byte No.	Data type	Content	Significance
1	Unsigned Int	0x11	Length of telegram
5	Unsigned Char	0x1D	Calibration: Add Point
6 - 7	Unsigned short	0xXX	Error codes (Page 416)
8 - 9	Unsigned short	0xXX	Current number of points in the list
10 - 13	Unsigned Int	0xXX	Image X (in px * 1000)
14 - 17	Unsigned Int	0xXX	Image Y (in px * 1000)

Additional information:	
Accepted in run mode:	Yes
Accepted in config mode:	No
Accepted when Ready is Low:	Yes
Status of Ready signal during processing:	Not altered
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)
Necessary settings in requesting job:	In "Output/Telegram/Payload" as first and second value the X- and Y- value of the finding position must be set.

Calibration: Calibrate by Point List (BINARY)

Overview telegram SBS calibration

Telegrams: Availability and supported interfaces (Page 415)

Calibration: Calibrate by Point List (BINARY) Request string to sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0x06	Length of telegram
5	Unsigned Char	0x1E	Calibration: Calibrate by Point List
6	Unsigned Char	0xXX	0: Temporary 1: Permanent
Calibration point list (BINARY) Response string from sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0x19	Length of telegram
5	Unsigned Char	0x1E	Calibration: Calibrate by Point List
6 - 7	Unsigned short	0xXX	Error codes (Page 416)
8 - 9	Unsigned short	0xXX	Current highest point pair index
10 - 13	Unsigned Int	0xXX	Deviation calibration, RMSE (Root Mean Square Error)
14 - 17	Unsigned Int	0xXX	Deviation calibration, mean
18 - 21	Unsigned Int	0xXX	Deviation calibration, max
22 - 25	Unsigned Int	0xXX	Deviation calibration, min
Additional information:			
Accepted in run mode:		Yes	
Accepted in config mode:		No	
Accepted when Ready is Low:		Yes	

Status of Ready signal during processing:	Not altered
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)

Calibration: Validate by Point List (BINARY)

Overview telegram SBS calibration

Calibration: Validate by Point List (Binary) Request string to sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0x05	Length of telegram
5	Unsigned Char	0x20	Calibration: Validate by Point List

Calibration: Validate by Point List (Binary) Response string from sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0x19	Length of telegram
5	Unsigned Char	0x20	Calibration: Validate by Point List
6	Unsigned short	0xXX	Error codes (Page 416)
8 - 9	Unsigned short	0xXX	Current highest point pair index
10 - 13	Unsigned Int	0xXX	Deviation calibration, RMSE (Root Mean Square Error)
14 - 17	Unsigned Int	0xXX	Deviation calibration, mean
18 - 21	Unsigned Int	0xXX	Deviation calibration, max
22 - 25	Unsigned Int	0xXX	Deviation calibration, min
Additional information:			
Accepted in run mode:		Yes	
Accepted in config mode:		No	
Accepted when Ready is Low:		Yes	
Status of Ready signal during processing:		Not altered	
Supported interfaces:		Telegrams: Availability and	

	supported interfaces (Page 415)

Calibration: Calibration plate (BINARY)

Overview telegram SBS calibration

Telegrams: Availability and supported interfaces (Page 415)

Calibration: Calibration plate (BINARY) Request string to sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0x09	Length of telegram
5	Unsigned Char	0x24	Calibration: Calibrate by Plate
6	Unsigned Char	0x01	Request version
7	Unsigned Char	0xXX	0: Temporary 1: Permanent
8	Unsigned Char	0xXX	0 - No fiducials are used. The origin of the measurement coordinate system is identical to the origin of the calibration coordinate system. 1 - No fiducials are used. Measurement coordinate system is identical to the device coordinate system. 2 - Use world system, fiducials job 3 - Use world system, fiducials request CAW.
9	Unsigned Char	0xXX	0: Calibration internal and external sensor parameters 1: Validate calibration 2: Calibration internal sensor parameters 5: Calibration transformation measurement coordinate system
Calibration: Calibration plate (BINARY) Response string from sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0x3D	Length of telegram

