OPERATING INSTRUCTIONS

Inspector P30

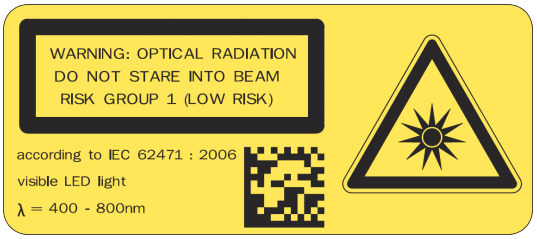
Vision Sensor

SICK
Sensor Intelligence.

VSPP-3F1122 (P30 Flex)

WARNING

The Inspector is equipped with a LED illumination that must be considered as a lamp system of Risk Group 1 (low risk) according to IEC 62471:2006



WARNING: OPTICAL RADIATION DO NOT STARE INTO BEAM
RISK GROUP 1 (LOW RISK) according to IEC 62471:2006
Visible LED light λ = 400-800 nm

DISCLAIMER

SICK uses standard IP technology for its products, e.g. IO Link, industrial PCs. The focus here is on providing availability of products and services. SICK always assumes that the integrity and confidentiality of data and rights involved in the use of the above-mentioned products are ensured by customers themselves. In all cases, the appropriate security measures, e.g. network separation, firewalls, antivirus protection, patch management, etc., are always implemented by customers themselves, according to the situation.

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Table of Contents

Introduction

1 Overview

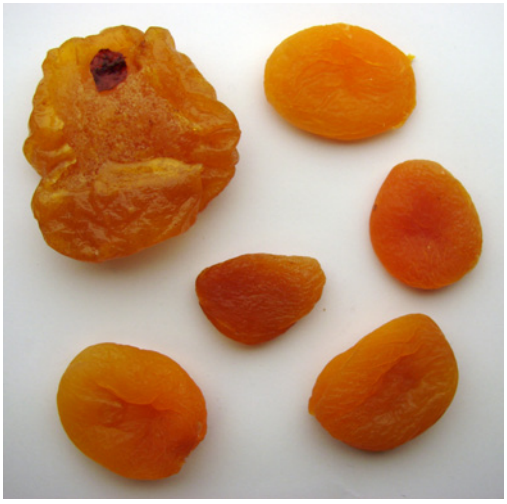
Inspector P30 is a function-specific variant within the Inspector Vision Sensor family. P30 has a tool set targeting *positioning* and *guidance* applications.

Figure 1.1 Inspector P30 is part of the Inspector vision sensor product family.

Inspector P30 uses two methods to locate the position of an object in the image:

- Locate the position of a known object shape
- Locate the position of free-form object shapes

Object with known shape.



Objects with free-form shapes, that is, the shape of the objects are not known before the image is taken.

The first method (locate the position of a known object shape) uses the *object locator*, which is a robust pattern matching function that searches for one pre-taught shape.

The second method (locate the position of free-form object shapes) uses the *blob locator*, which is a function that searches for objects by means of size and grey scale but does not care about the shape.

In positioning applications, the Inspector operates in three-step cycles:

1. Take an image
2. Locate the object(s) in the image
3. Report the object's position

In guidance applications, the first two steps are the same as for a positioning application but the third step is replaced by reporting a recommended direction of movement instead of a position.

2 Applications

Inspector P30 is designed for four main tasks, or application types:

1. Positioning of known shape
2. Positioning of free-form shapes
3. Two-directional guidance
4. Eight-directional guidance

In applications 1 and 2, the position and other results are reported as coordinates via Ethernet.

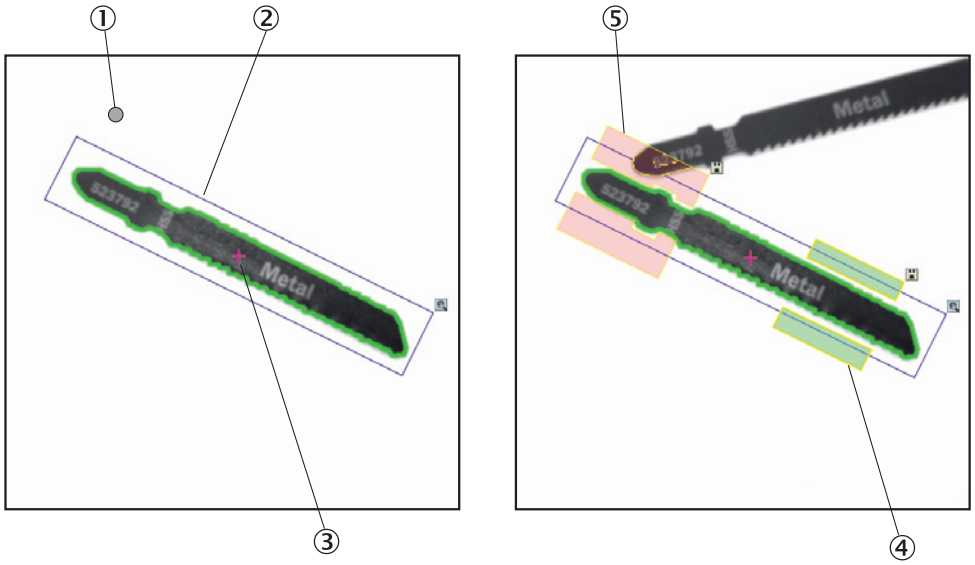
In applications 3 and 4, the recommended direction of movement is reported via digital outputs.

2.1 Positioning of Known Shape

In the first application, Inspector P30 uses the object locator to locate the position and rotation of a pre-taught, known object shape. The goal of the application can be to locate the object for robot picking or to align equipment for the next step in a production process.

The object locator can only locate one object per image. The reported pixel coordinate is the position of a *pick point*, which is located in the center of the teach region by default. The pick point can be manually moved. Pick point is a term frequently used in robot applications, and is also named *reference point*.

The left example below shows what Inspector P30 sees and reports in a simple robot picking application. The right example shows how *grip regions* can be added to ensure that the object can be picked by the robot's gripper.



① Background
② Object locator region
③ Pick point (reference point)
④ Grip region, free
⑤ Grip region, occupied

Figure 2.1 Inspector P30 locates the object and reports the position of the pick point/reference point (red cross) and the object's rotation. In the right image grip regions are added, for verifying that there are no obstacles when picking the object.

The result is reported via Ethernet as binary values or as ASCII strings, for example (ASCII string):

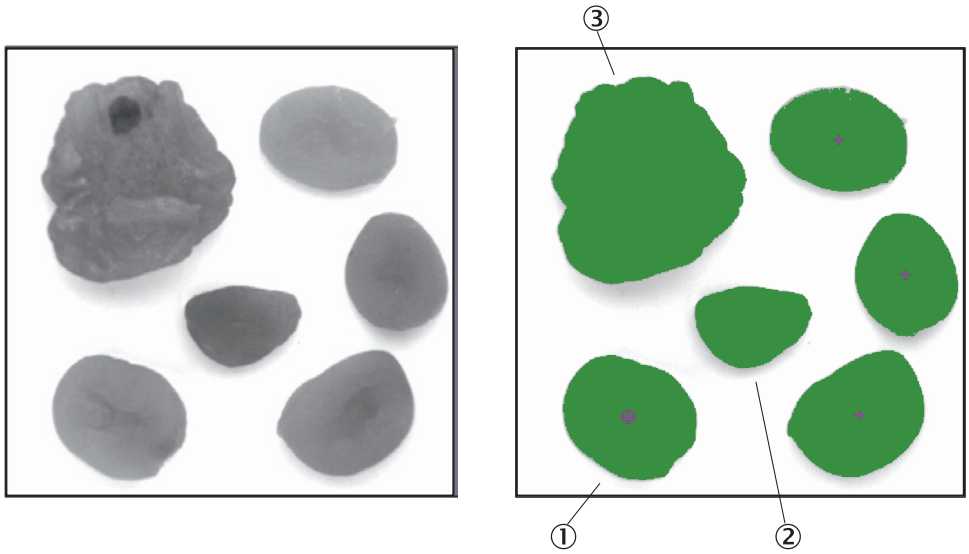
```
<Object locator: (X, Y) = (125.3, 220.8) rotation = 5.4>
```

2.2 Positioning of Free-form Shape

In the second application, Inspector P30 uses the blob locator to locate the position of one or more free-form object shapes. Free-form means that the shape does not matter and that the blob size and grey scale are used as search conditions. The goal of the application can be to sort objects by size and pick them with a robot.

The blob locator can locate up to 16 objects in one image. Because of the flexible shape, it is not possible to define a fixed pick point (reference point) on the object. Instead, each object's center of gravity is reported (purple crosses).

The following example shows how four free-form object shapes are located, and some others that are not located because they are either too big or too small. Note that all blobs are marked green, but only the valid ones (according to the search criteria) are marked by a purple cross. Also the object placed first in sort order is indicated with a circle around the purple cross.



① Largest located blob shape (**Sort by** size)
② Not located (too small)
③ Not located (too large)

Figure 2.2 Inspector P30 has located four free-form object shapes within the specified size range. Each object's center of gravity (purple cross) is reported.

The found objects are sorted either according to size or position. Note that the reported position (center of gravity) can sometimes be outside the object if its shape is curved or has a hollow center.

The result is reported via Ethernet as binary values or as ASCII strings, according to the sorting order of the blobs. Below is an example result when two blobs have been found (ASCII):

```
<Number of located blobs: 2 (X, Y, Area) = (65.4, 132.2, 7680) (X, Y,
Area) = (273.2, 311.9, 4122)>
```

2.3 Two-directional Guidance

In the third application, Inspector P30 guides machinery in two directions until the target's position reaches a specified *pass region*. The guiding is done via digital outputs.

The goal of the application can for example be to guide a vehicle along a line that is painted on the floor. Since the shape of the line changes when it turns, the free-form blob locator is best suited for this task.

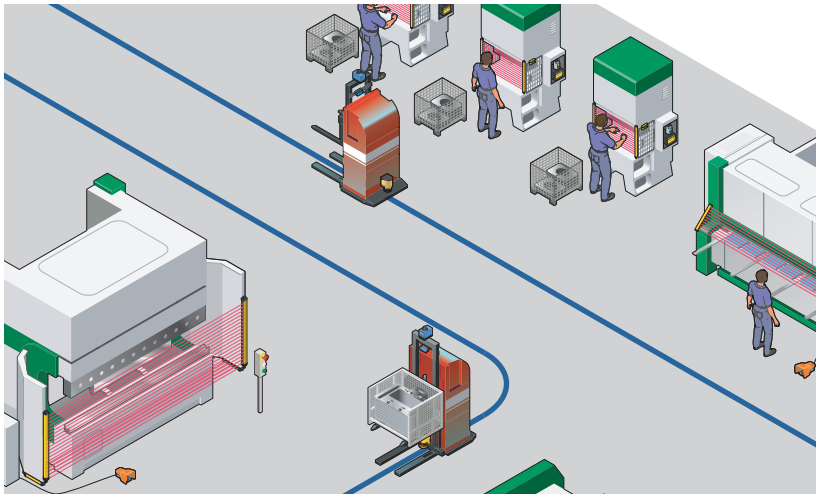
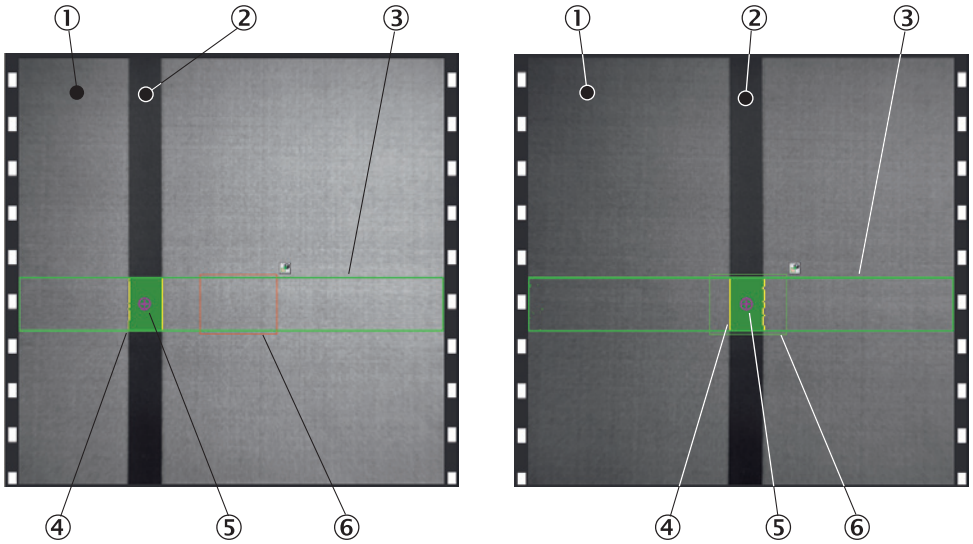


Figure 2.3 An AGV (Automatically Guided Vehicle) is guided to move along the blue line until it reaches the destination.

The following example shows what Inspector P30 sees and reports in an AGV (Automatically Guided Vehicle) application.



① Floor
② Guidance line
③ Blob locator region
④ Located blob
⑤ Reference point
⑥ Pass region

Figure 2.4 Two-directional guidance. In the left image, the guidance direction is left since the line's center of gravity is to the left outside of the pass region.

The green area is the located blob, that is, the part of the line that is inside the blob locator's search region, and the purple cross is the blob's center of gravity.

The result is reported via digital outputs **out1** and **out2** and also in the SOPAS Inspector GUI, see Section 12.2.1, "*Two-directional Guidance*" (page 52) for details.

out1	out2	Result
0	0	Line not located
0	1	Move right
1	0	Move left
1	1	Line is inside the pass region

2.4 Eight-directional Guidance

In the fourth application, Inspector P30 guides machinery in eight directions (360°, with 45° increments) until the target position is reached. Typically, the target has a known shape and therefore the object locator is best suited for the task.

The goal of the application is to move the machinery so that the target's reference point moves inside the pass region. The guiding is done via digital outputs. For successful guidance, it is necessary that the machinery can find the approximate location by itself, so that the target is visible in the Inspectors' image when the guidance starts.

The following example shows what Inspector P30 sees and reports in a stacker crane guidance application. A rectangular hole in the vertical beam works as target.

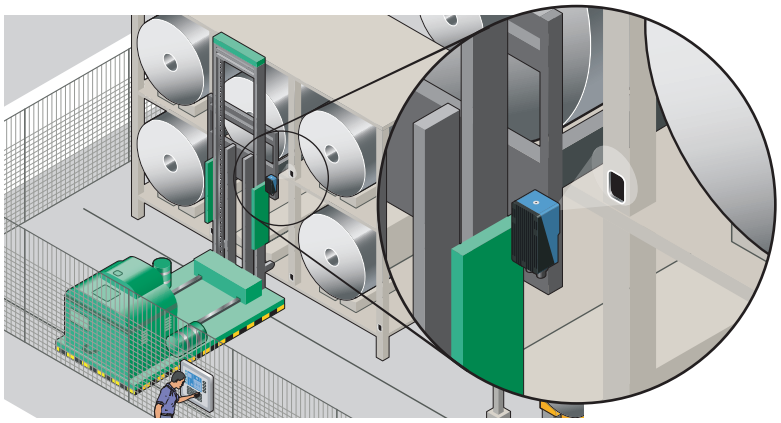
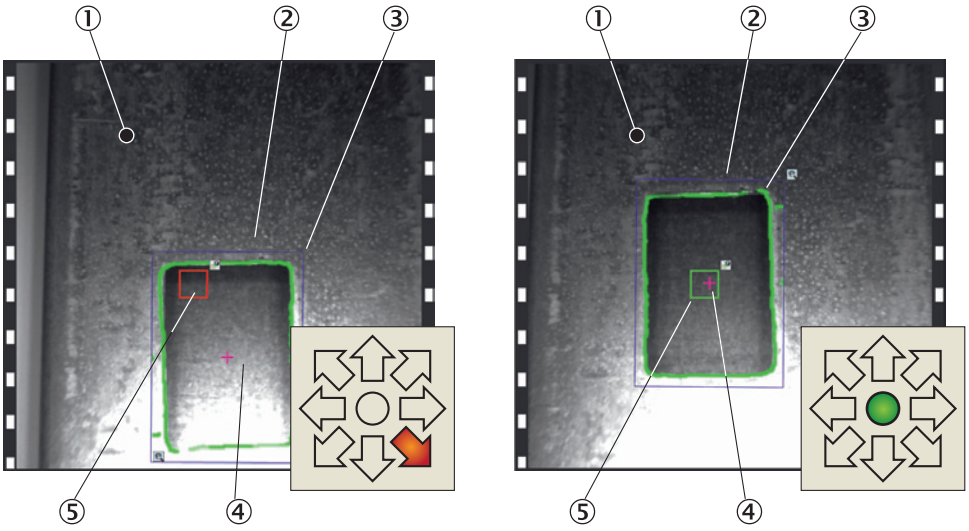


Figure 2.5 A stacker crane is guided to enter and exit the goods in the exact position in a stack storage.

In the live image the green contours of the object in the object locator region is shown when the Inspector has found the hole.



① Vertical beam
② Object locator region
③ Located object (target)
④ Reference point
⑤ Pass region

Figure 2.6 Eight-directional guidance. n the left image, the guidance direction is down and right, since the target's reference point is located down and right from the Inspector's pass region.

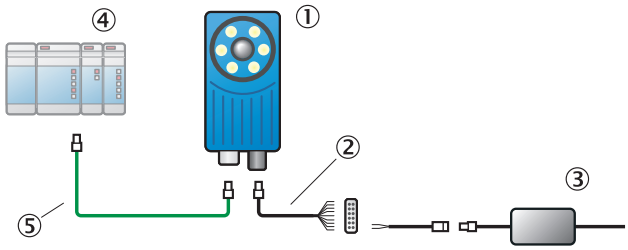
The result is reported via digital outputs and in the SOPAS Inspector GUI in a similar way as the two-directional guidance but instead using four outputs, **out1**, **out2**, **out3**, and **out4**. See Section 12.2, "*Directional Guidance via Digital Outputs*" (page 52) for a detailed definition of the outputs.

out1	out2	out3	out4	Result
0	0	0	0	Line not located
0	1	1	1	Move right
0	1	0	1	Move down right
1	1	0	1	Move down
1	0	0	1	Move down left
1	0	1	1	Move left
1	0	1	0	Move up left
1	1	1	0	Move up
0	1	1	0	Move up right
1	1	1	1	Inside pass region

3 System

Inspector P30 is designed to operate either stand-alone (without a PC) or connected to a PC or viewer for monitoring images and results.

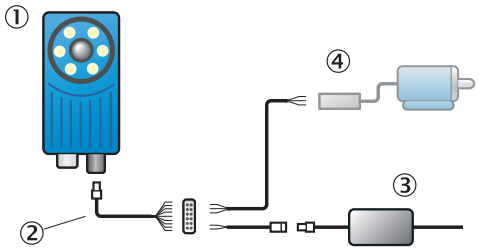
The following illustration shows the components in a minimal positioning system:



① Inspector P30
② Power I/O cable
③ Power supply
④ PLC or similar that receives reported positions
⑤ Ethernet cable

Figure 3.1 Typical components in a minimal positioning system.

The following illustration shows the components in a minimal guidance system:

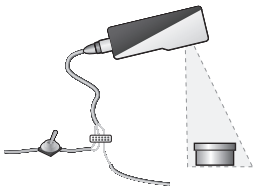


① Inspector P30
② Power I/O cable
③ Power supply
④ Vehicle control system or similar that receives guidance

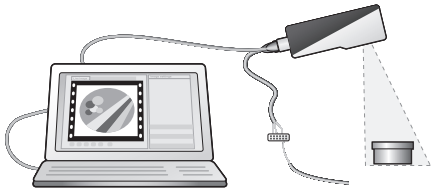
Figure 3.2 Typical components in a minimal guidance system.

The Inspector can be configured in two ways:

1. Via external teach, for example a teach button, for maximum simplicity (only the object locator is used)
2. Via the SOPAS Inspector PC application for maximum flexibility



External teach via teach button.



Configuration via the SOPAS Inspector

Figure 3.3 Configuring the Inspector P30.

3.1 Operating Modes

When connected to the SOPAS Inspector software, the Inspector P30 has two main operating modes:

Edit mode is for configuring the Inspector.

Run mode is for operation at full speed in production conditions.

The configuration can be stored to the flash memory to allow stand-alone operation without the PC connected. If the power is switched off and on, the Inspector P30 will automatically start running the configuration that is stored in flash.

3.2 Image Capturing Modes

Inspector P30 captures grey scale images of resolution 384x384 pixels. There are two image capturing modes:

1. Free-running mode: Images are captured at a constant rate determined by the configuration
2. Triggered mode: Image capture is triggered by an input signal, for example from a photo-electric switch

3.3 External Object Selection

The Inspector P30 can store up to 16 different configurations, or reference objects. Eight of these can be defined as selectable via digital inputs while the Inspector is running. This procedure is referred to as external object selection.