5	Unsigned Char	0x24	Calibration: Calibrate by Plate
6 - 7	Unsigned short	0xXX	Error codes (Page 416)
8 - 9	Unsigned short	0xXX	Current number of detected
10 - 13	Unsigned Int	0xXX	Deviation calibration, RMSE (Root Mean Square Error)
14 - 17	Unsigned Int	0xXX	Deviation calibration, mean
18 - 21	Unsigned Int	0xXX	Deviation calibration, max
22 - 25	Unsigned Int	0xXX	Deviation calibration, min
26 -29	Unsigned Int	0xXX	Delta X (in user unit * 1000)
Unsigned Int	Unsigned Int	0xXX	Delta Y (in user unit * 1000)
Unsigned Int	Unsigned Int	0	Reserved
38 - 41	Unsigned Int	0	Reserved
42 - 45	Unsigned Int	0	Reserved
46 - 49	Unsigned Int	0xXX	Delta Gamma (in degrees *1000)
50 - 53	Unsigned Int	0xXX	Deviation fiducials; mean
54 - 57	Unsigned Int	0xXX	Deviation fiducials, max
58 - 61	Unsigned Int	0xXX	Deviation fiducials, min

Additional information:	
Accepted in run mode:	Yes
Accepted in config mode:	No
Accepted when Ready is Low:	Yes
Status of Ready signal during processing:	Not altered
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)

Calibration: Set fiducial (BINARY)

Overview telegram SBS calibration

Telegrams: Availability and supported interfaces (Page 415)

Calibration: Set fiducial V1 (BINARY) Request string to sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0x08	Length of telegram
5	Unsigned Char	0x1E	Calibration: Set Fiducial
6	Unsigned Char	0xXX	Request version
7	Unsigned Char	0xXX	0: Temporary 1: Permanent
Calibration: Set fiducial V1 (BINARY) Response string from sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0x37	Length of telegram
5	Unsigned Char	0x2B	Calibration: Set Fiducial
6 - 7	Unsigned short	0xXX	Error codes (Page 416)
8 - 11	Unsigned Int	0xXX	X value
12 - 15	Unsigned Int	0xXX	Y value
16 - 19	Unsigned Int	0xXX	Z value
Unsigned Int	Unsigned Int	0xXX	Rot. X value
22 - 25	Unsigned Int	0xXX	Rot. Y value
Unsigned Int	Unsigned Int	0xXX	Rot. Z value
30 - 33	Unsigned Int	0xXX	Deviation fiducials; mean
Unsigned Int	Unsigned Int	0xXX	Deviation fiducials, max

38 - 41	Unsigned Int	0xXX	Deviation fiducials, min
Additional information:			
Accepted in run mode:			Yes
Accepted in config mode:			No
Accepted when Ready is Low:			Yes
Status of Ready signal during processing:			Not altered
Supported interfaces:			Telegrams: Availability and supported interfaces (Page 415)

Calibration: Copy Calibration (BINARY)

Overview telegram SBS visualization

Telegrams: Availability and supported interfaces (Page 415)

Calibration: Copy Calibration (BINARY) Request string to sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0x09	Length of telegram
5	Unsigned Char	0x25	Calibration: Copy Calibration
6	Unsigned Char	0x01	Request version
7	Unsigned Char	0x01	Constant
8	Unsigned Char	0xXX	Destination 0 : To all Jobs from Jobset ›0: To specified Job only
9	Unsigned Char	0xXX	0: Always copy when the calibration is active. 1: Only copy if the calibration method is the same.
Calibration: Copy Calibration (BINARY) Response string from sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0x08	Length of telegram
5	Unsigned Char	0x25	Calibration: Copy Calibration
6 - 7	Unsigned short	0xXX	Error codes (Page 416)
8	Unsigned Char	0xXX	00: Success ›0 : Job number at which error occurred.
Additional information:			

Accepted in run mode:	Yes
Accepted in config mode:	No
Accepted when Ready is Low:	Yes
Status of Ready signal during processing:	Not altered
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)

Calibration: Set parameter (BINARY)

Overview telegram SBS calibration

Calibration: Set parameter V1 (BINARY) Request string to sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0x07	Length of telegram
5	Unsigned Char	0x29	Calibration: Set Parameter
6	Unsigned Char	0x01	Request version
7	Unsigned Char	0xXX	0: Temporary 1: Permanent
8	Unsigned Char	0xXX	Parameter number (Page 547)
9 - 12	Unsigned Int	0xXX	Length of following data
13 ... n	Unsigned Char	0xXX	Parameter value (Page 547)
Calibration: Set parameter V1 (BINARY) Response string from sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0xXX	Length of telegram
5	Unsigned Char	0x29	Calibration: Set Parameter
6 - 7	Unsigned short	0xXX	Error codes (Page 416)
Additional information:			
Accepted in run mode:		Yes	
Accepted in config mode:		No	
Accepted when Ready is Low:		Yes	

Status of Ready signal during processing:	Not altered
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)

Parameter name	Parameter number	Parameter value	Length	Format	Status
Unit (user unit)	004	0: mm 1: cm 2: m 3: inch 4: au	1 Byte	Characters	no change
Z-Offset	021	(in user unit * 1000)	8 Byte	Signed Integer	no change
Focal length	022	(in mm *1000)	8 Byte	Signed Integer	invalid
Fiducial 1	024	in each case: 0: X value (in user unit * 1000) 1: Y value (in user unit * 1000) 2: Z value (in user unit * 1000)	Per value 8 bytes	Signed Integer	no change
Fiducial 2	025				
Fiducial 3	026				
Fiducial 4	027				

Calibration: Get parameter (BINARY)

Overview telegram SBS calibration

Calibration: Get parameter V1 (BINARY) Request string to sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0x07	Length of telegram
5	Unsigned Char	0x2A	Calibration: Get Parameter
6	Unsigned Char	0x01	Request version
7	Unsigned Char	0xXX	Parameter number (Page 549)
Calibration: Get parameter V1 (BINARY) Response string from sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0xXX	Length of telegram
5	Unsigned Char	0x2A	Calibration: Get Parameter
6 - 7	Unsigned short	0xXX	Error codes (Page 416)
8	Unsigned Char	0xXX	Parameter number (Page 549)
9 - 12	Unsigned Int	0xXX	Length of the following data
13 ... n	Unsigned Char	0xXX	Parameter value (Page 549)
Additional information:			
Accepted in run mode:		Yes	
Accepted in config mode:		No	
Accepted when Ready is Low:		Yes	

Status of Ready signal during processing:	Not altered
Supported interfaces:	Telegrams: Availability and supported interfaces (Page 415)

Parameter name	Parameter number	Parameter value	Length	Format
Status calibration	001	0: Invalid 1: Valid	1 Byte	Signed Integer
Calibration method	002	0: None 1: Scaling (Measurement) 2: Point pair list (Robotics) 3: Calibration plate (Measurement) 4: Calibration plate (Robotics)	1 Byte	Characters
Unit (user unit)	004	0: mm 1: cm 2: m 3: inch 4: au	1 Byte	Characters
Internal sensor parameter	005	0: Focal length (in mm *1000) 1: Kappa value (*1000) 2: Pixel pitch X (in µm * 1000) 3: Pixel pitch Y (in µm * 1000) Principal point X (in pixel * 1000) Principal point Y (in pixel * 1000) 6: Image size X (Pixel) 7: Image size Y (Pixel)	Per value 8 bytes	Signed Integer
External parameters	011	0: Shift X axis (in user unit * 1000)	Per value 8 bytes	Signed Integer