3.4 Accessories

There are a number of different accessories for Inspector P30, serving three main purposes:

1. To synchronize the image capturing
2. To improve the image quality
3. To mount the device

Examples of accessories are external lighting, photoelectric switch, encoder, color filters, and dome. See Chapter 15, “*Use Digital Inputs*” (page 61) and Chapter 16, “*Improve Image Quality*” (page 65), for details about when to use which accessory.

Getting Started

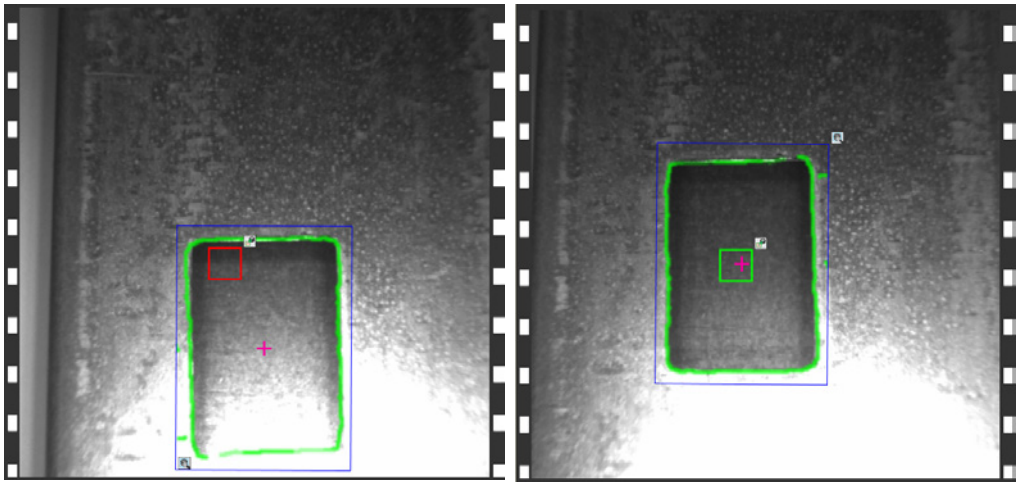
4 Preparations

4.1 Overview

To get started using the Inspector P30, this chapter will guide you through the setup steps of a stacker crane guidance application, from opening the box until it works. The stacker crane application example to solve in this chapter is described next, before the practical exercise starts.

4.2 Task

The goal is reached when the target's reference point (purple cross) is guided to move inside the object pass region (red/green rectangle).



The goal is to set up the Inspector P30 to perform eight-directional guidance in a stacker crane application.

The guiding is completed when the target's reference point (cross) is inside the pass region (small rectangle).

Figure 4.1 Eight-directional guidance is used in this stacker crane application example.

For the exercise that follows, either choose your own object or print out this page and use as target:

Figure 4.2 Object for the example guidance application.

4.3 Open the Box

The Inspector P30 is delivered with the following parts:

- Inspector P30 device
- Product installation CD
- A Quick Start guide
- A Hex key for adjusting focus
- Tool for removing the front window and changing the lens

In this application example, you will need the Inspector P30, the CD and the Hex key for adjusting the focus. The front window and lens tool is explained in the How To part of the manual, see Section 16.1, "*Change Lens*" (page 65). For a list of the box content, see Section A.6, "*What's Included – Inspector P30*" (page 91).

4.4 Install SOPAS Inspector

SOPAS is the PC application for Windows used to control devices in the Inspector family. SOPAS is available in two versions:

- **SOPAS Inspector**
- **SOPAS Engineering Tool**

SOPAS Inspector is only used for one Inspector at a time. **SOPAS Engineering Tool** is used when simultaneously working with different SICK devices or multiple Inspectors. This manual only describes SOPAS Inspector (recommended).

4.4.1 Install from CD

To install the SOPAS application:

1. Start your computer and insert the SOPAS Inspector CD into your CD drive. The following window is displayed:

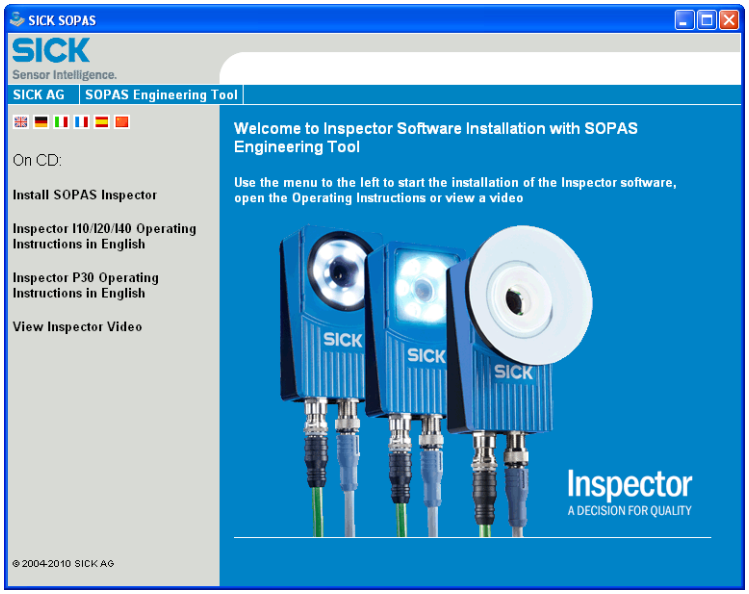


Figure 4.3 SOPAS Inspector welcome screen.

2. If your CD does not automatically show this window, open the CD and open the file `start.exe`
3. Click **Install SOPAS Inspector**. The installation program starts
4. Follow the on-screen instructions to complete the installation

5 Connect

5.1 Connect the Hardware

1. Mount the Inspector P30 so that it is facing the object.

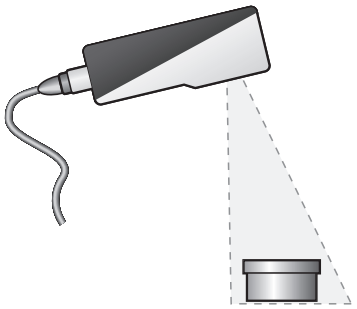


Figure 5.1 Mount the Inspector P30 facing the object.

2. Connect the Ethernet cable to the PC.

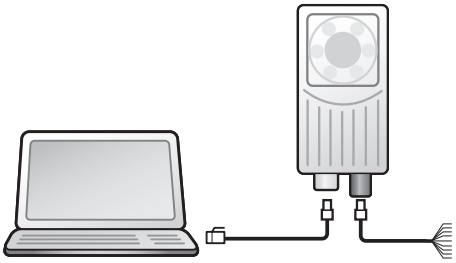


Figure 5.2 Connect the Ethernet cable.

3. Connect the Inspector P30 power I/O cable to a 24 V DC power supply:
   Brown +24 V DC, pin 1
   Blue Ground (GND), pin 2

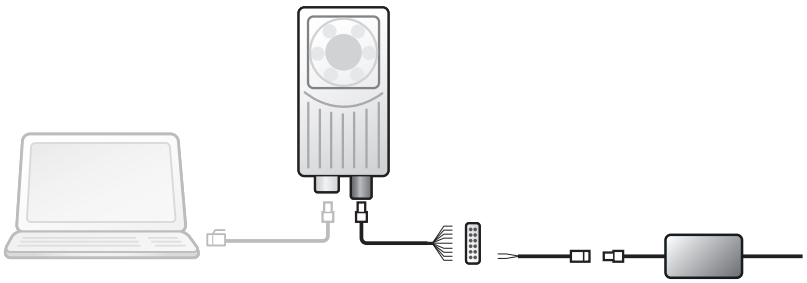


Figure 5.3 Connect to 24V DC power supply.

5.2 Connect SOPAS to the Inspector

Start SOPAS Inspector on the PC and wait for the search for available devices to finish in the SOPAS welcome screen. Select the Inspector you want to connect to in the list of available devices.

Note

If the device is not in the list, click **Search connected devices** to open the **Connection Wizard** and perform a full search. For details see Section 8.1, “*Use the Connection Wizard*” (page 29).

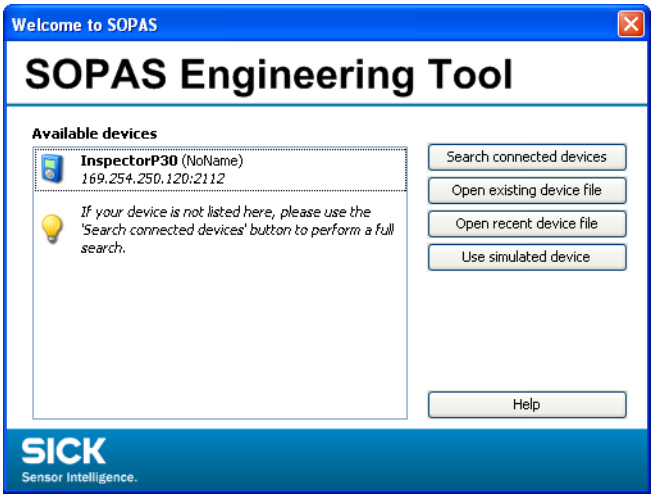


Figure 5.4 SOPAS welcome screen.

If the Inspector can be connected to, the connection is established and the SOPAS Inspector main window is opened. If the IP address of the Inspector must be changed before SOPAS can connect to the Inspector, the **Found devices** page in the **Connection Wizard** will be opened instead. See Section 8.3, “*Troubleshooting Connection Problems*” (page 30) for instructions how to change IP address.

6 Get a Good Image

1. When the device is connected the live image is shown in the main view. Switch from **Run** to **Edit** mode.
2. Place the Inspector in front of the object so that it is visible in the **Live image** tab.
3. In the **Image settings** tab, click **Auto** to automatically adjust the image exposure and gain values.
4. Adjust the focus by turning the adjustment screw on the top of the Inspector using the included 2 mm Hex key.

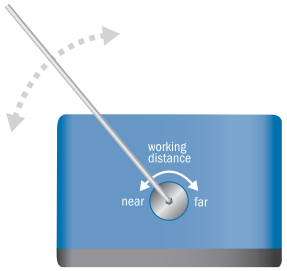


Figure 6.1 Adjusting focus.

The **Image settings** tab displays a focus feedback bar, which indicates when the focus is optimal.

Figure 6.2 Focus feedback bar.

The image should now be sharp and neither too bright nor too dark.

Too dark *Good image* *Too bright*

Figure 6.3 Getting a good image.

7 Configure the Application

7.1 Teach the Object

1. With the object in focus in the **Live image** tab, teach the object by pressing **Teach object locator**.

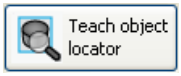


Figure 7.1 Teach object locator button.

A blue rectangular region appears that shows which part of the image that shall be taught (object locator region).

2. If necessary, move, resize and rotate the region. The green contours show what shape is recognized by the object locator.

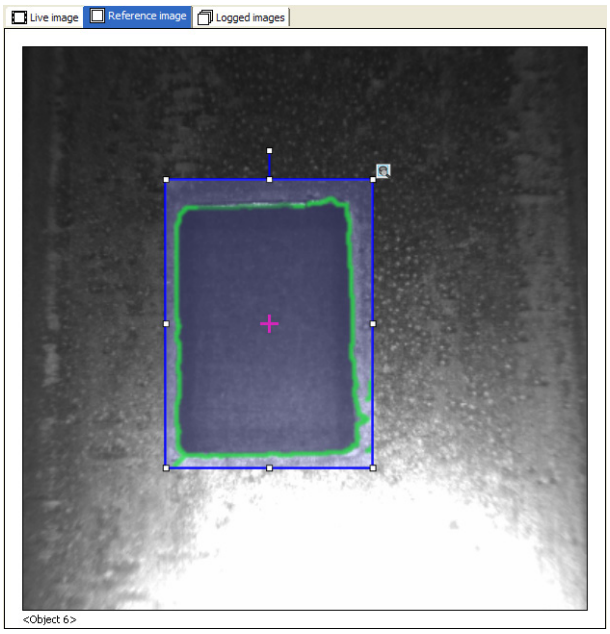
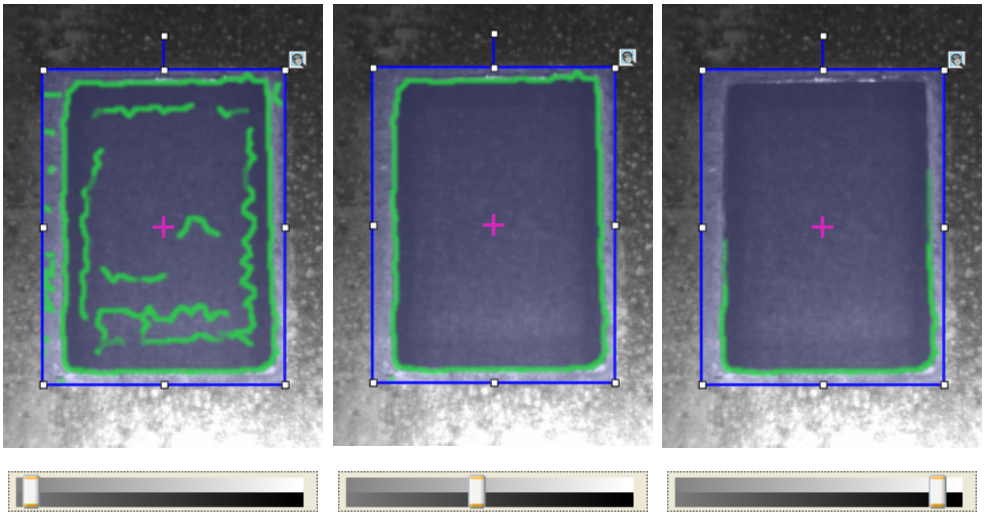


Figure 7.2 Object locator region.

3. For the object locator to work well, the amount of green contours needs to be enough (see the following images). The amount of contours is adusted with the **Edge strength** slider in the **Object locator** tab.

Figure 7.3 Edge strength slider.



Bad, too many contours. *Good, enough amount of contours.* *Bad, too few contours.*

Figure 7.4 Adjusting the amount of contours.

In the center of the blue object locator teach region is the reference point, shown by the purple cross. If a particular point on the object shall be reported, for example as a pick point for a robot, move it manually to the desired position. In this guidance application, we can let it stay in its default position in the center.

4. To activate the guidance function, place an object pass region in the image, for example around the target's reference point.

Figure 7.5 Object pass region.

This region can also be moved and resized. Unlike the reference point that moves with the object in the live image, the object pass region will remain in a constant position in the image.

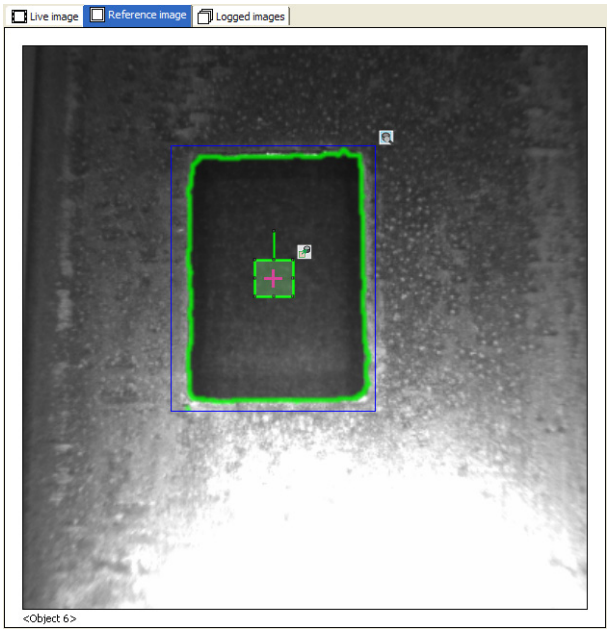


Figure 7.6 Object pass region in the center of the object locator region.

7.2 Monitor the Result

1. Switch from the **Reference image** tab to the **Live image** tab and see how the Inspector locates the object when it is moved around and shows the recommended direction of the device with the guidance arrows in the **Results** tab.

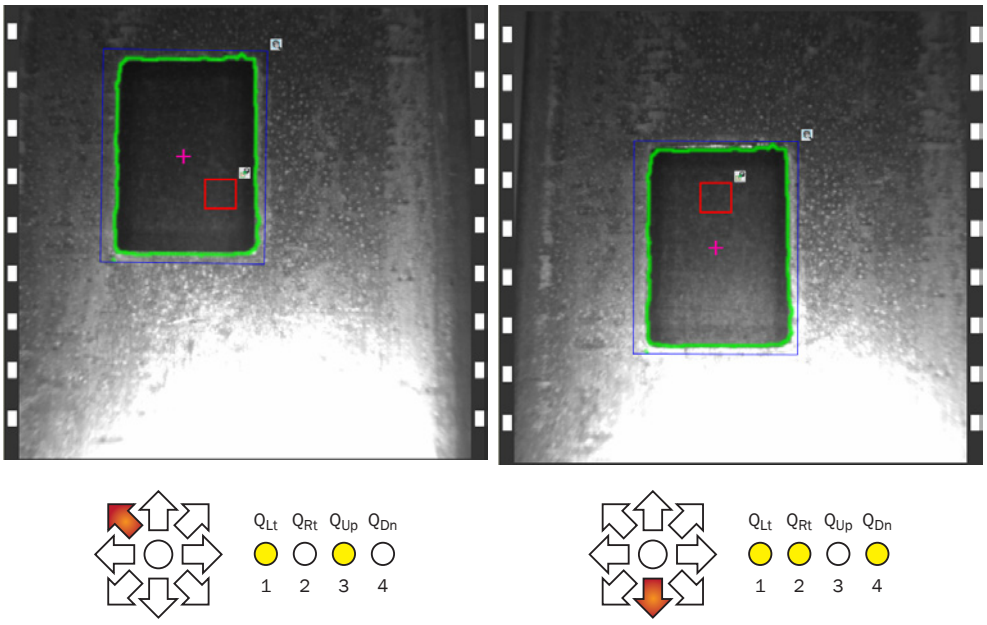


Figure 7.7 Recommended guidance direction.

The **Results** tab shows the behavior of the digital outputs. The details of the output definitions is found in Chapter 13, “*Use Result and Statistics*” (page 56).

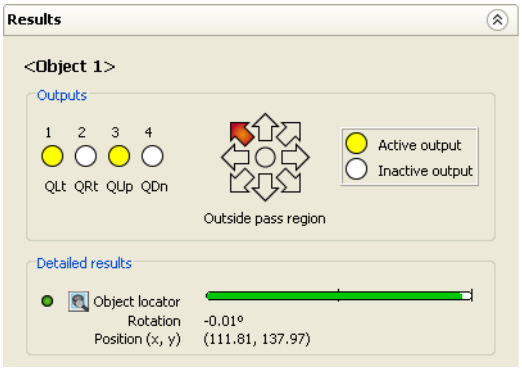


Figure 7.8 Output status in the Results tab

In addition, detailed results such as match score (the green bar) and the location of the reference point is displayed. For positioning applications, this is information that can be retrieved from the Inspector via Ethernet. Note that the x and y coordinates are the number of pixels from the top left corner of the image.

Notes

When configuring the Inspector P30, the physical outputs are disabled by default. You can enable them in **Edit** mode by clicking **Enable built-in outputs in Edit mode** in the **I/O Settings** dialog in the **InspectorP30** menu.

When put in **Run** mode, outputs will automatically be enabled.

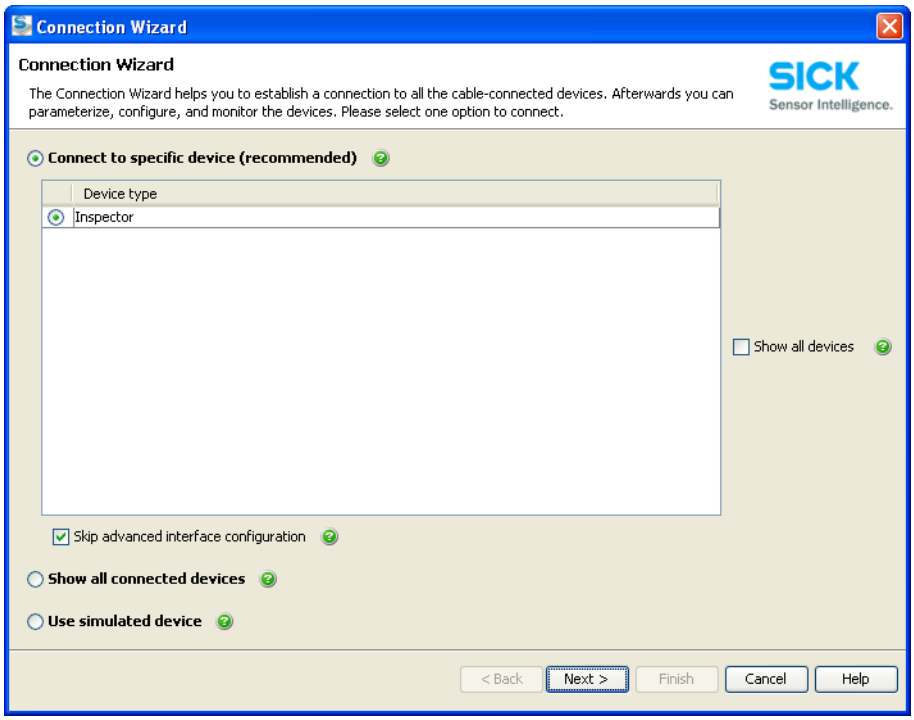
How To

8 Connect

To connect to an Inspector that is plugged in to the PC or the network, either select the Inspector in the SOPAS welcome screen, see Section 5.2, "*Connect SOPAS to the Inspector*" (page 21), or choose **Connection Wizard** from the SOPAS Inspector **Communication** menu

8.1 Use the Connection Wizard

To connect to an Inspector using the **Connection Wizard**, choose **Connect to specific device** and select **Inspector** in the device type list. Then click **Next**.