Parameter name	Parameter number	Parameter value	Length	Format
		1: Shift Y axis (in user unit * 1000) 2: Shift Z axis (in user unit * 1000) 3: Rotation X (in degree * 1000) 4: Rotation Y (in degree * 1000) 5: Rotation Z (in degree * 1000)		
Transformation calibration coordinate system	012	0: Shift X axis (in user unit * 1000) 1: Shift Y axis (in user unit * 1000) 2: Shift Z axis (in user unit * 1000) 3: Rotation X (in degree * 1000) 4: Rotation Y (in degree * 1000) 5: Rotation Z (in degree * 1000)	Per value 8 bytes	Signed Integer
Transformation measurement coordinate system	014	0: Shift X axis (in user unit * 1000) 1: Shift Y axis (in user unit * 1000) 2: Shift Z axis (in user unit * 1000) 3: Rotation X (in degree * 1000) 4: Rotation Y (in degree * 1000) 5: Rotation Z (in degree * 1000)	Per value 8 bytes	Signed Integer
Z-Offset	021	(in user unit * 1000)	8 Byte	Signed Integer
Focal length	022	(in mm *1000)	8 Byte	Signed Integer

Parameter name	Parameter number	Parameter value	Length	Format
Fiducial 1	024	in each case: 0: X value (customer unit * 1000) 1: Y value (customer unit * 1000) 2: Constant 0	Per value 8 bytes	Signed Integer
Fiducial 2	025			
Fiducial 3	026			
Fiducial 4	027			

Get image (BINARY)

Overview telegram SBS visualization

Get image (BINARY) Request string to sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0x06	Length of telegram
5	Unsigned Char	0x03	Get image
6	Unsigned Char	0xXX	0 – Last Image 1 – Last Failed Image 2 – Last Good Image
Get image (BINARY) Response string from sensor			
Byte No.	Data type	Content	Significance
1 - 4	Unsigned Int	0xXX	Length of telegram e.g. 00 04 B0 0D (Dez. 307213)
5	Unsigned Char	0x03	Response ID Get image
6 - 7	Unsigned short	0xXX	Error codes (Page 416)
8	Unsigned Char	0xXX	Image type 0 - Grayscale 3 – COLOR_BAYER_BG At conversion of the image from Bayer into RGB, the appropriate image type must be considered.
9	Unsigned Char	0xXX	Image result 00 - Failed image 01 - Good image
10 - 11	Unsigned	0xXX	No. of rows

	short		e.g. 01 E0 = 480
12 - 13	Unsigned short	0xXX	No. of columns e.g. 02 80 = 640
14 ... n	Unsigned Char	0xXX	Binary image data (rows * columns)
Additional information:			
Accepted in run mode:			Yes
Accepted in config mode:			No
Accepted when Ready is Low:			Yes
Status of Ready signal during processing:			Low
Supported interfaces:			Telegrams: Availability and supported interfaces (Page 415)

Data output in BINARY

Output data (BINARY), dynamically composed from user settings in the software. For detailed information to the file format see also:

Basic String Construction:

‹START› ((((‹OPTIONAL FIELDS› ‹SEPARATOR› ‹PAYLOAD›))) ‹CHKSUM› ‹TRAILER›

Output data (BINARY):

‹OPTIONAL FIELDS›			
Name	**Number of bytes**	**Binary contents / example**	**Significance / Comments**
Header	1 - max. 8	User defined, max. 8 characters	Start string (Header)
Selected Fields	2 (Word)	1 Byte per field	By this field output of all active checkboxes "byte-wise" can be activated - Output order is from left to right and from top to down. - For each checkbox there is one byte beginning with LSB = low significant bit. - Checkbox "Selected fields" is not part of the output!
Data length	2 (Word)	e.g. 0x00, 0x02 = length = 2 Byte	Length of telegram in bytes
Status	2 (Word)	e.g. 0x00, 0x06 (triggered) e.g. 0x00, 0x05 (free-run)	Byte1: 00000xxx Bit0 = ‹Free-run› Bit1 = ‹triggered› Bit2 = ‹Op.mode› (1=run / 0=config) Byte2 (reserved), always 0x00
Detector result	4 ... n	e.g. 0x05 (Bit1+3=5) 0x00 (two bytes number of detectors)	Byte 1 Bit1 (LSB) = global job result (1 = Pass, 0 = Fail) Bit2 = Boolean result, alignment only, alignment inactive = true

‹OPTIONAL FIELDS›			
Name	**Number of bytes**	**Binary contents / example**	**Significance / Comments**
		0x01 0x01 (Detector result D1)	Bit3 = AND conjunction of all detectors of the active job Byte 2 and 3 two byes for the number of detectors inside job (without alignment) Byte 4 - n 1 Byte per each block of 8 used detectors e.g.: Bit1 (LSB) = Detector 1, Bit2 = Det. 2, ...
Digital outputs	n	Byte 1 and 2: number of active outputs Bytes 3 ... n: outputs, bitcoded	Results of all digital outputs (bit-coded)
Logical outputs	n	Byte 1 ... 2 number of active logical outputs Byte 3 ... n all active logical outputs, bitcoded	Example: 18 logical outputs are configured, but only output 1, 2 and 9 are linked to functions (are active): 000, 003, 003, 001 2 bytes number of active outputs, all results bit-coded ... In this example there are needed 2 bytes because of output 9.... 1. result byte = 00000011 (log. output 1 + 2) 2. result byte = 00000001 (log. output 9)
Execution time	4 (Integer)		Current (job) cycle time in [ms]
Active job no.	1		Active job no. (1 ... 255)

‹PAYLOAD›				
Detector specific				For detector:
Name	**Number of bytes**	**Binary contents / example**	**Significance / Comments**	
Detector result	1	1 = Pass 0 = Fail	Boolean detector result	All detectors
Score value 1 … n	4		Score (0 … 100 %)	All detectors
Execution time	4		Execution time of individual detector in [msec].	All detectors
Distance	4		Calculated distance, [1/1000] *1)	Caliper
Position X 1 … n	4		Position found X (x-coordinate). [1/1000] *1)	Pattern matching Contour Edge detector Caliper Datacode Barcode OCR
Position Y 1 … n	4		Position found Y (y-coordinate). [1/1000] *1)	Pattern matching Contour Edge detector Caliper Datacode Barcode OCR
DeltaPos X	4		Delta position X between object taught and object found [1/1000] *1)	Pattern matching Contour Edge detector
DeltaPos Y	4		Delta position X between object taught and object	Pattern matching Contour Edge detector

‹PAYLOAD›				
Detector specific				
Name	**Number of bytes**	**Binary contents / example**	**Significance / Comments**	**For detector:**
Angle	4		Orientation of object found (0° ... 360°) [1/1000] *1)	Pattern matching Contour Edge detector Datacode Barcode OCR
Delta Angle	4		Angle between object taught and object found (0°..360°) [1/1000] *1)	Pattern matching Contrast Edge detector
Scaling	4		Only with contour (0.5 ... 2) [1/1000] *1)	Contour
R(ed) G(reen) B(lue)	4		Value for color parameter, signed integer [1/1000] *1)	Color value Color list
H(ue) S(aturation) V(alue)	4		Value for color parameter, signed integer [1/1000] *1)	Color value Color list
L(uminanz) A B	4		Value for color parameter, signed integer [1/1000] *1)	Color value Color list
Result index	4		Index in list, signed integer [1/1000] *1)	Color list
Color distance	4		Distance between	Color list

‹PAYLOAD›				
Detector specific				
Name	**Number of bytes**	**Binary contents / example**	**Significance / Comments**	**For detector:**
			taught and current color, signed integer [1/1000] *1)	
Area	4		BLOB	BLOB
Area (incl. holes)	4		Area of the BLOB, including holes, in pixels, signed integer [1/1000] *1)	BLOB
Contour length	4		Number of pixels of outer contour, signed integer [1/1000] *1)	BLOB
Compactness	4		Compactness of BLOB (Circle = 1, all other ›1). The stronger the shape of the BLOB deviates from circle the larger the value of compactness will be. Signed integer [1/1000] *1)	BLOB
Center of gravity X	4		X- coordinate of center of gravity of BLOB, signed integer [1/1000] *1)	BLOB
Center of gravity Y	4		Y- coordinate of	BLOB