SOPAS will now search for Inspectors that are connected to your computer:

- If there is only one Inspector connected, SOPAS will automatically try to connect to that Inspector and open the main window.
- If there are more than one Inspector connected, or if there was a problem connecting to the only connected Inspector, the **Found devices** page will be displayed.
- If the **Interface selection** page is displayed, click **Next** to go forward and to start searching for Inspectors.

The icons and colors in the list of found devices have the following meanings:


The Inspector can be connected to.


The Inspector is used by another user.


The IP address of the Inspector must be changed before SOPAS can connect to the Inspector.

See Section 8.3, "*Troubleshooting Connection Problems*" (page 30) for instructions on how to change IP address.

8.2 Use a Simulated Device

How to use a simulated device instead of connecting to an Inspector is described in Chapter 20, “*Use the Simulated Device*” (page 80).

8.3 Troubleshooting Connection Problems

No device was found

- Make sure the Inspector has started.
  You may have to wait up to 40 seconds after switching on the power or restarting the Inspector.
- Make sure the PC has a network connection.
  The icons in the Windows taskbar can indicate if the PC's network connection is not working properly:


The PC has no connection to the network


The PC is trying to connect to the network, but does not yet have a network connection.

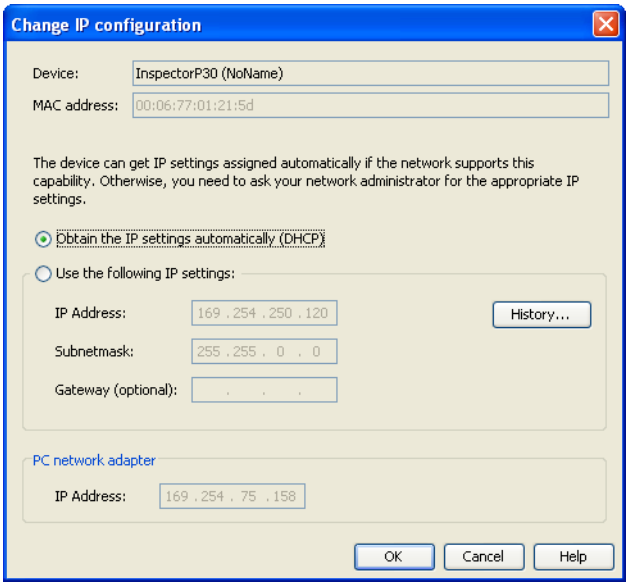

The PC is connected to a network, but the connection is not properly set up.
This should be OK if the Inspector is connected directly to the PC without any local network.

- Click **Rescan** to make SOPAS search the network again.

Ethernet connector icon is red. Notice: "Please configure the device interface"
You will need to change the IP address of the Inspector or the PC before connecting.

To change the IP address, of the Inspector, do the following:

1. Select the Inspector in the list of found devices.
2. Depending on the connection to the Inspector, do one of the following:
   - If the Inspector is connected with the Ethernet cable directly to the PC, choose to change the device IP settings **Automatically**. When the new settings are presented, click **Yes** to write the settings to the Inspector.
   - If the Inspector is connected via a local network, there is probably a DHCP server available that distributes IP addresses. In that case choose to change the device IP settings **Manually**, select **Obtain the IP settings automatically (DHCP)** and click OK.



Other Connection problems

See the SOPAS help for Engineering Tool for more information on other connection related problems.

8.4 Connect to an Inspector Remotely

You can connect to an Inspector without scanning for it if you know the IP address of the Inspector. This could be useful for example if you have a remote connection to the Inspector over VPN (virtual private network)

Note

The PC must be on the same subnet as the Inspector in order to connect to it.

1. Choose **Connection Wizard** from the **Communication** menu.
2. Choose **Connect to specific device**, and select **Inspector** in the device type list.
3. Make sure that **Skip advanced interface configuration** is not selected, and click **Next**.
4. On the Interface selection page, click **Configure interface**.
5. Disable **Auto IP** by deselecting **Enable Auto IP**.
6. In the Internet Protocol (IP) dialog box, click **Add** to add a new item to the list of IP address configurations.
7. In the Add dialog box, choose **Single address** and enter the IP address of the Inspector.
8. Click **OK** twice to return to the connection wizard, and then click **Next** to locate the Inspector.

If SOPAS was able to locate the Inspector, it will be displayed on the Found devices page. In that case, click **Next** to connect to the Inspector.

If SOPAS was not able to locate the Inspector, the list of found devices will be empty. In that case, see Section 8.3, “*Troubleshooting Connection Problems*” (page 30) for troubleshooting tips.

9 Use SOPAS Inspector

The **SOPAS Inspector** is the graphical PC based configuration application for any of the Inspector variants. It is a slim version of **SOPAS ET** (Engineering Tool) for supervision of one Inspector at the time.

The main usage of **SOPAS Inspector** is to configure the Inspector. It also features a powerful support for monitoring live or log images, result and statistics in runtime. It also has also a powerful support for post analysis and fine tuning of configuration in a simulated device environment.

SOPAS ET can be used for configuration of several devices, Inspectors and other SICK devices compliant with SOPAS, in a single application. **SOPAS ET** has a slightly different user interface and functions, this is not a subject to be described in this chapter. For further information on how to use multiple device configurations, see the SOPAS help for Engineering Tool.

9.1 Framework

This section specifically describes the framework when connected to a real device. For specific controls for simulated device, see Chapter 20, "*Use the Simulated Device*" (page 80). After having connected to a device, the figure below describes the application window on the PC.

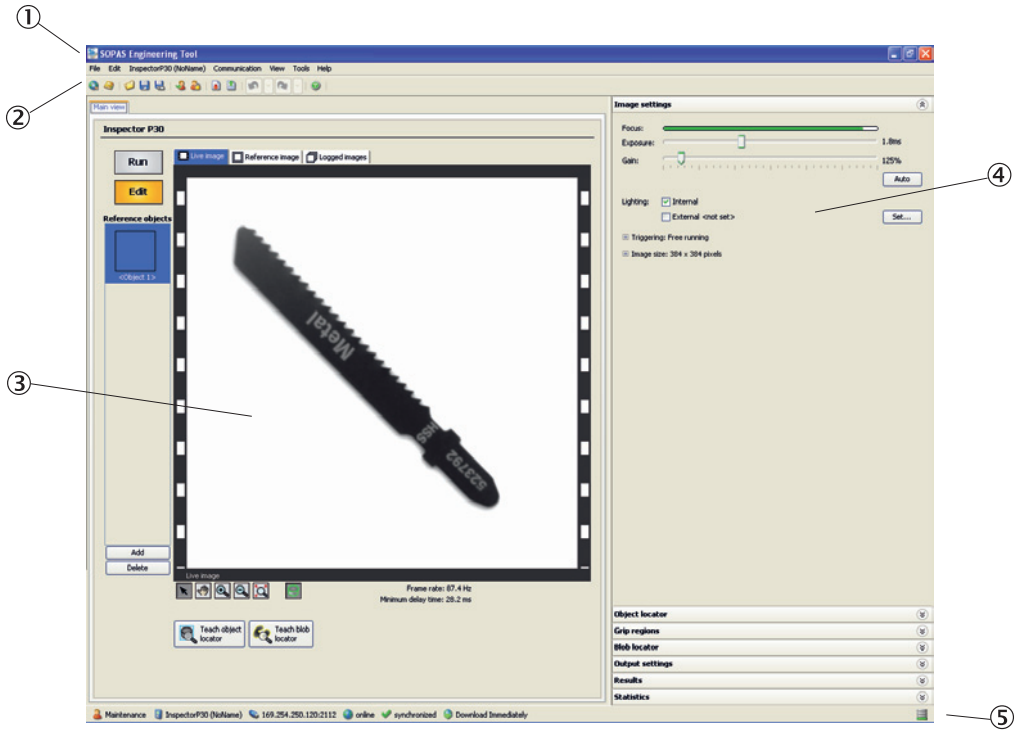


Figure 9.1 SOPAS Inspector main window

① Menu bar:

- **File** menu with for example alternatives for opening, and saving device configuration
- **Edit** menu with for example the possibility to load data to device
- **InspectorP30** menu, see Section 9.3, "*InspectorP30 Menu*" (page 34)
- **Communication** menu for communication alternatives, for example run **Connection Wizard**
- **View** menu. Select visible views in the GUI.
- **Tools** menu. For example for switching language

- **Help** menu for starting **Help** and view version information **About Inspector** (application, FPGA, and monitor firmware version)

② Toolbar

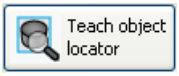
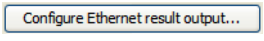
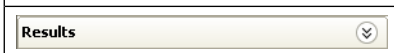
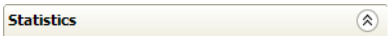
③ Main view with information and controls for (see Section 9.4, “*Main View*” (page 35)):
- Image view that can be either of **Live image**, **Reference image**, **Logged images**.
- **Reference objects** list
- **Teach object locator** and **Teach blob locator**.

④ Tabs for different detailed configuration tasks for Inspector P30

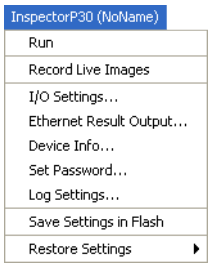
⑤ Status bar reporting the user level, connected device, and synchronization status

9.2 Configuring Workflow

The basic flow when configuring an application is described in the table below. The flow assumes that the device is mounted and that a connection to the Inspector P30 has been established. For more information on how to connect, see Chapter 5, “*Connect*” (page 21) and Chapter 8, “*Connect*” (page 29):

SOPAS Inspector GUI reference	Description
	To be able to change the settings click **Edit**.
	Adjust the image settings to obtain a good image for the application and decide on how to capture the image, see Chapter 10, “*Adjust Image*” (page 37), and Section 15.1, “*Connect an Image Trigger*” (page 61).
 or 	Depending on the application type choose **Teach object locator** or **Teach blob locator** to start configuring the application. See Section 11.1, “*Teach a New Object*” (page 40).
 or 	Configure the settings for the locator tools, see Section 11.2, “*Locate a Known Shape – Object Locator Tab*” (page 40) and Section 11.3, “*Locate Free-Form Shapes - Blob Locator Tab*” (page 43).
  or 	If the application is a guidance application, add an object pass region, see Section 12.2, “*Directional Guidance via Digital Outputs*” (page 52). Configure the settings for the digital outputs, for example active time and delay, see Section 12.4, “*Output Delay, Active Time and Invert*” (page 54), optionally choose to configure Ethernet based result output from the Inspector P30, see Section 12.1, “*Result via Ethernet*” (page 48) .
	Click **Run** to set the device in operating mode. If configuration should be permanently stored on the device choose Yes when asked if store to flash should be done
	Monitor the results for the analyzed images.
	Monitor the statistics for the analyzed images.

9.3 InspectorP30 Menu



Run

To switch the Inspector to **Run** mode:

1. Choose **Run** from the **InspectorP30** menu.
   A warning dialog box is displayed if any settings have been changed.
2. Click **Yes** to save the new settings in the Inspector's flash memory. Click **No** to discard changes.

Edit

To switch the Inspector P30 to **Edit** mode, choose **Edit** from the **InspectorP30** menu.

Record Live Images

Saves a stream of live images to file on the disk drive on the PC. For a detailed description see Section 19.2, "*Record Live Images to PC*" (page 79).

I/O Settings

To view or change input and output settings, choose **I/O settings** from the **InspectorP30** menu. Note that the setting made here are global for all reference objects. For more information about digital inputs, see Chapter 15, "*Use Digital Inputs*" (page 61). For more information about output settings, see Section 12.2, "*Directional Guidance via Digital Outputs*" (page 52).

Ethernet Result Output

To configure the device to send Ethernet based result output, choose **Ethernet Result Output** from the **InspectorP30** menu. For more information, see Section 12.1, "*Result via Ethernet*" (page 48).

Device Info

To see information about the current device, choose **Device Info** from the **InspectorP30** menu. For more information, see Section 9.3.1, "*Device Info*" (page 35).

Set Password

To change the current password in the Inspector for user level **Maintenance** (used for **Edit** mode), choose **Set Password** from the **InspectorP30** menu. The **Login** dialog box is displayed.

Enter current password (default password is `Inspector`). Select user level **Maintenance**. Enter new password and re-enter new password. Click **OK**.

To remove password protection of **Edit** mode (user level **Maintenance**), set the password to the default password `Inspector`.

Log Settings

To select which types of images that should be logged, choose **Log Settings** from the **InspectorP30** menu. For more on image log see Section 19.1, "*Use Image Log*" (page 78).

The 30 most recent images of the specified type are saved in the log. The images can be viewed in the **Logged images** tab.

Save Settings in Flash
To save all device data (settings) in the Inspector's flash memory, choose **Save Settings in Flash** from the **InspectorP30** menu. A progress bar is displayed during the process. The Inspector will stop analyzing images until the flash memory is updated. For more information about device data, see Chapter 21, "*Handle Device Data*" (page 82).

Restore Settings
It is possible to restore settings and return to the factory settings. All device data will be deleted. To restore settings choose **Restore Settings** from the **InspectorP30** menu. For more information about device data see Chapter 21, "*Handle Device Data*" (page 82).

9.3.1 Device Info

To see information about the current device, choose **Device Info** from the **InspectorP30** menu. The **Device Info** dialog box is displayed, with two different tabs:

- General
- Network

General
Here you can see the following information about the device:

Name	The name of the current Inspector P30 (device). The name can be changed. The name appears next to the **InspectorP30** menu and also in the **Connection Wizard**.
Serial no	The serial number of the current Inspector P30 (device).
Save System Dump	To save the contents of the memory of the Inspector, click **Save system dump**. Select the directory where to save the dump. This is only used for support provided by SICK.

Network
Here you can see the following information about the network:

TCP/IP	The network configuration type; DHCP or Manually.
IP address	The IP address and port of the current Inspector P30 (device).
Netmask	The netmask of the current Inspector P30 (device).
Gateway	The gateway address for the network.
Network speed	The network speed for the current network connection.
MAC address	The MAC address or the Ethernet ID for the network card in the Inspector.

9.4 Main View

Run/Edit switch
Click **Edit** to teach reference images, set up inspections, and to test. Click **Run** mode is for operation at full speed in production conditions. Settings can not be changed in **Run** mode.

List of Reference Objects
The **Reference objects** list contains all taught reference objects. To select which reference object to work with, select **Edit** mode and click on the reference object in the list. Click **Add** to create a new reference object. Click **Delete** to remove the selected reference object. Reference objects can also be copied by right-clicking a reference object in the list and selecting **Copy to new reference object**.

9.4.1 Live Image Tab

Live Image

The **Live image** tab contains view control buttons, teach buttons and output selection. When clicking on one of the teach buttons, an image is captured and an **Object locator** or **Blob locator** region is placed in the new reference image.

View Controls

The view control buttons consists of tools to work with regions and to set the view of the image. The buttons are:


Select regions. When moving the mouse pointer over the image the coordinates are visible in the frame of the image.


Move (pan), move a zoomed in image


Zoom in


Zoom out


Zoom to fit


Show or hide contours and feedback graphics

Frame Rate and Minimum Delay time

Frame rate shows the number of analyzed images per second (in Hertz, Hz). For triggered inspections, the frame rate is the minimum time between two frames. Trigger pulses that occur at a higher rate are discarded, and can be view in the **Statistics** tab as **Number of ignored trigger pulses**. The Minimum delay time is the shortest delay time on any output signal (in milliseconds, ms).

10 Adjust Image

10.1 Adjust Focus

To adjust focus, place an object to inspect in front of the Inspector, so that it is visible in the **Live image** tab.

Adjust the focus by turning the adjustment screw (hex key) on the top of the Inspector. Use the 2 mm Hex key that came with the Inspector. Look at the **Live image** tab and adjust until the image is focused.

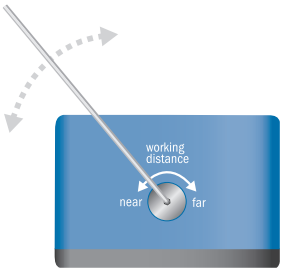


Figure 10.1 Adjust focus

10.2 Adjust Image Settings

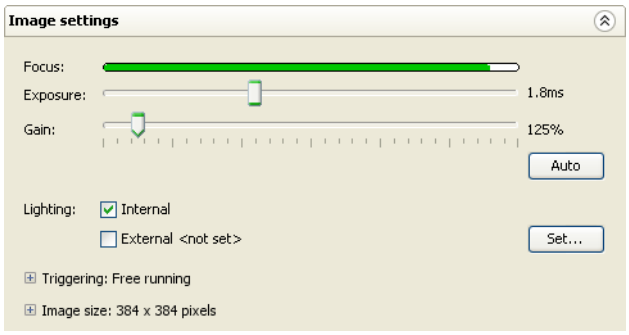
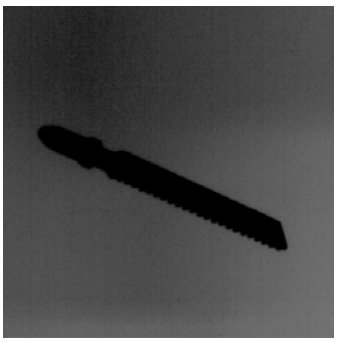


Figure 10.2 Image settings

Adjusting **Exposure** and **Gain** settings changes the image quality. To adjust exposure time and gain to good values, click **Auto**. The **Auto** adjustments will change exposure time and gain, only after clicking on **Auto**, the settings will not change continuously.



Under exposed (increase exposure time)

Good exposure

Over exposed (reduce exposure time)

10.2.1 Adjust Exposure

Exposure is the duration of the exposure, measured in milliseconds (ms).

Increasing the exposure time results in brighter images, but may also result in a lower frame rate.

If the object is moving and exposure time is too long, the image will be blurred, which may result in lower accuracy in the inspections. When a short exposure time is necessary because of object speed, there are two methods to make the image bright enough:

- Use external high-intensity lighting
- Increase the gain

To adjust exposure time, drag the **Exposure** slider on the **Image settings** tab.

10.2.2 Adjust Gain

The **Gain** setting is used for increasing the gain of an image after it has been captured. Increasing the gain may also increase the noise in the image and make it appear grainier. To adjust gain, drag the **Gain** slider on the **Image settings** tab. Setting **Gain** to 100% means that the image will be unaffected. A higher value means that the image will be brighter.

10.3 Use Lighting

The Inspector has a built-in lighting using LEDs (Light Emitting Diodes).

There are four different combinations of how to use lighting:

- None, only ambient light is used, such as normal indoor light or sunlight
- Internal (or built-in) lighting
- External lighting
- Internal and external lighting

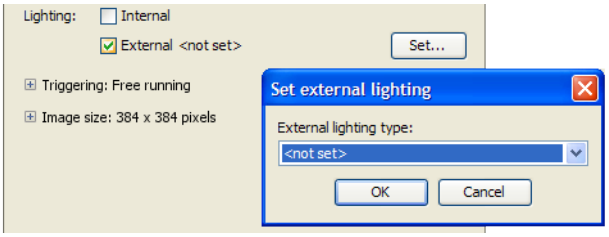


Figure 10.3 Use lighting options.

Note

The internal and external light is active during the whole exposure time.

10.3.1 Use Internal Lighting

To turn on (or turn off) the built-in lighting in the Inspector select (or deselect) the **Internal** check box on the **Image Settings** tab.

10.3.2 Use External Lighting

Before the Inspector can use an external lighting, the type must be specified.

To use external lighting with the Inspector:

1. Select **External** on the **Image Settings** tab.
2. Choose the correct external light source from the list in the **Set external lighting** pop-up dialog box.
3. Click **OK**

If a SICK ICL light source is used, the only configuration required is selecting the ICL-type in the list and all other settings will be configured automatically. Note that if the selected expos-

ure time is longer than the maximum active time for the selected light source, then the exposure time is automatically adjusted to this limitation.

If a SICK light source used in combination with the VLR Trigger unit, the **Other – active low** choice shall be selected from the list.

Non-SICK External Light

If a non-SICK external light source is to be used, select **Other – active high** or **Other – active low** depending on the specifications of the external lighting. The option **Other – active high** is used for light sources that triggers on an active high signal (+5 V) and the option **Other – active low** is used for light sources that triggers on an active low signal (0 V). The signal is active during the whole exposure time, so adjust the **Exposure** setting to be lower than the maximum active time for the light source. If the external illumination has restriction of the duty cycle, the only way is to use an image trigger and adjust the trig rate so that the duty cycle of the light source is not exceeded.

Warnings

Do not use longer exposure time than what the external light is designed for. See the technical data for the light source.

Do not use shorter cycle time (frame rate) than what the external light is designed for. See the technical data for the light source.

10.4 Adjust Image Size/Field of View

The image size is the size in pixels of the images captured by the Inspector.

The image size can be changed by changing field of view. Adjust the field of view so that the Inspector only captures images of the area in which the objects are expected to be found. The default field of view is the full area that the Inspector sees.

To change the field of view:

1. In the **Image Size** section of the **Image settings** tab, click **Change**.
2. In the **Live image** tab, resize the grey rectangle **Valid FOV** (field of view) region with the handles. The **Minimum FOV** (red rectangle) depends on all applied regions, that must be inside the field of view.

Full FOV

Reduced FOV

3. Click **Resize**. The Inspector will now use the new image size.

11 Locate the Object

The Inspector P30 uses two methods to locate the position of an object in the image:
1. Object locator for known shapes
2. Blob locator for free-form shapes

For either of the methods to work reliably the image quality must be good enough. For more information on how to improve and adjust the image, see Chapter 10, "*Adjust Image*" (page 37) and Chapter 16, "*Improve Image Quality*" (page 65).

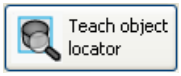
11.1 Teach a New Object

There are two ways to teach the Inspector P30:

Using SOPAS Inspector

With SOPAS Inspector you can connect to an Inspector P30 from a PC, view images, teach new reference objects and change settings.

To teach a new reference object click **Edit** and then choose the type of locator that is needed:



*Click **Teach object locator** to teach an object locator reference object*

*Click **Teach blob locator** to teach a blob locator reference object*

Note

It is possible to replace the image in the taught reference object. Click on the reference object in the **Reference objects** list and then choose **Live image** tab and adjust the settings of the image. Finally click **Replace reference image**.

Using Teach Button without PC

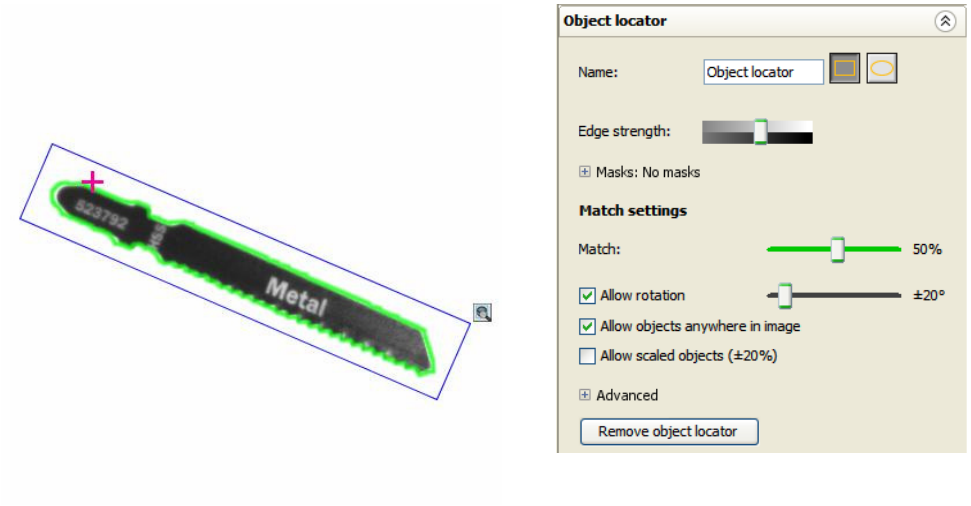
The Inspector P30 can also teach an object by using the external input **in2**. See Section 15.3, "*Use External Teach*" (page 62) for a detailed description on how to perform external teach.

11.2 Locate a Known Shape – Object Locator Tab

The Object locator is used to locate an object that has a known shape. The method uses a pattern matching function that recognizes edges in the image.

The following example shows the device in Edit mode, where the Object locator is taught to find an known shape in the Reference image. The reference point (purple cross) has been moved manually from the center of the object locator region to the particular point on the object that shall be reported. The reference point for the object locator can be moved with either the mouse or the arrow keys on the keyboard.

When switching to Live image, the Inspector will analyze the live image and display the results. The results can be reported via Ethernet and the digital output pins. For more information on configuring Ethernet results see Section 12.1, "*Result via Ethernet*" (page 48).



*Teach the shape to be located in **Reference image** tab* *Configure the settings for the **Object locator***

The edges that will be searched for are those inside the object locator region (blue rectangle), that are outlined with green fuzzy contours. The following settings can be made for the object locator:

Edge strength

The amount of contours found is adjusted with the **Edge strength** slider. The Edge strength setting determines how much of the object's contours that are highlighted. In most cases, you should make sure that most of the characteristic contours in the object are highlighted but nothing is highlighted in the background or outside the object. Use the **Mask** tool to mask out areas of the region that lie outside the object if it is difficult to make pixels in the area around the object disappear with the **Edge strength** setting.

Match

The **Match** setting tells how well the located object must match. The match score can be set between 0% and 100%. Move to the left (lower values) if the Inspector fails to locate objects, move to the right (higher values) if the Inspector claims to locate objects that are not of the correct shape.

Allow rotation

The **Allow rotation** setting consists of a check box and a slider. If the check box is deselected, then the slider is inactivated. If the check box is selected, then the allowed rotation can be set between zero and ±180°. Deselect the check box if the object always appears with the same rotation as in the reference image. This speeds up the inspections and makes it more robust. If the objects appear with different rotations, make sure that the allowed angle is sufficiently high, since the Inspector will not locate objects that are rotated more than allowed angle.

Allow objects anywhere in image

The **Allow objects anywhere in image** setting is used for telling where in the image to search for objects. When selected, the Inspector will locate objects that are partially outside the image (although with a lower score). When deselected, you can specify the region (Search region in green color) in which the objects are allowed.

	Objects located outside or partially outside this search region will not be located.
Allow Scaled Objects (±20%)	The **Allow scaled objects** setting is used when objects appear at different distance from the Inspectors lens. Deselect if the inspected objects always have the same size in the image as the reference object. Deselection will speed up and make the inspections more robust. When selected, the Inspector will locate objects that are scaled up to ±20%.
Advanced – Search Method	See Section 17.1, "*Improve the Object Locator*" (page 70).

11.2.1 Use Grip Region

When using an object locator there is a possibility to check regions relative to the found object for presence of edges. These so called grip regions and are added by clicking **Grip region** and drawing the region in the **Reference image** tab. The region can then be edited and masks can be added if needed. The grip regions can, for example, be used to identify if the located object is neighbor-free in order to be picked without interfering with other objects. The grip region is regarded as failed if any part of it is placed outside the FOV.

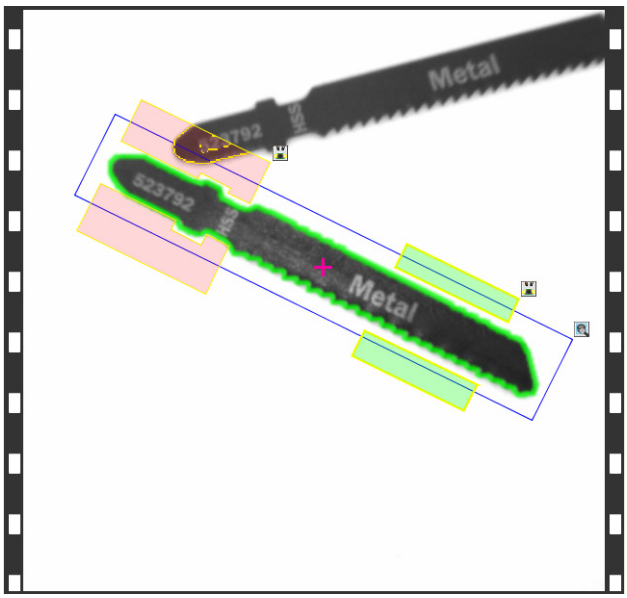


Figure 11.1 *Object locator with Grip region to check that the found object is neighbor-free so it's possible to pick*

The grip region settings are made in the **Grip regions** tab.

Figure 11.2 *Grip region settings.*

Edge strength	The edge strength setting sets the minimal contrast required for a pixel to be marked as an edge. These pixels are highlighted (yellow) in the reference image.

Note

The edge strength setting affects all grip regions in the selected reference object.

The edge strength setting for grip regions is different from **Edge strength** used in the **Object locator** tab.

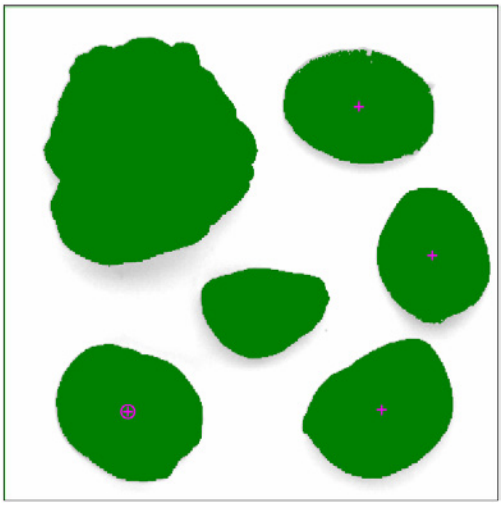
Number of Edge Pixels

The setting tells in what interval the number of edge pixels must be for the grip region to pass. If any grip region in a reference object fails the overall inspection result will be **Not located**.
The two sliders can be set between 0% and 100%, specifying the range in between. The percentage range refers to percentage of edge pixels within the grip region. Note that if the inspection region is changed the percentage will not automatically be changed.

11.3 Locate Free-Form Shapes - Blob Locator Tab

The Blob locator is used to locate the position of one or more free-form shapes, also called blobs. The method uses a Blob locator function that recognizes objects of any shape in the image. A blob can either be dark object on a bright background, or bright object on a dark background. The located blob is found among pixels grouped together in a user configured intensity interval where the blob size matches a user configured area interval. The following example shows the Inspector in Edit mode, where the Blob locator is configured to find free-form shape(s) in the Reference image.

*Original image as seen in the **SOPAS Inspector, Live Image** tab*



Reference object image with a blob locator search region. The green areas mark the blobs. The two blobs without reference point are too big and too small compared to the configuration settings

The found blobs that meet the selection criterias are marked with purple crosses at the each blob's Center of Gravity (COG). The first blob in the configured **Sort by** setting is marked with a purple cross with a purple circle around it.

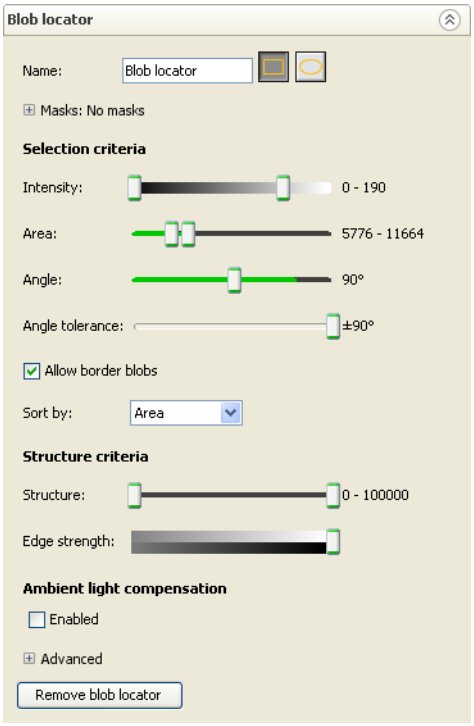


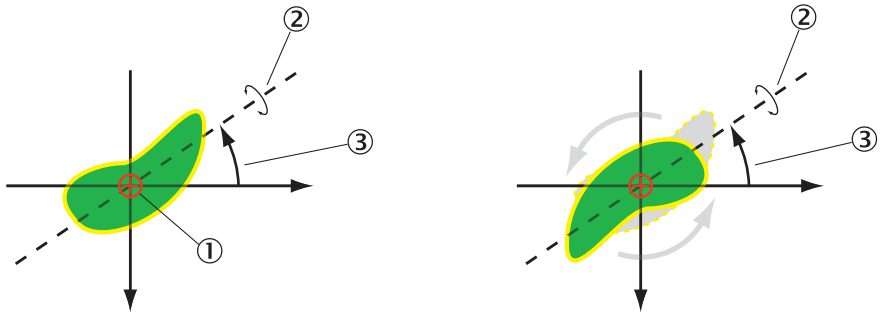
Figure 11.3 Blob locator configuration tab

The following settings can be done for the blob locator:

Intensity	Choose the **Intensity** interval with the sliders, for pixels to be selected to be inside a blob.
Area	Choose the blob **Area** interval for a shape to be selected as a blob. NOTE! For area calculations all holes in the found blobs are filled, and after that the area is calculated.
Angle	Choose the **Angle** of rotation for the blob. The calculated/reported angle is always a positive value between 0° and 180°. See Section 11.3.1, "*Use Blob Angle*" (page 44) for explanation on how the angle is calculated and reported.
Angle tolerance	Choose the Angle tolerance which is between 0° to ±90°. See Section 11.3.1, "*Use Blob Angle*" (page 44).
Allow border blobs	Enable to allow blobs that touches the border of the blob search region.
Sort by	Choose the sorting order for the found blobs. This will be the order in which the blobs are presented in the **Results** tab as well as in the Ethernet result output. If guidance is used, the first found blob in accordance with the **Sort by** criteria, is used for the guidance towards the pass region.
Structure criteria	See Section 11.3.2, "*Use Blob Structure*" (page 45).
Ambient light compensation	See Section 17.2, "*Improve the Blob locator*" (page 71).
Advanced	See Section 17.2, "*Improve the Blob locator*" (page 71).

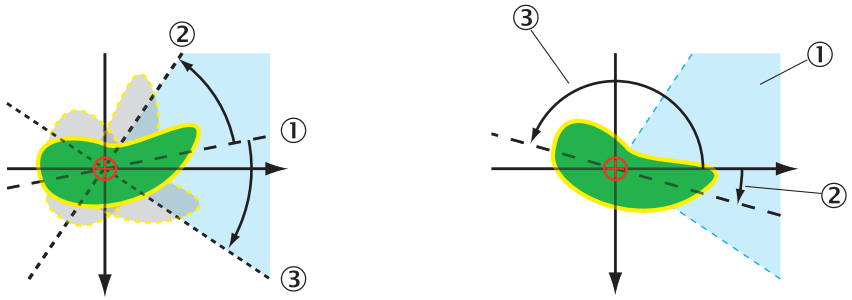
11.3.1 Use Blob Angle

The blob angle is the angle between the x-axis and an axis around which it would be easiest to rotate the blob. This angle will always be between 0° and 180°, since the Inspector does not distinguish between a blob and the same blob rotated 180°.



① Reference point
② Blob rotation axis in the xy-plane which is the axis around which it would be easiest to rotate the blob
③ The angle of rotation is calculated as the angle between the blob rotation axis and the horizontal, x axis in the image

When specifying the allowed rotation of blobs, two values are set; **Angle** and **Angle tolerance**. If for example **Angle** is set to 10° and **Angle tolerance** to ±45°, the range of allowed blob angles would be from -35° to 55°. But since the angle reported by the Inspector is always between 0° and 180°, the resulting blob rotations will be either in the range 0° to 55° or in the range (180°-35°) to 180°.



① Specified **Angle**
② Max allowed positive rotation of the blob
③ Max allowed negative rotation of the blob

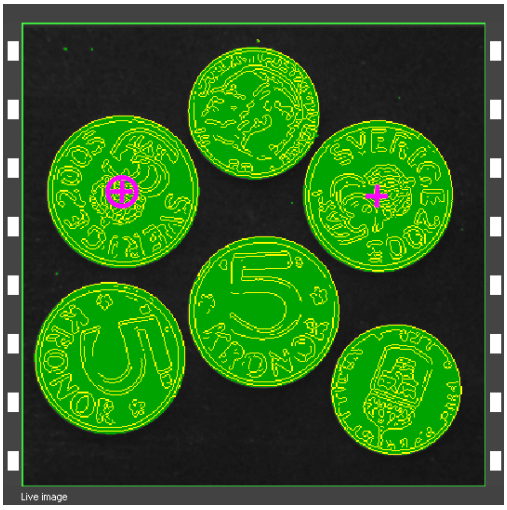
① Allowed range of blob rotation
② Actual rotation of the blob
③ Reported angles of rotation, since the Inspector P30 always reports an angle in the interval 0° to 180°.

11.3.2 Use Blob Structure

The structure criteria can be used to inspect if a blob has a smooth or a rugged surface. The resulting structure is a measurement of the number of edges inside a blob. When locating objects that has two (or more) sides the structure measurement can be used to identify the side facing up.

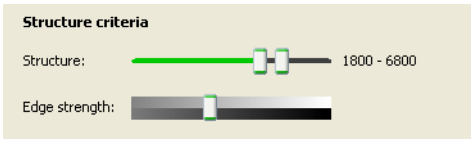
In the example image below the **Structure** criteria, or more specifically the number of edges inside a located blob, is used to evaluate which side is facing up, heads or tails.

The original image of coins.

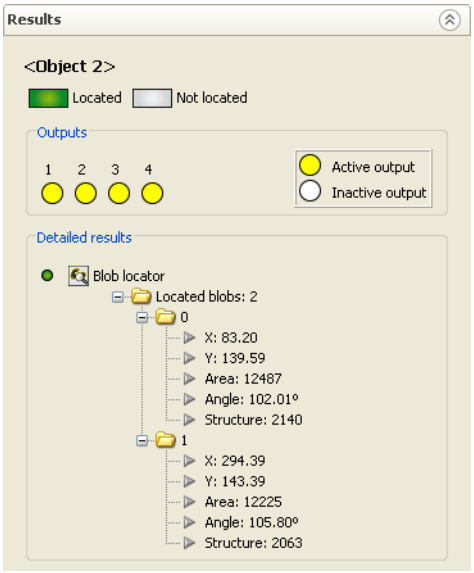


*The resulting image after blob selection with use of structure criteria. The first blob in accordance with the **Sort by** sort order is marked with a cross with a circle around it.*

If **Structure** and **Edge strength** settings are configured to be used and the resulting *Structure* is outside the boundaries, the blob(s) will be regarded as not located. Vice versa, if **Structure** is of no interest, set the structure boundaries to default, that is min to 0 and max to 1000000.



*The Blob locator **Structure** setting to select blobs.*



The Blob locator results. The larger coins with the most structure defining heads or tails (result in the image above).

Note

The edge pixels on the edge of the blob are not counted as a part of the *Structure*

11.3.3 Use Blob Counter

The result output from the blob locator contains information about the number of located blobs and can be used for applications where there is a need to count and verify the presence of a certain number of blobs.

An example would be to count and verify that the correct number of pins are present on a power connector, see the following images.

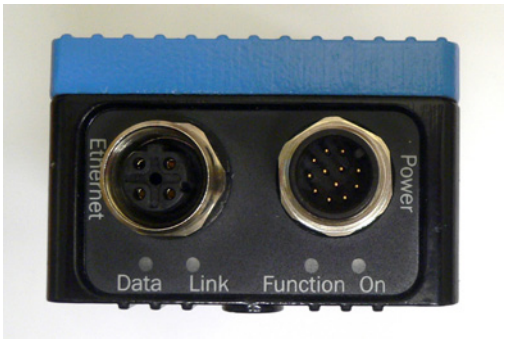
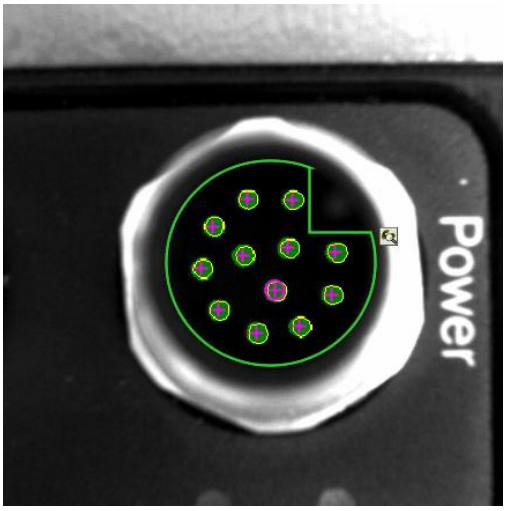


Photo of the power connector (right).



Live image counting blobs.

12 Setup Inspection Results

The result from the Inspector P30 is either the object's coordinates and angle (x,y,θ), reported via Ethernet, or directional guidance via digital outputs towards a pass region. The x and y coordinates are the number of pixels from the top left corner of the image.

Inspector P30 delivers results in pixels with sub-pixel precision and angles with sub angle precision. No alignment to external coordinates is done in the device.