‹PAYLOAD›				
Detector specific				**For detector:**
Name	**Number of bytes**	**Binary contents / example**	**Significance / Comments**	
			center of gravity of BLOB, signed integer [1/1000] *1)	
Center X	4		X- coordinate of fitted, geometric element (rectangle, ellipse), signed integer [1/1000] *1)	BLOB
Center Y	4		Y- coordinate of fitted, geometric element (rectangle, ellipse), signed integer [1/1000] *1)	BLOB
Width	4		Width of geometric element (rectangle, ellipse). Width ›= 0, width ›= height, negative value indicates failure, signed integer [1/1000] *1)	BLOB
Height	4		Height of geometric element (rectangle, ellipse). Heigh ›= 0,	BLOB

‹PAYLOAD›				
Detector specific				**For detector:**
Name	**Number of bytes**	**Binary contents / example**	**Significance / Comments**	
			height <= width, negative value indicates failure, signed integer [1/1000] *1)	
Angle (360)	4		Orientation of object in degree (range: -180 ... +180°, 0° = east, counterclockwise), signed integer [1/1000] *1)	BLOB
Eccentricity	4		Eccentricity numerical (range 0,0 ... 1,0), signed integer [1/1000] *1)	BLOB
Face up / down, area	4		Face up / down discrimination, based on area, indicated by sign, signed integer [1/1000] *1)	BLOB
String	1...n	Maximum length 127 !!	Contents of Code. Depending from code string length may change. If a fix string length is needed, parameters minimum string length (detector	Datacode Barcode OCR

‹PAYLOAD›				
Detector specific				For detector:
Name	**Number of bytes**	**Binary contents / example**	**Significance / Comments**	
			specific data output) and maximum string length (detector parameters) have to be used.	
String length	4		Length of Code in Bytes	Datacode Barcode OCR
Truncated	1	0x00 = Code komplett, 0x01 = Code abgeschnitten	Code truncated	Datacode Barcode OCR
Compare result	1		Result of string comparison	Datacode Barcode OCR
Quality parameter	1 ... n		Output of quality parameters according to selection	Datacode Barcode
Contrast	4		Contrast of the code (0-100%)	Barcode
Correction	4		Number of modules corrected by error corrections	Barcode
Module height	4		Height of modules in pixels	Datacode
Module width	4		Width of modules in pixels	Datacode

‹PAYLOAD›

Detector specific

Name	Number of bytes	Binary contents / example	Significance / Comments	For detector:
Confidence	5 ... n		Output of the confidence values of the individual characters	OCR
Result	4		Degree of similarity between the read string and the reference string from 0 to 100 %	OCR
Min. Quality	1		Minimum required quality was achieved	OCR

‹CHKSUM›

Name	Number of bytes	Significance / Comments
Checksum	1	XOR checksum of all bytes in telegram

‹TRAILER›

Name	Number of bytes	Binary contents / example	Significance / Comments
Trailer	1 - max. 8	User defined, max. 8 characters	End of string (Trailer)

*1) All detector-specific data with decimal places are transmitted as integers (multiplied by 1000) and must therefore be divided by 1000 after data reception. Values are transferred in format "Big-endian".

Example: "Score" Value (Binary protocol)

In Vision Sensor Configuration Studio/Vision Sensor Visualisation Studio "Score" = 35 is displayed.

Over Ethernet there will be received the following four bytes: 000,000,139,115

Formula for recalculating: (HiWordByte*256 + HiLowByte) *65536 + HiByte*256 + LoByte = Value

Because Big-endian (from Sensor) is sent calculation goes as following:

000 = HiWordByte, 000 = HiLowByte, 139 = HiByte, 115 = LoByte

(0*256 + 0) * 65536 + (139 * 256) + 115 = 35699 / 1000 = 35,699 (real score value)

Angles or other negative values are transferred in two's complement.