12.1 Result via Ethernet

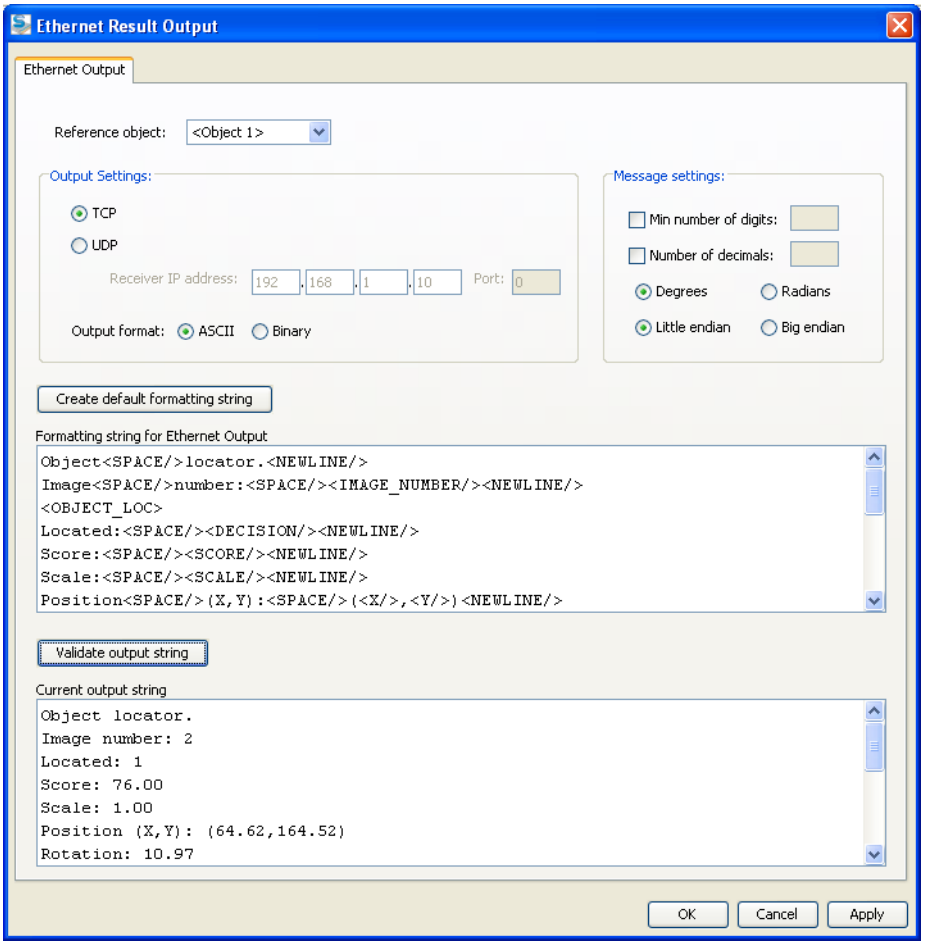


Figure 12.1 Ethernet Result Output configuration

Coordinate and angle results are reported as binary values or as ASCII strings via Ethernet communication. The format of the string can be arbitrarily user defined and can be different for each reference object.

To set up the result reporting via Ethernet click **Configure Ethernet result output** in the **Output settings tab** or choose **Ethernet Result Output** on the **InspectorP30** menu:

1. Select a **Reference object** from the list
2. Choose which Ethernet protocol to be used for the communication, **TCP** or **UDP**
3. For UDP enter the PC/PLC **Receiver IP address** and **Port** number.
4. Choose whether the results should be sent in ASCII (text) or binary format
5. Set other **Message settings**
6. Click the **Create default formatting string** button

Object locator default string

The default auto-generated result string for reporting a single object's position and angle is:

```
Object<SPACE/>locator.<NEWLINE/> ①
Image<SPACE/>number:<SPACE/><IMAGE_NUMBER/><NEWLINE/> ②
<OBJECT_LOC> ③
Located:<SPACE/><DECISION/><NEWLINE/> ④
Score:<SPACE/><SCORE/><NEWLINE/> ⑤
Scale:<SPACE/><SCALE/><NEWLINE/> ⑥
Position<SPACE/>(X,Y):<SPACE/>(<X/>,<Y/>)<NEWLINE/> ⑦
Rotation:<SPACE/><ROTATION/><NEWLINE/> ⑧
</OBJECT_LOC> ⑨
```

① Add explanatory text
② Explanatory text and analyzed image's number
③ Start of container for object locator
④ Explanatory text and value for locator decision
⑤ Explanatory text and locator score value
⑥ Explanatory text and locator scale value
⑦ Explanatory text and locator position
⑧ Explanatory text and locator rotation value
⑨ End of container for object locator

Blob locator default string

The default auto-generated result string when the Blob Locator has found several free-form shapes is of the format:

```
Blob<SPACE/>locator.<NEWLINE/> ①
Image<SPACE/>number:<SPACE/><IMAGE_NUMBER/><NEWLINE/> ②
Found<SPACE/>blobs:<SPACE/><FOUND_BLOBS/><NEWLINE/> ③
<BLOB_LOC index="all"> ④
------------------------<NEWLINE/> ⑤
Blob<SPACE/>information:<NEWLINE/> ⑥
Position<SPACE/>(X,Y):<SPACE/>(<X/>,<SPACE/><Y/>)<NEWLINE/> ⑦
Area:<SPACE/><AREA/><NEWLINE/> ⑧
Angle:<SPACE/><ANGLE/><NEWLINE/> ⑨
Structure:<SPACE/><EDGE_PIXELS/><NEWLINE/> ⑩
Touches<SPACE/>ROI<SPACE/>border:<SPACE/><EDGE_FLAG/><NEWLINE/> ⑪
</BLOB_LOC> ⑫
```

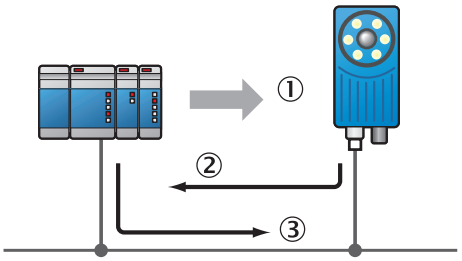
① Add explanatory text
② Explanatory text and analyzed image's number
③ Explanatory text and number of found blobs in analyzed image
④ Start of container for blob locator and instruction to loop over all found blobs
⑤ Separator
⑥ Explanatory text
⑦ Explanatory text and blob locator position
⑧ Explanatory text and blob locator area
⑨ Explanatory text and blob locator angle value

⑩ Explanatory text and blob locator structure value
⑪ Explanatory text and blob locator edge value
⑫ End of container for blob locator

For a complete list of parameters that can be added to the output string see Appendix B,"*Ethernet Result Output*" (page 92).

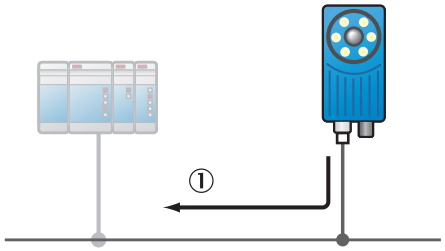
12.1.1 UDP versus TCP

The basic difference between these protocols, for the Ethernet result output function, is which side that initiates the connection to receive/send the data.



TCP:

① PC/PLC initiates the connection
② Inspector P30 sends results to the PC/PLC
③ PC/PLC acknowledges that results are received (built into the TCP/IP protocol)



UDP:

① Inspector P30 sends results to the specified IP address and port, without knowing if it has been received

Note

For TCP the port number that the Inspector P30 listens to is `2114`.

12.1.2 ASCII versus Binary

The Inspector P30 supports the possibility to choose whether the configured output shall be sent in ASCII format or in a binary format. The parameters that should be transferred in binary format are also defined in the XML based formatting, but some tags are not supported in the binary format. If such a parameter is added to the formatting it will be ignored by the Inspector P30. In binary mode all added text and text formatting, for example `<SPACE/>`, are ignored. Only the values of the parameters describing results from the inspected images are sent out. For details on which tags can be used in binary output see Appendix B,"*Ethernet Result Output*" (page 92).

12.1.3 Attributes

Attributes are used to control the formatting and identification of inspections. Some of them are controlled directly in the **Ethernet output** settings window under the section **Message settings**. Other attributes are listed in the table in Appendix B,"*Ethernet Result Output*" (page 92).

Min number of digits	Choose the minimum number of digits (including decimal point) to be sent out in the result. If the value to be sent out has less number of digits, the result is padded with leading zeros. Default value is 0 which means the number of digits that will be sent will differ depending on how many digits are needed. **Note:** This attribute is only applicable for ASCII
Number of decimals	Choose number of digits to be sent out after the decimal point for parameters with decimals. This will be a rounded value. Default value is 2. Max number of decimals is 9. **Note:** This attribute is only applicable for ASCII

Degrees/Radians	Choose unit for the rotation for object locator and angle for blobs.
Little/Big Endian	Only applicable when using binary format. This describes the order of the bytes transferred from the device on Ethernet. When using **Little endian** the least significant byte is transferred first and for **Big endian** the most significant byte is transferred first. See the 2-byte example in tables below:

	Most significant byte	Least significant byte
Value to be sent from device:	10000100	01110000

Transfer order	First transferred byte	Second transferred byte
Little endian	01110000	10000100
Big endian	10000100	01110000

12.1.4 XML based Formatting

The formatting of the result string is defined by a formatting string written in XML. It is possible to mix XML tags and free text in the formatting string. The text parts will appear as is in the result string, whereas the XML tags will be replaced by the appropriate values. All white spaces in the formatting strings are ignored. In order to include whitespace in the result string use the tags <SPACE>, <TAB> and <NEWLINE>.

The tags are either container tags or value tags. The container tags do not generate any text on their own. It is the value tags inside the container tags that generate the text. The following container tags are valid in the Inspector P30:

Container tag	Explanation
OBJECT_LOC	Used to present values concerning the **Object locator**
GRIP_REGION	This is a container tag within the OBJECT_LOC container for presenting values concerning the configured grip regions
BLOB_LOC	Functionality for iterating over all found blobs. This means that the texts and value tags within the <BLOB_LOC> tag will be repeated once for each found blob. If only the properties of a single blob are wanted, this can be controlled with the index attribute.

The XML based formatting string is entered in the **Formatting string for Ethernet Output** part of the **Ethernet Output** configuration window. To get a default string for the current chosen reference object click **Create default formatting string**. To verify the syntax of the string click **Validate output string**. The output that will be sent over Ethernet or Errors are reported in the **Current output string** part of the **Ethernet Output** window.

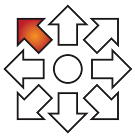
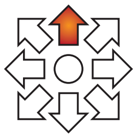
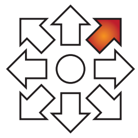
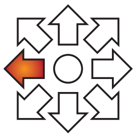
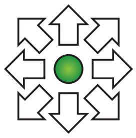
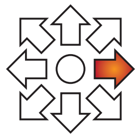
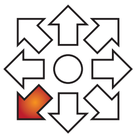
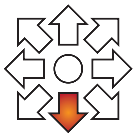
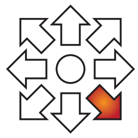
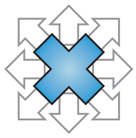
Notes

When using binary transfer, the **Validate output string** button will only show how many bytes that will be sent for the current analyzed image and whether the formatting was correct.

The number of bytes presented in the **Current output string** window can vary if formatting is set up to, for example, send results for all found blobs.

12.2 Directional Guidance via Digital Outputs

Inspector P30 gives eight-directional guidance via digital outputs, using four digital outputs. Directions are given for the chosen reference point as compared to the defined pass region. The directions are binary coded to represent the possible results, where 0 means *inactive* and 1 means *active*. The table describes the mapping between movement direction and digital outputs where the movement direction describes in which direction the Inspector has to be moved to get into or closer to the pass region. The arrows in the table are shown in the **Results** tab of the **SOPAS Inspector**.

Recommended device movement, and output pin values[a]		
 Q_{Lt} Q_{Rt} Q_{Up} Q_{Dn} ● ○ ● ○ 1 2 3 4	 Q_{Lt} Q_{Rt} Q_{Up} Q_{Dn} ● ● ● ○ 1 2 3 4	 Q_{Lt} Q_{Rt} Q_{Up} Q_{Dn} ○ ● ● ○ 1 2 3 4
 Q_{Lt} Q_{Rt} Q_{Up} Q_{Dn} ● ○ ● ● 1 2 3 4	 Q_{Lt} Q_{Rt} Q_{Up} Q_{Dn} ● ● ● ● 1 2 3 4	 Q_{Lt} Q_{Rt} Q_{Up} Q_{Dn} ○ ● ● ● 1 2 3 4
 Q_{Lt} Q_{Rt} Q_{Up} Q_{Dn} ● ○ ○ ● 1 2 3 4	 Q_{Lt} Q_{Rt} Q_{Up} Q_{Dn} ● ● ○ ● 1 2 3 4	 Q_{Lt} Q_{Rt} Q_{Up} Q_{Dn} ○ ● ○ ● 1 2 3 4
	 Q_{Lt} Q_{Rt} Q_{Up} Q_{Dn} ○ ○ ○ ○ 1 2 3 4	

[a]Output pin values 0001, 0010, 0011, 0100, 1000, and 1100 are not used

By default the current output is active until the Inspector P30 has captured and analyzed the next image. The output only changes if the position of the object has changed in a way that shall give a different recommended direction of movement.

Notes

For the blob locator, the guidance is given in relation to the first blob's reference point, chosen by the **Sort by** criteria

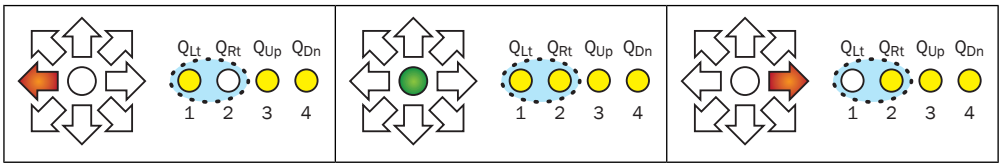
The outputs are disabled by default when teaching the Inspector P30 in edit mode, but they can be manually enabled, see Section 9.3, "*InspectorP30 Menu*" (page 34). When switching to **Run** mode, the outputs will be enabled automatically.

By default, the outputs will be +24 V when active and 0 V when inactive (*active high*). You can change this by selecting **Invert** output signals on the **Output settings** tab, in which case the outputs will be 0 V when active and +24 V when inactive (*active low*).

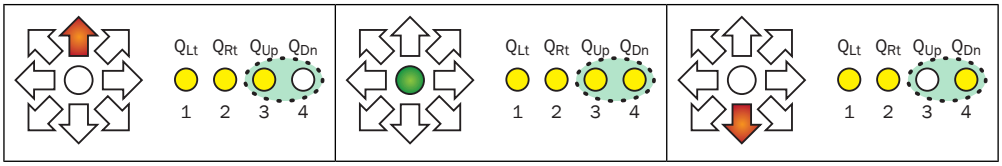
12.2.1 Two-directional Guidance

If guidance is needed in only two directions this is also supported by the Inspector. No special configuration is needed. The pins are used in the same way but depending on which directions are needed only two pins will have to be treated outside the device:

- If "right-left" guidance is needed this can be achieved by only using **out1** and **out2** on the device and don't care about **out3** and **out4**.



- If "up-down" guidance is needed this can be achieved by using **out3** and **out4** on the device and don't care about **out1** and **out2**.

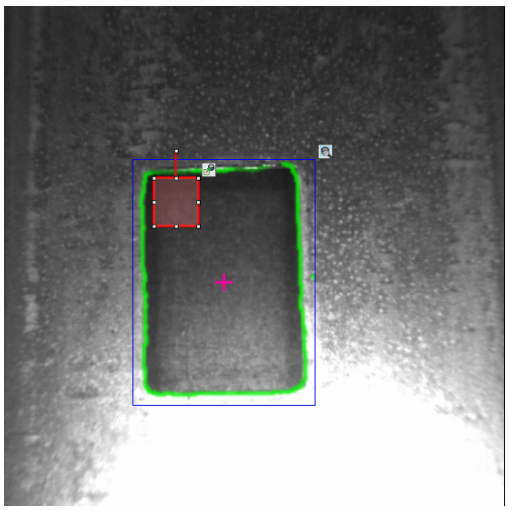


Note

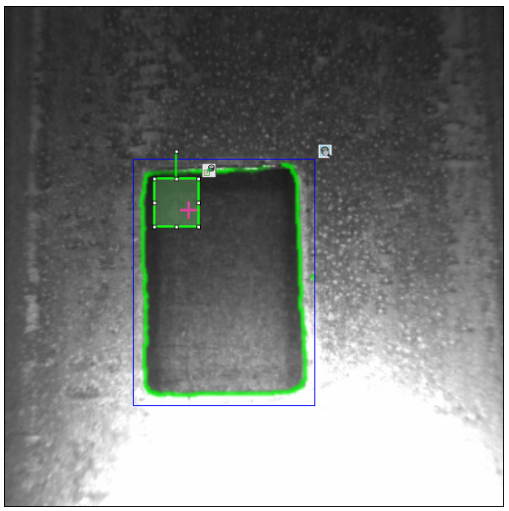
The unused output pins might still change values during the guidance depending on the application

12.2.2 Setup Object Locator Pass Region

When an object locator is used a default reference point is added to the reference object. This reference point is placed in the center of the ROI. To move the reference point to another coordinate, move the purple cross to the appropriate place with the mouse or arrow keys on the keyboard.



*Example: default reference point placement, outside the **Pass region***



*Example: reference point moved manually, inside the **Pass region***

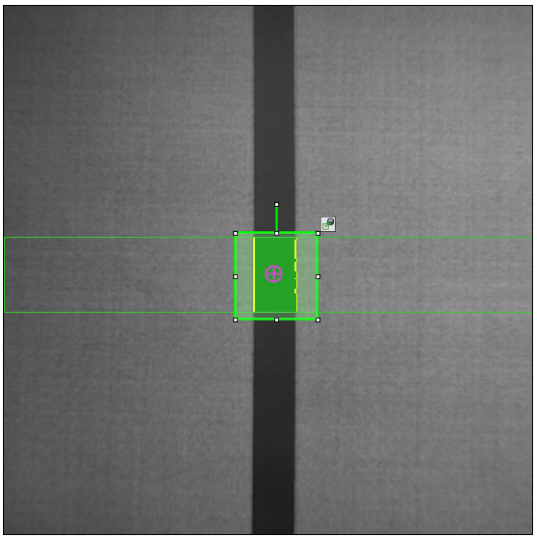
The pass region is added by clicking on **Pass region** and drawing a region in the reference image. The reference point's position in relation to the region will be reported via the digital out signals.

Note

Depending on where the known shape is found and the reference point was placed, the actual result of the reference point's position can be outside the FOV. Directions will still be given for this reference point

12.2.3 Setup Blob Locator Pass Region

When creating a blob locator the reference point is always placed in the Center of gravity (COG) for the identified blob(s), see figure below.



*Example: blob locator reference point inside the **Pass region***

The pass region is added by clicking on **Pass region** and drawing a region in the reference image. In case of detecting more than one blob, the pass region will work in relation to first found blob's COG in accordance with the configured **Sort by** parameter in the **Blob locator** tab. For this first blob, directions through the digital outputs will be active as well as visible through the arrows in the **Results** tab. The reference point for this blob is shown in the image as a purple cross with a purple circle.

12.3 Digital Outputs without Directional Guidance

When directional guidance is not needed the pass region is not added to the reference object. In this case the digital outputs will have two possible values in accordance with the table below.

Digital output values	Description
0000	For blob locator: No blobs could be found in the search region. For object locator: No object with the configured shape was found in the search region
1111	For blob locator: At least one blob could be found in the search region. For object locator: A matching object with the configured shape was found in the search region
0001-1110	Not used.

12.4 Output Delay, Active Time and Invert

12.4.1 Set Output Delay

The delay is always counted from when the exposure of the image started. To set a delay on a built-in output:

1. Select the output in the list on the **Output settings** tab.
2. Set the output delay by selecting either:

Minimum	The delay will be as short as possible – minimum delay time – which is the same as the time it takes the Inspector to make the inspection. The inspection time depends on many different settings for the current reference object. The time is displayed below the image in the **Live image** and **Reference image** tabs.
Fixed	Set the delay as a time (in milliseconds) or a number of encoder pulses.

When setting a delay in encoder pulses, the encoder should be connected to **in4**, and this input should be reserved as an encoder input. To do this, see Section 15.2, "*Connect an Encoder*" (page 62).

Notes

The output delay set is used for all outputs for the active reference object. That is, it is not possible to have individual output delays for a reference object.

If you set the delay time to be shorter than the minimum delay time, a warning will be displayed and the minimum delay time will be used.

If the delay is set in encoder pulses, and the time these take when inspecting is shorter than the minimum delay time, the trig pulse is ignored. The number of ignored trig pulses is displayed in the Statistics tab, see Section 13.2, "*Statistics*" (page 57).

12.4.2 Set Output Active Time

The active time is always counted from when the output signal is activated. To set the active time for a built-in output:

1. Select the output in the list on the **Output settings** tab.
2. Set the active time by selecting either:

Hold until result changes	The output will be active as long as the inspection result does not change. Once the inspection result changes, the output will change. Note that the deactivation of the output will be after the output delay time.
Fixed	Set the active time as a time (in milliseconds) or a number of encoder pulses.

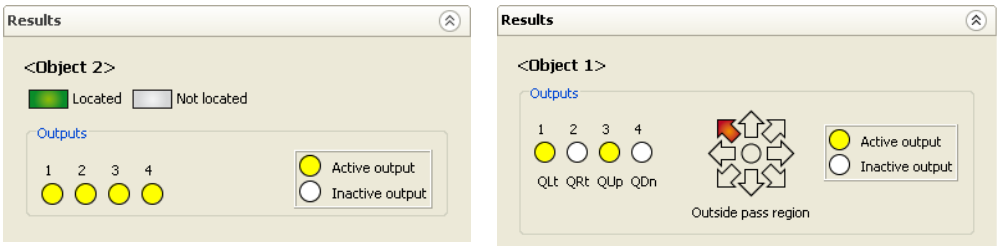
12.4.3 Invert Output Signals

Normally the output signal level is low (0 V) when inactive and high (+24 V) when active, that is active high. You can change this by selecting **Invert output** signals on the **Output settings** tab. When inverted, all output signals will be +24 V when inactive, and 0 V when active.

13 Use Result and Statistics

13.1 Results

The inspection result is displayed in the **Results** tab. The upper part of the **Results** tab shows the digital output signals and overall result information depending on if guidance is used or not.



Output results when using positioning without guidance *Output results when using guidance*

Name of reference object

The name of the reference object is displayed above the results. Same name as in the **Reference objects** list.

Output results

Two different results are presented:

Located	An known or a free-form object was located
Not located	No object was located

Outputs

The status of the outputs is displayed in the **Results** tab. See Section 12.2, "*Directional Guidance via Digital Outputs*" (page 52) for a detailed definition of the outputs.

The color of the output indicates the status:

Color	Status
Yellow	Active output
White	Inactive output

Active output can correspond either a high or a low signal. See Section 12.4.3, "*Invert Output Signals*" (page 55).

Object locator with detailed results

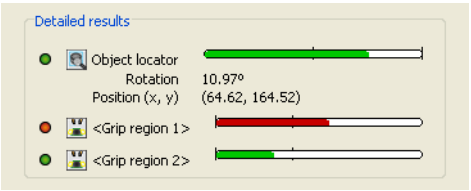
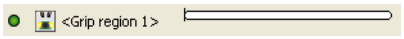


Figure 13.1 Detailed results for the object locator

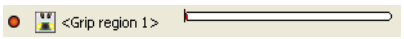
The horizontal line in the **Object locator** bar corresponds to the **Match** setting in the **Object locator** tab. When the match score in the live image is higher than the threshold value, the bar is green (located) otherwise red (not located).

The **Rotation** and **Position** is presented for located objects. The x and y coordinates are the number of pixels from the top left corner of the image.

If **Grip region** inspections are used, a horizontal line indicates the match compared to the selected thresholds. If the lower threshold for the grip region has been set to zero or a low value the result can be seen in the green or red bullet. Green means that the grip region was passed. See Section 11.2, "*Locate a Known Shape – Object Locator Tab*" (page 40) for more information on how to configure an object locator.



Grip region that passed, and where the number of allowed edge pixel is set to 0%



Grip region failed because it contained at least one edge pixel

Blob locator with detailed results

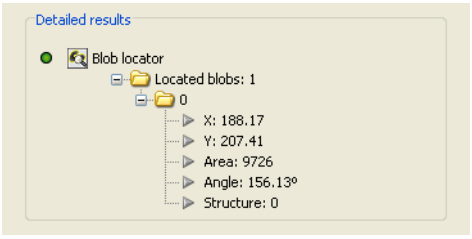


Figure 13.2 Detailed results for the blob locator

A list of located blobs is presented.

The following data is presented for each blob: **X** position, **Y** position, **Area**, **Angle**, **Structure**.

X and Y	The pixel position of the blob counted from the upper left corner of the field of view
Area	Area of the blob
Angle	The angle of rotation for the blob. For more information on how this angle is calculated see Section 11.3, "*Locate Free-Form Shapes - Blob Locator Tab*" (page 43).
Structure	The structure measurement for the blob. For more information on blob structure see Section 11.3.2, "*Use Blob Structure*" (page 45).

See Section 11.3, "*Locate Free-Form Shapes - Blob Locator Tab*" (page 43) for more information on how to configure a blob locator.

13.2 Statistics

Statistics are collected for each reference object used by the Inspector. The statistics are updated in **Run** mode for the currently selected reference object, and all other reference objects are resting until selected.

The statistics is started to be updated as soon as the selected reference object is being used for inspections (**Run** mode). Switching between different reference objects will add to the statistics for each reference object until the statistics is reset.

Note

If any reference object settings are changed, then the statistics will be reset for that particular reference object.

The statistics is displayed in the **Statistics** tab.

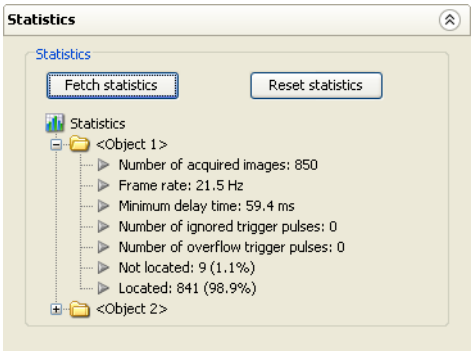


Figure 13.3 Statistics tab

To update the statistics, click **Fetch statistics**. The following statistics are collected for each reference object:

Number of acquired images	Total number of captured images.
Frame rate	The current maximum frame rate in Hertz (Hz). The same value as under the live image.
Minimum delay time	The latest minimum delay time in milliseconds (ms). The same value as under the live image.
Number of ignored trigger pulses	Loosing trig pulses can happen if you are using an external image trigger (**in3**) and the inspected objects are moving too fast (too high speed on conveyor belt).
Number of overflow trigger pulses	This can happen if there is a long distance between the image trigger and the Inspector (where the image is captured) and/or if there is a long distance between the Inspector and the rejecting device connected to the Inspectors output signals. The Inspector needs to remember all objects in the queue, the queue can be too long if the inspected objects are moving too fast (too high speed on conveyor belt).
Not located	The total number of captured images where an **Object locator** or a **Blob locator** did not locate a shape/blob. Moreover, if a grip region is applied and did not pass, this will count as **Not located**. If using pass region in a guidance application, an analyzed image is counted as **Located** even if found outside the pass region. The result is presented in percent of all captured images.
Located	The total number of captured images where an **Object locator** or a **Blob locator** did locate a shape/blob, and all grip regions (if any) were passed. In a guidance application an analyzed image is counted as **Located** independent of if the object was inside the pass region or not. The result is presented in percent of all captured images.

Note

For the simulated device the only statistics available then are **Not located** and **Located**.

To reset the statistics for all reference objects, click **Reset statistics**.

14 Work with Multiple Objects

The Inspector can store up to 16 different reference objects, making it easy to switch between different inspection tasks with different reference objects.

14.1 Teach Additional Objects

To teach an additional object:

1. Under the **Reference objects** list, click **Add**. A new reference object is created. This new object is empty, without a reference image.
2. Place a new object in the Inspector's field of view and adjust image settings. Choose which type of reference object that should be created
   - If a known shape should be stored click **Teach object locator**.
   - If a free-form shape (blob) should be stored click **Teach blob locator**.

   A new reference image is placed in the image container.
3. To change the name of the reference image, double-click on the name, and type a new name.

For more information about image capturing and image settings, see Chapter 10, "*Adjust Image*" (page 37).

14.2 Select Reference Object

The time it takes to switch reference object is typically in the order of 0.5s, and maximally 1s.

14.2.1 Select Object from PC

To select which reference object to be used for the inspections/when inspecting:

1. Select Edit mode, by clicking **Edit**.
2. In the **Reference objects** list, click on the desired reference object
3. Click **Run**, to start the inspection.

14.2.2 Select Object with Inputs on the Inspector

To select which reference objects to use with the inputs on the Inspector, see Section 15.4, "*Select Reference Objects with Inputs*" (page 64).

14.3 Duplicate Reference Objects

To duplicate a reference object:

1. Right-click on source reference object and select **Copy to new reference object** from the pop-up menu.
2. The new reference object is placed at the end of the **Reference objects** list.

To change the name of the reference image, double-click on the name, and type a new name.

14.4 Settings for Multiple Reference Objects

Some settings in SOPAS Inspector are unique for an individual reference object and some settings are common for all reference objects.

The settings made in the Configuration pane in the main view and some other functions are unique for an individual reference object:

- Image settings
- Object Locator
- Blob Locator

- Output Settings
- Ethernet Result Output

Other settings – made from the **Inspector** menu – are global and applies to all reference objects, for example:

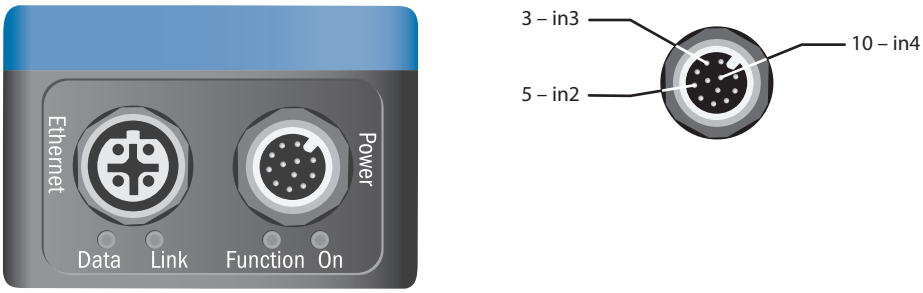
- I/O settings
- Log settings

15 Use Digital Inputs

The Inspector has three built-in digital inputs that can be used for different purposes:

- Trigger inspections (**in3**)
- Encoder (**in4**)
- Teach reference object (**in2**)
- Select which reference object to use when inspecting

The input signals are shown in the figure.



To use a digital input for triggering inspections, encoder input or teaching objects, connect the signal to its input on the Inspector and set the usage of the input in SOPAS Inspector. By default, **in2** is already configured for teaching reference objects.

Any input that is not used for trig, encoder or teach signals can be used for reference object selection. For example, if an encoder is used, **in4** should be set as encoder input but the remaining two inputs can be used for object selection, making it possible to select between up to four objects with the inputs.

15.1 Connect an Image Trigger

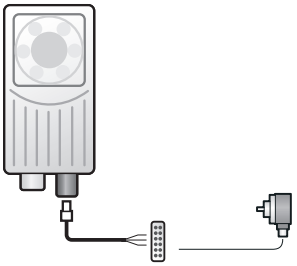
To use an external trigger for triggering the Inspector to capture the images, do the following:

1. Connect the image trigger to **in3** (pin 3, cable color is white on DOL-1212 cables) on the Inspector.
2. Choose **I/O Settings** from the **InspectorP30** menu, and select **Use external image trigger**.
3. Under **Triggering** in the **Image settings** tab, select **Triggered by In3**, and choose whether the images should be triggered on the **Rising edge** (from 0 V to +24 V) or on the **Falling edge** (from +24 V to 0 V).
   You can also set a delay between the trigger pulse and when the image is captured, by specifying a delay time in milliseconds or number of encoder pulses.

Notes

- If there are multiple reference objects, you must choose Triggered by **in3** for each reference object for which images should be triggered. It is possible for the Inspector to have reference objects where image capturing should be free-running for some and triggered for others.
- The image trigger and the Inspector should be connected to a common ground, to avoid problems with signals not being registered properly by the Inspector.

15.2 Connect an Encoder



To use an encoder for controlling delay times for image triggering and/or output signals, do the following:

1. Connect the encoder to **in4** (pin 10, cable color is violet on DOL-1212 cables) on the Inspector.
2. Choose **I/O Settings** from the **InspectorP30** menu, and select **Use encoder (In4)**.
3. Set the delays to be a number of encoder pulses:
   - Image capture delay are set on the **Image settings** tab for the reference object.
   - Output delays and active times are set on the **Output settings** tab by setting the delay and/or active times in the **Fixed fields**.

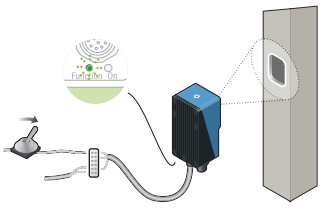
Notes

- The output delay set is used for all outputs for the active reference object. That is, it is not possible to have individual output delays for a reference object.
- The encoder and the Inspector should be connected to a common ground, to avoid problems with signals not being registered properly by the Inspector.
- The maximum encoder frequency is 40kHz.

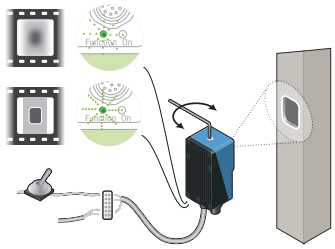
15.3 Use External Teach

To be able to teach reference objects without using a PC, do the following:

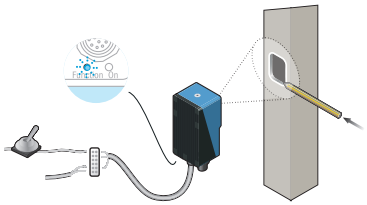
1. Choose **I/O Settings** from the **InspectorP30** menu, and select **Enable external teaching**. This is enabled by default.
2. Make sure the Inspector is in **Run** mode. Place an object in front of the Inspector and connect **in2** (pin 5, cable color is pink on DOL-1212 cables) to +24 V. After about 3 seconds, the Inspector will start capturing images and flash with the lighting, if used. Also, the **Function** LED will start flashing.



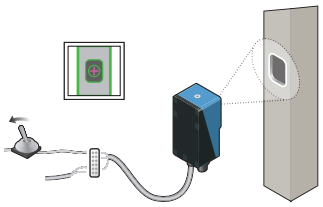
3. Adjust focus by turning the focus screw. The frequency with which the **Function** LED is flashing indicates how focused the images are – the faster it flashes, the better the focus.



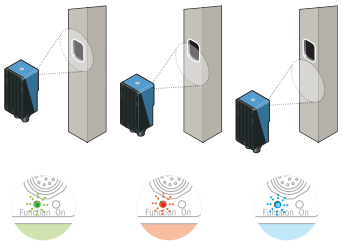
4. Find the field of view (that is, the area covered in the captured image) by using a finger, a pen or similar. When the finger/pen enters the field of view, the color of the **Function** LED changes from green to blue. The LED color reacts on motion in the image. So ensure that the finger/pen is moving and that the rest of the scene is stationary.



5. When done, disconnect **in2** from the power. The Inspector will now use the most recent image as the reference image, and learn the contours of the object in view. All device data is saved in flash memory. During the flash storage, the **Function** LED flashes white.



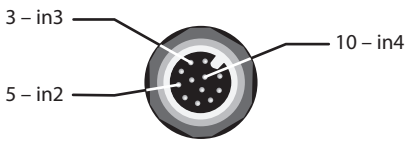
6. The Inspector will then automatically switch to **Run** mode and start a *guidance application* with the teached reference object.



Note

- When teaching an Inspector that has not previously been configured a guidance application is setup with a circular pass margin around the pick point (reference point). The radius of the pass margin is 5 pixels.
- If the Inspector already contains reference objects, using external teach will only replace the reference image for the active reference object and change the exposure settings (exposure and gain). The exposure settings can also be kept by enabling **Use current exposure settings** in the **I/O Settings** dialog. Any modifications made to the reference object will remain, for example if the object locator region has been resized.

15.4 Select Reference Objects with Inputs



To be able to select objects with the inputs on the Inspector, you must first set up which combination of inputs that should select each object.

1. Select **I/O Settings** from the **InspectorP30** menu, and select the **Enable external object selection**.
2. Select which input signals to be used for object selection. If an input is already used for image triggering, encoder or external teach, that input cannot be used for object selection and the check box for that input is therefore disabled.
3. Select which **Reference objects** to activate for each combination of inputs. The object is selected from the drop down menu. The **Inputs** number is the binary value with the selected input signals (**in2** etc). The most significant binary digit is **in2** (if used) or the one with the lowest number. The digit “0” means that the corresponding input is active low and the digit “1” means that the corresponding input active high.
4. Click **OK** when all settings are complete.

Important

- When selecting a reference object with the digital inputs, the input signal levels must be kept during the time that the reference object should be used. As soon as the input signal changes, another reference object will be selected instead.
- The device providing the signals and the Inspector should be connected to a common ground, to avoid problems with signals not being registered properly by the Inspector.

16 Improve Image Quality

16.1 Change Lens

It is possible to change the lens on Inspector P30 in order to operate at different working distances and to be able to fit the field of view (FOV) for a better inspection. A special tool is required to open the front window of the Flex housing and to replace the standard lens. The tool is delivered in the Inspector P30 package.

To replace the standard lens of the Flex housing:

1. Open the front window of the Flex housing using the large end of the supplied tool.
2. Remove the standard lens by using the small end of the tool.

3. Attach the new lens. Depending on the focal distance of the lens, and the working distance, one or more distance rings may be necessary. Refer to the table below for the correct number of distance rings to use.

Theoretical FOV size (384x384 pixels)

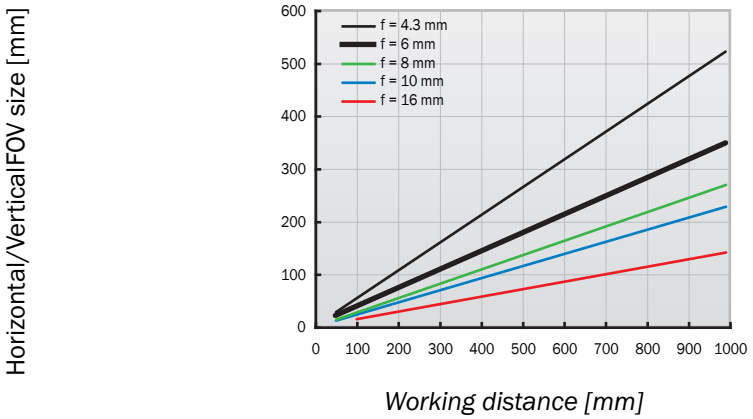


Table 16.1 Lens and working distances

Lens	Distance ring	Working distance
Focal length 16 mm	Black (3 mm) + Silver (1.5 mm)	100 mm – 140 mm
	Black (3 mm)	140 mm – 600 mm
	Silver (1.5 mm)	600 mm - ∞
Focal length 10 mm	Silver (1.5 mm)	50 mm – 120 mm
	None	120 mm - ∞
Focal length 8 mm	Silver (1.5 mm)	50 mm - ∞
Focal length 6 mm	None	50 mm - ∞
Focal length 4.3 mm	Black (3 mm)	50 mm - ∞

4. Attach the front window again to the Flex housing.

After replacement, both the lens and the front window must be securely fastened to prevent them from falling off during operation.

Important

- To keep IP 67 classification, open and close the front window only with the supplied tool. Make sure that the seal fits properly.
- To avoid damages, only Inspector accessory lenses offered by SICK must be used.
- Minimize the risk of getting dust into the device by changing the lenses in a dust-free environment. Do not keep the device without the front window. Wipe off the front window before you remove it.

16.2 Improve Reflex Avoidance

When working with shiny objects there might be a need to minimize the effects of the reflexes produced by the surface. This can be done in two ways:

- Mount a Dome accessory to the device that diffuses the internal lighting
- Tilt the device with an angle towards the inspection area

16.2.1 Dome

It is possible to replace the front window with a Dome lighting. The Dome lighting diffuses the internal lighting in order to improve performance when working with glossy objects.

When using a Dome lighting, the following combination of lens and working distance is optimal:

Lens	Working distance
4.3mm	50mm

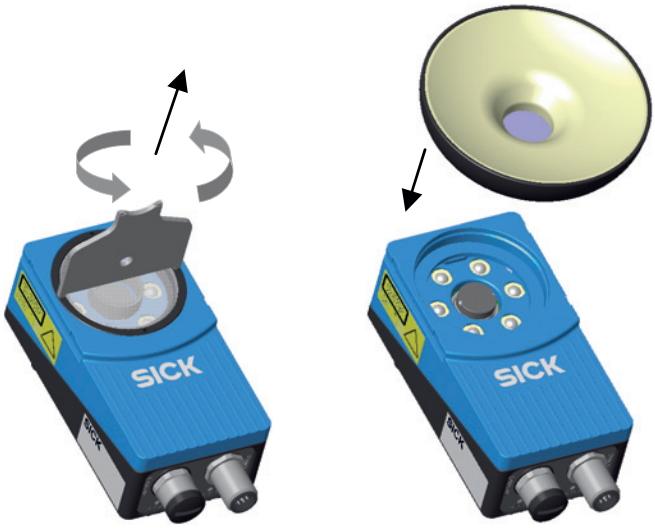
Depending on the object being inspected other working distances may also work well. For example objects with flat and less glossy surfaces could possibly be inspected at a larger distance.

Also more narrow lenses can be used, for example using a 10mm lens for Inspector P30, with the effect that the FOV is correspondingly decreased.

A special tool is required to open the front window of the Inspector. The tool is delivered in the Inspector Flex package.

To replace the front window with the Dome:

1. Open the front window of the Flex housing using the large end of the supplied tool. See the left image below.



2. Attach the Dome to the Flex housing by hand.

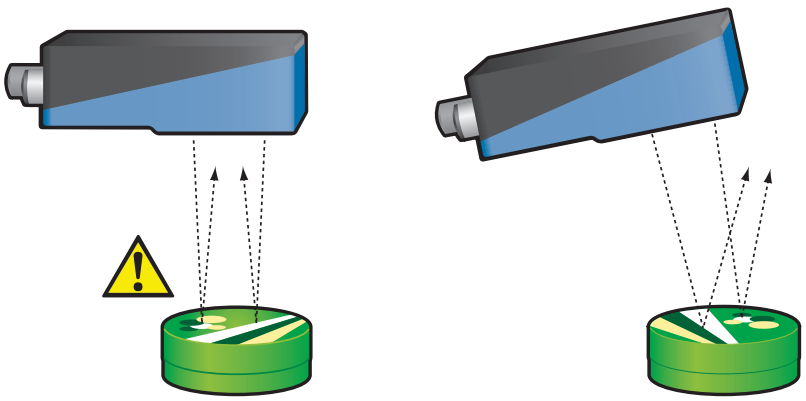
After replacement, the Dome must be securely fastened so that there is no risk of it falling off during operation.

Important

- To keep IP 67 classification, open and close the front window only with the supplied tool. Make sure that the seal fits properly.
- To avoid damages, only the Inspector Flex Dome accessory offered by SICK must be used.
- Minimize the risk of getting dust into the device by changing the lenses in a dust-free environment. Do not keep the device without the front window. Wipe off the front window before you remove it.

16.2.2 Tilt Device

Depending on the physical installation limitations and the nature of the application it's possible to limit the reflections from the inspected material by tilting the device as compared to the object.



Not recommended for glossy objects Slight tilt for glossy objects (recommended)

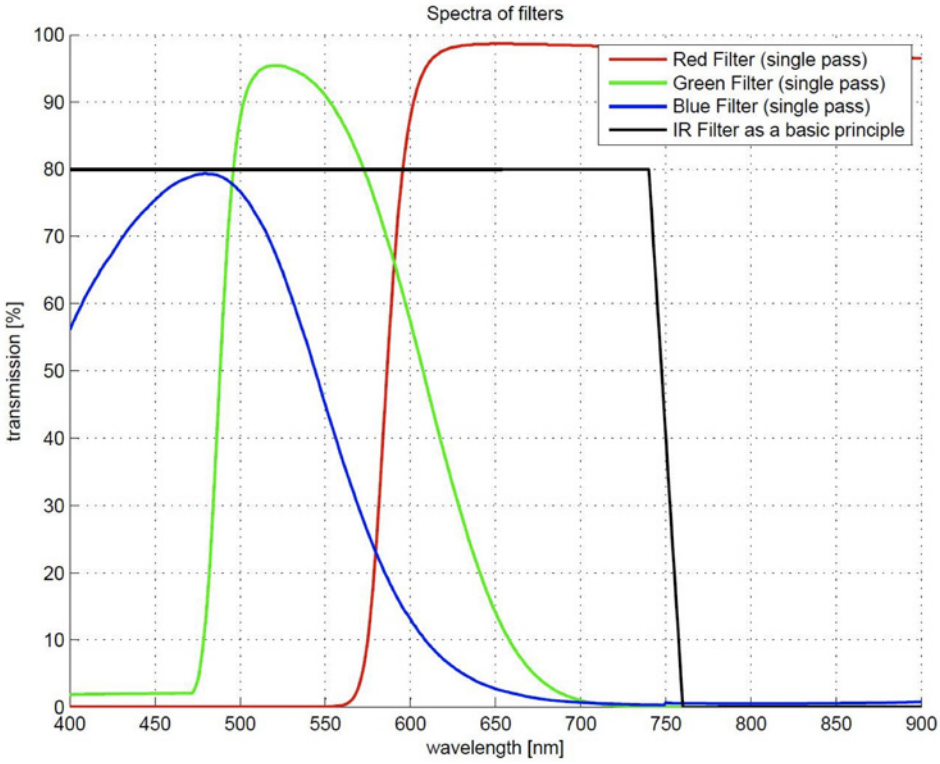
Note

The tilt should be as little as possible but enough to be able to succeed with the configured application. If the device is tilted too much then the perspective will be distorted. Due to this

tilted device is not recommended when inspecting objects that has free rotation or small objects that move a lot within the field of view.

16.3 Optimize Contrast on Multi Colored Targets

On the Inspector it is possible to replace the front window with a front glass filter accessory in order to handle multicolored objects. Available filters are red, green, and blue. Refer to the graph below for the transmission characteristics of the three different filters.



The right edge of the red filter is limited by the internal IR-filter of the Inspector.

The color filters can be used both with internal and external illumination. The main function of the color filters is to suppress the particular color. Please note that the transmission of the filters is only shown for single pass. For the internal lighting the overall transmission is lower because of the double passing.

A special tool is required to open the front window of the Flex housing and to mount the color filters. The tool is delivered in the Inspector Flex package.

To decide for a color filter, use the principle of opposing colors in order to enhance the color that is needed, see figure.

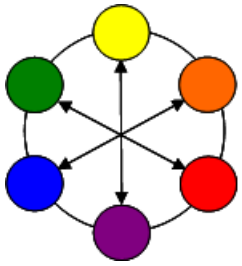
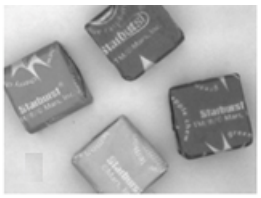


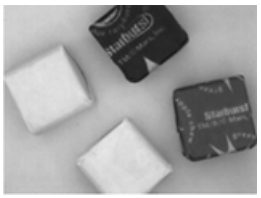
Figure 16.1 Opposing colors

Below is an example of an image and the result of using different color filters:

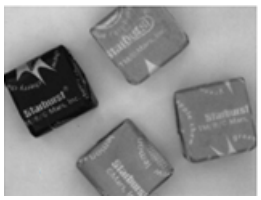
Original photo in color



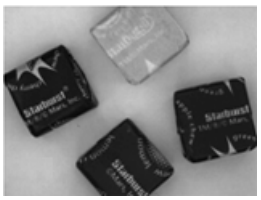
Standard window - no color



Using red color filter



Using green color filter



Using blue color filter

17 Improve Locator Robustness

If the Inspector P30 for example fails to locate correct objects or locates objects that are defect, there are a number of different ways to improve the accuracy/robustness of the locator functions.

17.1 Improve the Object Locator

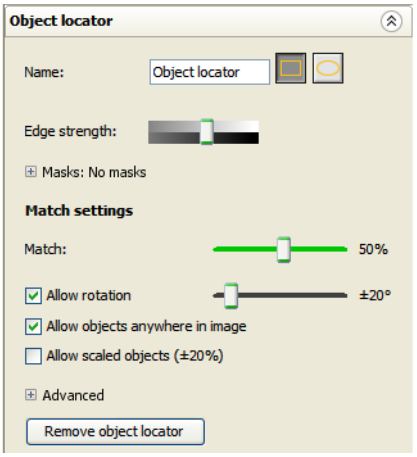


Figure 17.1 Object locator settings

If the Inspector has problems locating objects correctly, try the following:

Fine-tune the learned contours
Change the **Edge strength** setting on the **Object locator** tab to adjust which contours that the Inspector uses for locating. Also see Section 7.1, "*Teach the Object*" (page 24) and Section 2.1, "*Positioning of Known Shape*" (page 10).

Modify the size and shape of the object locator region
Try to remove contours that are not distinguishing for the object, for example contours in the background. If there are no contours in the background, then it is good if the Object locator region (blue) covers the object with a margin. Use rectangular or elliptical shape on the locator region to adapt to the type of object.

Deselect Allow rotation if possible
Objects that are rotated more than the **Allow rotation** setting will not be located at all.

Deselect Allow scaled objects if possible
If the objects always appear at the same size as the reference object, deselecting **Allow scaled objects** will avoid having the Inspector confusing scaled contours from the correct ones.

Restrict Allow objects anywhere in image if possible.
If the objects will always be located in a certain part of the image, restricting the search region to this area will avoid having the Inspector confusing contours outside or partially outside this region from the correct ones.

Restrict the allowed region by deselecting **Allow objects anywhere in image**, and adjusting the **Search region** (green rectangle) in the image.

Adjust search method

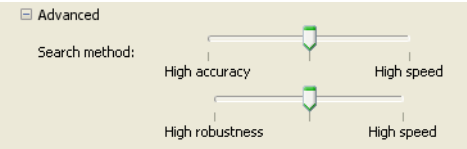


Figure 17.2 Advanced Object locator settings

Switch to a more robust search method for locating the objects, by changing the **Search method** setting (under **Advanced** on the **Object locator** tab). The Inspector's **Search method** can be changed using two sliders. One slider determines the trade-off between **High robustness** and **High speed**. The other slider determines the trade-off between **High accuracy** and **High speed**.

The term **High robustness** means that the object is located better in difficult images. This includes images that for example contain much background clutter, heavy shadows, small objects, low contrast, or much occlusion. For simple and clean scenes with large and high contrast objects it is typically sufficient to run at the High speed mode.

The term **High accuracy** relates to which sub-pixel precision the object is located. For simple applications it may not be necessary to find the optimal sub-pixel position of the object. A fast coarse localization may then suffice. But for applications where the positioning of the detailed inspections needs to be precise, this slider should be set to high accuracy.

Increase Object locator region

In general, the larger the Object locator region is the more robust the object locator will be.

17.2 Improve the Blob locator

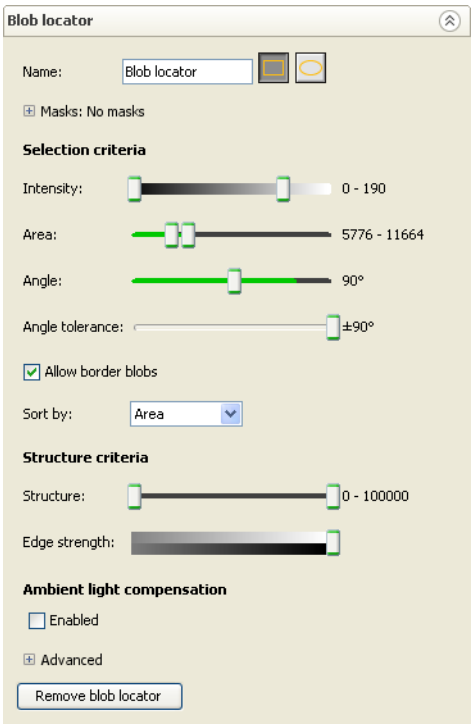


Figure 17.3 Blob locator settings

If the Inspector has problems locating blobs correctly, try the following:

Modify the size and shape of the blob locator region

Try to remove areas which could include objects that are not to be defined as blobs. Use rectangular or elliptical shape on the locator region to adapt search region's shape.

Mask out difficult areas

Areas that are known to vary between images, such as date codes or highly reflective areas, should be ignored in the blob locator region. This is achieved by masking the area.

Adjust search method

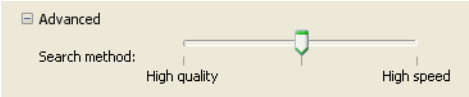


Figure 17.4 Advanced Blob locator settings

Switch to a faster search method for locating the objects, by changing the **Search method** setting (under **Advanced** on the **Blob locator** tab). The Inspector's **Search method** can be set with the slider that determines the trade-off between **High accuracy** and **High speed**. Normally the **High speed** option can be used on images where there is minor disturbance/noise in the image apart from the blobs themselves and **High accuracy** should be used on images with more disturbance/noise.

17.2.1 Enable Ambient light compensation

The ambient light compensation can be used to handle variations in the surrounding light conditional environment. To enable the function click **Enabled** under **Ambient light compensation** in the **Blob locator** tab. A yellow framed ROI is displayed and it is recommended to position the ROI somewhere within the field of view for the Inspector where there will not be any blobs passing by during the free-running/trigged inspection. Mask functionality can also be used to get a suitable shape of the ROI. The yellow ambient light compensation ROI of the live image is compared to the corresponding ROI of the reference image to get the adapted thresholds. It is recommended to place the ambient light compensation ROI at a place within FOV with similar grey level as the blobs that should be detected.

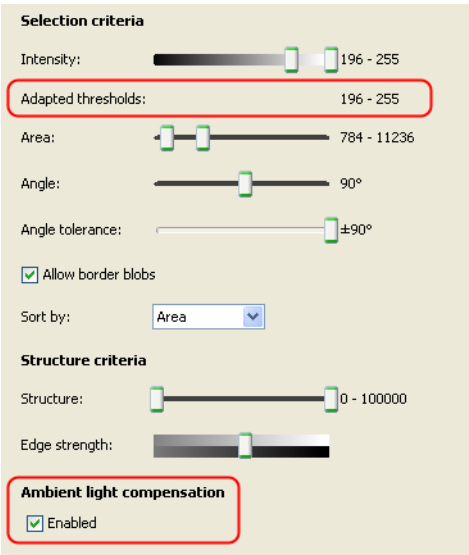
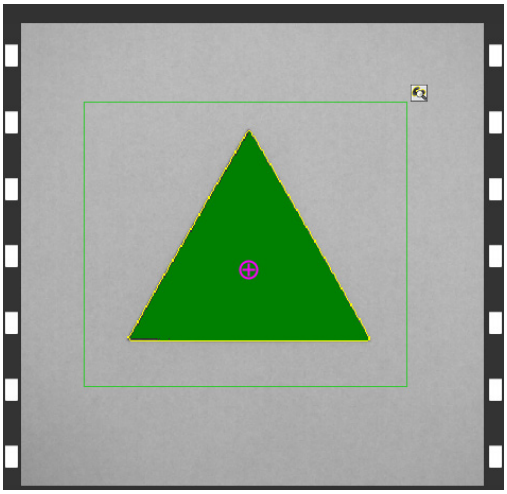
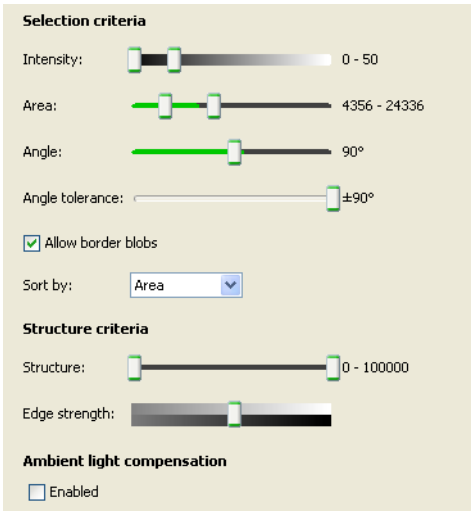


Figure 17.5 Ambient light compensation settings.

The following example illustrates the principle of ambient light compensation.

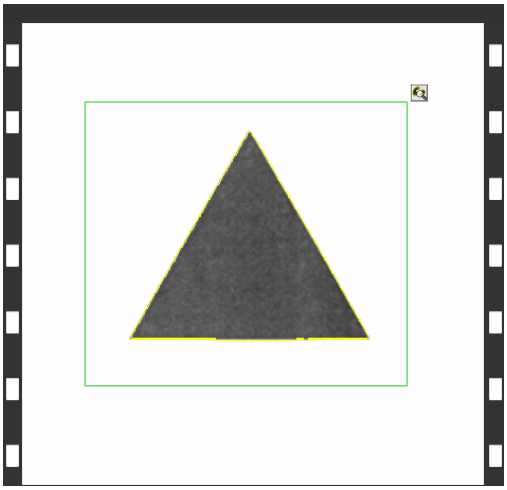


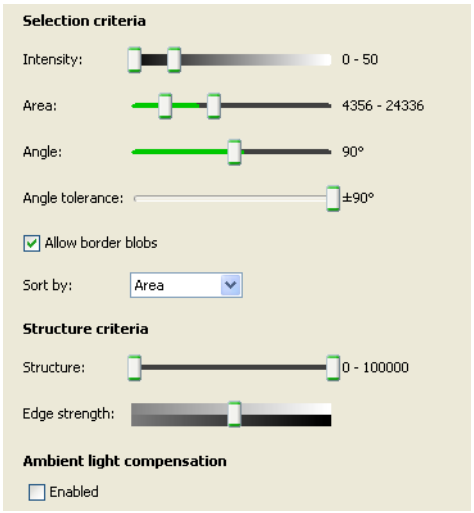


The triangular blob is detected (purple cross with circle) in normal light conditions without the ambient light compensation enabled.

The blob has got grey values less than 50 and is therefore detected.

Now light conditions change and ambient light is added to the scene.

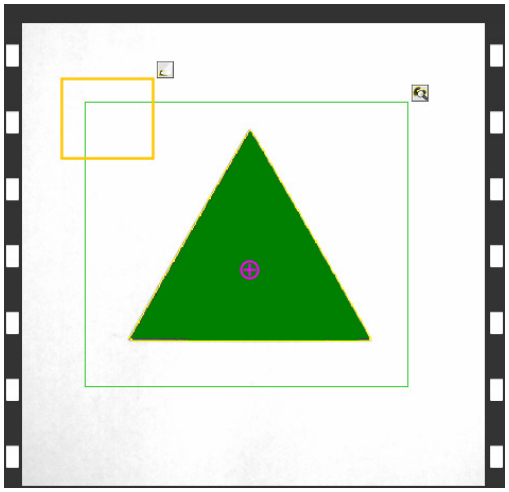




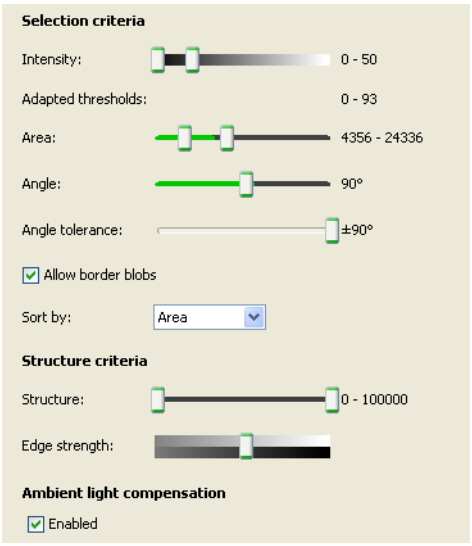
The triangular blob is not detected since the grey values of the triangle blob is now above 50 .

The thresholds for detecting a blob is still between 0-50.

To enable robust blob detection under varying ambient light conditions the ambient light compensation feature is enabled.



An ambient light compensation region has been added in the top left part of the image. The blob is now detected even though ambient light has been added to the scene.



The thresholds for detecting a blob has adaptively changed to 0-93, and therefore the triangular blob is now detected.

17.3 Environmental Conditions

Try to improve the quality and reduce the variations in the images captured by the Inspector when inspecting.

- Shield out ambient light or use external lighting to reduce the variation in exposure caused by the ambient light.
- If the objects will be moving at high speed, shorten the exposure time, to avoid motion blur in the images. If this is difficult to do while maintaining a good image quality, consider adding external lighting, see Section 10.3.2, “*Use External Lighting*” (page 38).

18 Improve Speed

There is a number of ways to improve the inspection speed if it is not fast enough. When testing these improvements, observe the frame rate shown below the image.

18.1 Decrease Image Size

To adjust image size, see Section 10.4, "*Adjust Image Size/Field of View*" (page 39).

18.2 Adjust Locator Settings

18.2.1 Improve Speed of Object Locator

To improve inspection speed by adjusting **Object locator** settings, try the following:

Reducing Max Rotation

Set **Allow rotation** to (slightly higher than) the largest rotation that the objects will ever appear, compared to the reference object. This way, the Inspector will not spend time trying to find known shapes with more rotation.

If the objects are never rotated compared to the reference object, deselect **Allow rotation**. See Section 17.1, "*Improve the Object Locator*" (page 70).

Reducing the Search Region

The object location is sometimes faster for small search regions. To change the Search region:

1. Deselect **Allow objects anywhere in image**. See Section 17.1, "*Improve the Object Locator*" (page 70).
2. In **Edit mode**, resize the green Search region with the handles in the **Reference image** or **Live image** tab.

Note

If no grip regions are outside the Search region, consider reducing the field of view instead of reducing the search region, see Section 10.4, "*Adjust Image Size/Field of View*" (page 39).

Note

A smaller object locator Search region will in most cases increase the speed. Adding masks to the object locator does not affect the speed. The size of the Search region normally has a limited effect on the speed.

Scaled Objects

Deselect **Allow scaled objects** if the known shapes always appear with the same size as the reference object. This way, the Inspector will not spend time trying to find known shapes that are scaled. See Section 17.1, "*Improve the Object Locator*" (page 70).

Adjust Search Method

Switch to a faster search method for locating the known shapes, by changing the **Search method** setting (under **Advanced** on the **Object locator** tab).

For more information on how the **Search method** settings affect the robustness, accuracy, and speed of the object locator see the Adjust Search Method paragraph in Section 17.1, "*Improve the Object Locator*" (page 70).

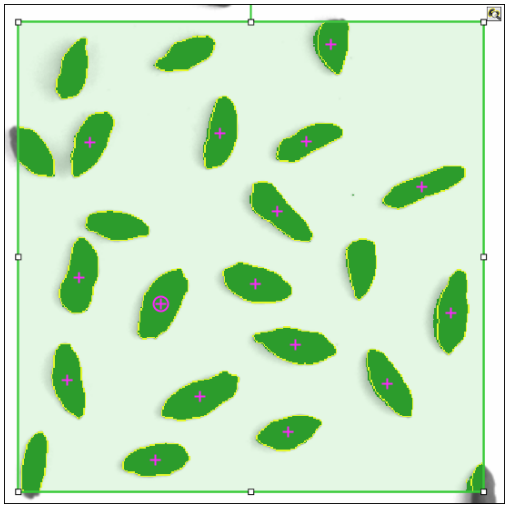
18.2.2 Improve Speed of Blob Locator

To improve inspection speed by adjusting **Blob locator** settings, try the following:

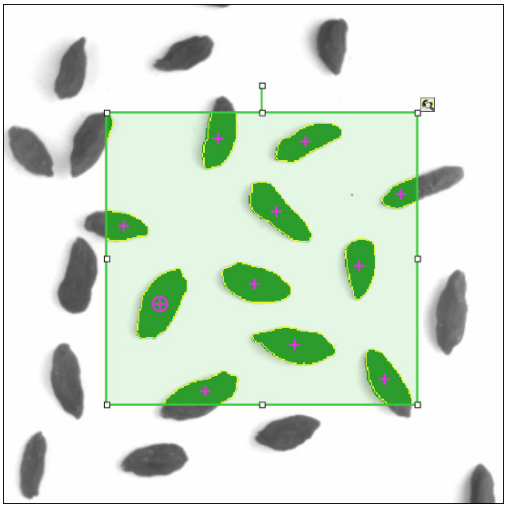
Reducing the Search Region

The location of blobs is faster for small search regions. To change the Search region:

1. In **Edit mode** adjust the Search region size in the image in the **Reference image** tab by pulling the search region handles.



Example: the search region covering a major part of the sensor



Example: decreasing the search region speeds up the inspection

Adjust Search Method

Switch to a faster search method for locating the blobs, by changing the **Search method** setting (under **Advanced** on the **Blob locator** tab).

For more information on how the **Search method** settings affect the accuracy and speed of the blob locator see the Adjust Search Method paragraph in Section 17.2, "*Improve the Blob locator*" (page 71).

18.3 Reduce Exposure Time

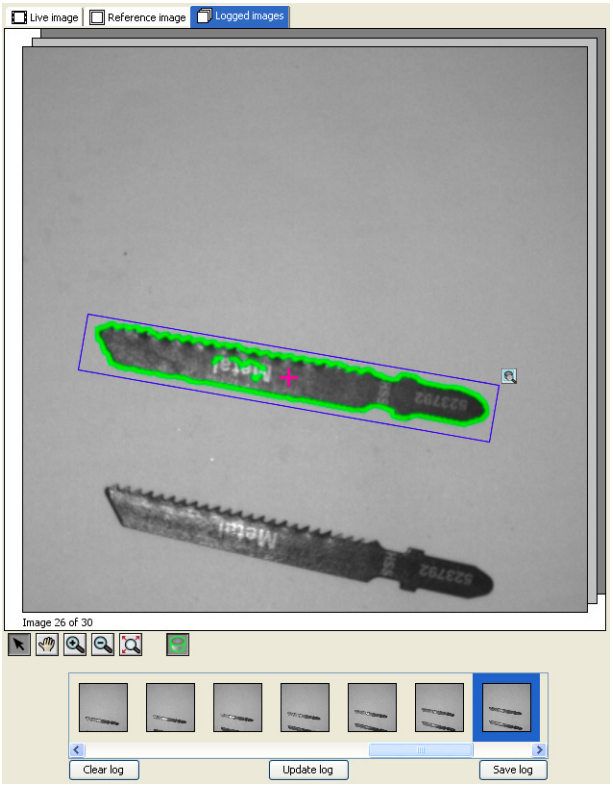
If the exposure time is a large part of the **Minimum delay time**, reducing the exposure time may be effective for increasing the speed. See image settings Section 10.2, “*Adjust Image Settings*” (page 37).

To reduce the exposure time without making the image darker, try increasing the gain and/or adding external lighting.

19 Log and Save Images

19.1 Use Image Log

The Inspector saves up to 30 images in its memory. To view the logged images, click on the **Logged images** tab. To be able to log images there must be at least one **reference object** with either an **Object locator** or a **Blob locator**.



Log Settings

To change which images the Inspector should log, choose **Log settings...** from the **InspectorP30** menu.

For the Inspector P30 you can choose the following alternatives:

All	Every inspected image
Located	Images where a shape or blob was found, and all grip regions (if any) passed
Not located	Images where a shape or blob was not found, or any grip region failed

Save logged images to PC

To save the log to the PC – all images and the results from the inspection – click **Save log** in the **Logged images** tab.

The log is saved as an HTML file (LogReport.html) that can be viewed in any web browser. The images are saved in two folders together with the HTML file, one folder that contains the images without graphical feedback, and one folder that contains the same images but with the graphical feedback.

The images without graphical feedback can be used in the simulated device.

Update the image log

While viewing the logged images, images that the Inspector adds to the log are not automatically added to the list on the **Logged images** tab. To update the displayed list of images with images added by the Inspector, click **Update log**.

When updating the log, the oldest images are removed from the list, keeping the maximum number of images at 30.

Clear the image log

To remove all images from the image log, click **Clear log**. The images are also removed from the Inspector.

19.2 Record Live Images to PC

To record images captured by the Inspector as files on the PC, choose **Record Live Images** from the **Inspector** menu.

After selecting a folder in which to save the images, a dialog box is displayed in which the number of recorded images is displayed.

To stop recording images, click **Stop recording** in the dialog box.

The images will be saved as separate files in the folder you selected. The images are saved in 8-bit grey scale BMP format.

Note

This saves only the images that are displayed in the **Live image** in the PC application, which is not necessarily every image that the Inspector captures.

20 Use the Simulated Device

SOPAS Inspector has a built in simulated device (that emulates the real Inspector) which can be used to simulate and test device settings. The simulated device can be used for evaluating inspection settings by using previously recorded images. The simulated device gives the same result as an Inspector.

20.1 Start the Simulated Device

There are two ways to start the simulated device:
- Starting the simulated device when already connected to an Inspector
- Starting the simulated device when starting **SOPAS Inspector**

20.1.1 Start the Simulated Device when Connected to an Inspector

To start the simulated device when connected to an Inspector, select **Switch to Simulated Device** from the **Communication** menu.

20.1.2 Start the Simulated Device without PC Application Running

To start the simulated device without PC application running:
1. Start the **SOPAS Inspector** application.
2. In the SOPAS welcome screen, select the **Connect to new device** option. Click **OK**.
3. In the **Connection Wizard** dialog box, select the **Use simulated device** option. Click **Next**.
4. Select the **InspectorP30** device and click **Next**. The simulated device is started.
5. Click **Finish** to start working with the simulated device.

20.2 Control the Simulated Device

The buttons in the bottom of the **Live image** tab controls the simulated device. These controls are only visible when using the simulated device. The buttons are:


Run, loops over the images in the selected folder.


Pause, pauses on the current image.


Next image, steps to the next image and pauses.


Previous image, steps to the previous image and pauses.

20.3 Select Images to be Used

To use saved images with the simulated device, the images must be in bitmap (.bmp) file format (8 bit grey scale). In order to retrieve images to PC, see Chapter 19, "*Log and Save Images*" (page 78). If the resolution does not match the selected FOV:
- Large images will be truncated and the centered part of the image will be used.
- Small images will be centered in the field of view and filled with black outside the image.

To select image source folder used by the simulated device:
1. Click **Select images**.
2. Select the image folder. Click **Open**. The folder path is displayed under the **Select images** button

Please note that the selected image folder must not contain more then 500 images, which is the limit for the simulated device.

20.4 Copy Device Data from the Simulated Device to an Inspector

If you have used the menu option **Switch to Simulated Device**, then you can copy device data from the simulated device to an Inspector, by selecting **Switch to Physical Device** from the **Communication** menu.

If the connection to the simulated device were made with the connection wizard, then you can copy device data by:

1. In the simulated device, select **Save Device File** from the **File** menu.
2. Connect to an Inspector by using **Connection Wizard**, see Section 8.1, "*Use the Connection Wizard*" (page 29).
3. Load device data to device, see Section 21.4, "*Copying Device Data From one Inspector to Another*" (page 82).

21 Handle Device Data

Device data is all settings and information that the Inspector needs to make inspections. The device data consists of:

- Settings for each reference object; image settings, object locator settings, detailed inspection settings and output settings.
- Reference images with object locator Search region and detailed inspection regions.

The image log and statistics are not included in the device data.

A device file is a file that contains device data and is mapped to a specified Inspector.

21.1 Save Device Data on the Inspector (in flash)

To save all device data (settings) in the Inspector's flash memory, select **Save Settings in Flash** from the **InspectorP30** menu. A progress bar is displayed during the process. The Inspector will stop inspecting until the flash memory is updated.

Please note that it may take several minutes to save the settings in flash. The more reference objects present the longer time it takes.

Settings that are saved in the Inspector's flash memory will be used when the Inspector starts again after a power loss. If you do not save the settings in the flash memory, the changes made will be lost if the power is disconnected.

21.2 Save Device Data on PC

Choosing **Save Device File as** from the **File** menu will save the Inspector's current device data to a new file on the PC. This file will contain all device data including the reference images and a reference to the Inspector used.

When opening a saved file, the PC application will try to connect to the Inspector for which the file was saved. All device files have the extension **.sdv** (SOPAS Device File).

21.3 Use Saved Device Data on the Inspector

To use saved device data, choose **Open Device File** from the **File** menu and select the file (**.sdv**). When opening a saved file, the PC application will try to connect to the Inspector for which the file was saved.

If you have unsaved changes in the Inspector, you will be asked if you want to save these before continuing.

If the Inspector, for which the file is saved, is found, then you can start using it.

If the Inspector is found but the device data differ between the Inspector and the file, then you are asked if you want to use the device data in the Inspector or from the file.

If the Inspector is not found, use the **Connection Wizard** to set up a connection with an Inspector and download the saved device data (see Section 21.4, "*Copying Device Data From one Inspector to Another*" (page 82)).

21.4 Copying Device Data From one Inspector to Another

To copy device data from one Inspector (source) to another Inspector (target):

1. Connect to the source Inspector, by using **Connection Wizard**, see Section 8.1, "*Use the Connection Wizard*" (page 29).
2. Save the device file, choosing **Save Device File as** from the **File** menu.
3. Connect to the target Inspector using the **Connection Wizard**.
4. Download the device data to the target Inspector by using **Load Device Data to Device** Wizard.

a. Choose **Load Device Data to Device** from the **Edit** menu. Click **Browse** to browse for device files.
b. Select the device file and click **Open**.
c. The device data is transferred to the Inspector. Click **Finish**.

21.5 Restore Settings

It is possible to restore settings and return to the factory settings from the Inspectors flash memory. All device data will be deleted. To restore settings:

1. Select **Restore settings** from the **InspectorP30** menu. A warning dialog box is displayed.
2. Click **Yes** to restore settings to factory settings. Or click **No** to cancel.

Note

The IP address of the Inspector will not be reset when restoring the settings.

22 Manage Network Address

22.1 View Network Address

To view IP address:

1. Choose **Device info...** from the **InspectorP30** menu.
2. Select the **Network tab**. The IP address is displayed.

22.2 Change Network Address

To change the IP settings of an Inspector, for instance as a preparation before moving the Inspector to another network, do the following:

1. Open the **Connection Wizard** from the **Communication** menu in SOPAS Inspector.
2. Choose **Connect to specific device**, select **Inspector** in the device type list, and deselect **Skip advanced interface configuration**. Then click **Next**.
3. In the **Interface selection** page, click **Next**.
4. In the **Found devices** page, select the Inspector to configure and select to change the device IP settings **Manually**.
5. Change the IP configuration and click **OK**.

The wizard will now configure the Inspector with the new IP configuration and the **Found devices** page will after a while be shown again. If the task was only to change the IP address of the device, the connection flow can now be cancelled.

Appendix

A Technical Data

A.1 Drawings and Measurements

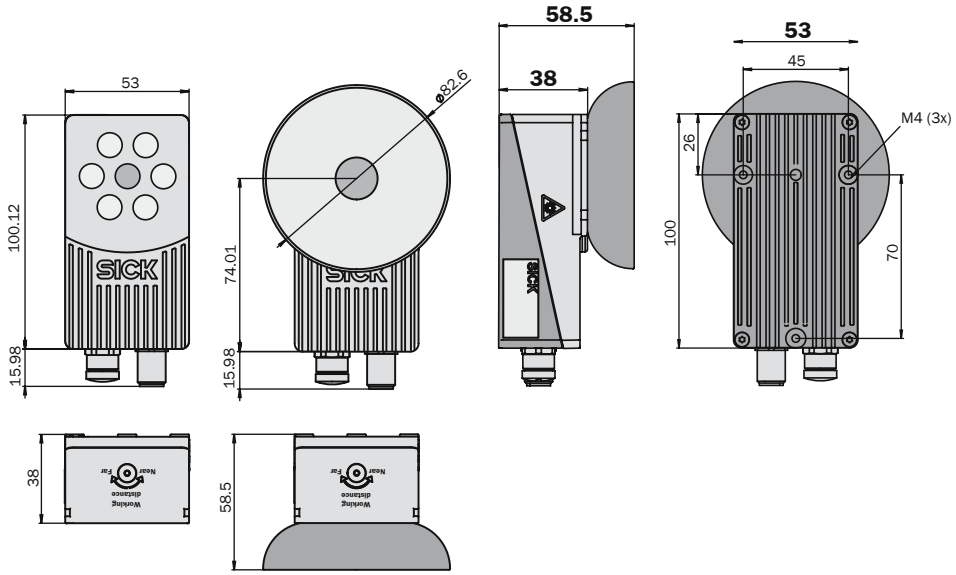


Figure A.1 Measurements

Brackets

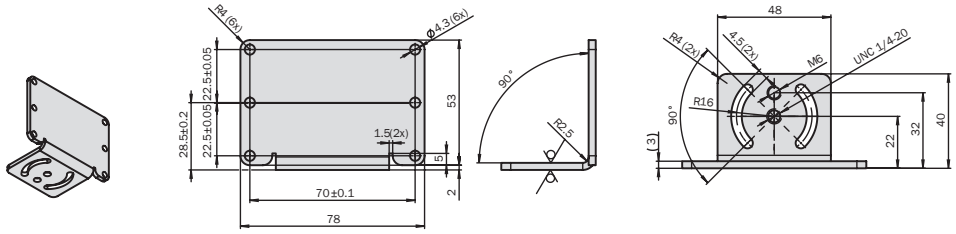


Figure A.2 Inspector angle bracket

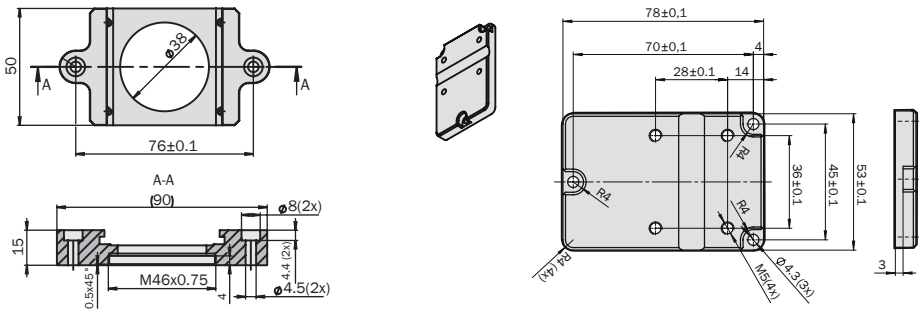
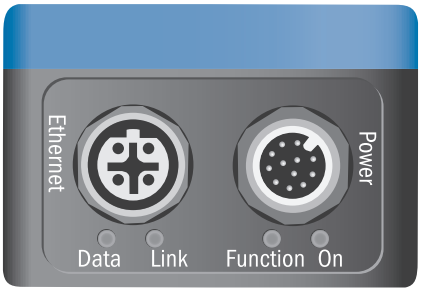


Figure A.3 Inspector light/filter adapter and Inspector universal adapter

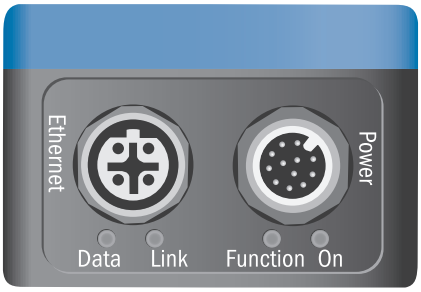
A.2 Inspector Connectors

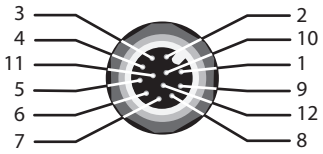
Ethernet, 10/100 Mbit/s



Inspector connector pinning – Ethernet 4 pin M12		
Pin	**Signal**	**Signal description**
1	Tx+	Transmit +
2	Rx+	Receive +
3	Tx-	Transmit –
4	Rx-	Receive –

Power In/Out





Inspector connector pinning – Power In/Out, 12 pin, M12 connector			
Pin	**Color**[a]	**Signal**	**Signal description**
1	Brown	Power	24 V power supply
2	Blue	GND	Ground 0V
3	White	in3/Trigger	Image trigger + External object selection (24 V)
4	Green	out1/Q_{Lt}	Output 1 – Used for coded directional guidance (B-type)
5	Pink	in2/Teach	External teach + External object selection (24 V)
6	Yellow	out2/Q_{Rt}	Output 2 – Used for coded directional guidance (B-type)
7	Black	out3/Q_{Up}	Output 3 – Used for coded directional guidance (B-type)
8	Grey	out4/Q_{Dn}	Output 4 - Used for coded directional guidance (B-type)

Inspector connector pinning – Power In/Out, 12 pin, M12 connector			
Pin	**Color**[a]	**Signal**	**Signal description**
9	Red	Ext trigger	External trigger, external illumination, (5 V TTL)
10	Violet	in4/Encoder	Encoder + External object selection (24 V)
11	Grey/pink	TRB	Reserved
12	Red/blue	TRA	Reserved

[a]Colors are valid for cable type DOL-1212.

A.3 LED Description

Inspector P30 – LED description			
LED	**Mode**	**Color**	**Description**
Data	All	Yellow	Ethernet Data
Link	All	Green	Ethernet Link
Function	Run/Edit	Blue	Not located
		Red	Located but outside of pass region (guidance only)
		Green	Located (positioning) Located within pass region (guidance)
	External teach	Flashing	Image focus. Higher frequency means better focus.
		Green	No motion in field of view
		Blue	Motion in field of view
		White	Device data is stored in flash memory
	Anytime	Red, slow flashing	Fatal error
On	All	Green	Power On

A.4 Technical Specification

		VSPP-3F1122 - P30 Flex
Working distance	50 ... ∞ mm	x
Working distance, internal lighting	50 ... 200 mm	x
Field of view, internal lighting	20x20 ... 72x72 mm^2	x

		VSPP-3F1122 - P30 Flex
Optics	Exchangeable	x
Performance		
- Max	75 fps	x
- Typical[a]	50 fps	x
Repeatability		
- Position	±0.2 pixels Object locator ±0.1 pixels Blob locator	x
- Angle	±0.05° Object locator ±0.02° Blob locator	x
Tool set	Object locator with grip regions	x
	Blob locator with ambient light compensation and structure measurement	x
Max. reported positions	16	x
Reference images	16 objects	x
Offline support	Emulator	x
Production control		
- Operator interface	SOPAS	x
- Data store and retrieve	30 images device log	x
	Record images on PC	x
- PLC communication	TCP/IP, configurable protocol	x
Resolution	384x384 pixels	x
Light source	White ring light, 6x High-Power LEDs	x
- LED class	Risk group 1 (low risk, IEC62471:2006)	x
Spectral response	Approx. 400 ... 750 nm	x
Supply voltage	24 VDC ±20%	x
- Ripple	< 5 Vpp	x
- Current consumption	< 450 mA, without load	x
Digital outputs	4 outputs 24 V (B-type)	x
- Output current	100 mA	x
- Default outputs	Directional guidance	x
Control of external light	5 V TTL	x
Digital inputs	3 inputs 24 V	x
- Configurable inputs	External trigger, encoder, external teach, reference object selection	x
- Max encoder frequency	40 kHz	x

		VSPP-3F1122 - P30 Flex
Interface	100 Mb Ethernet	x
Ambient temperature[b]	Operation: 0 °C ... 45 °C	x
	Storage: -20 °C ... 70 °C	x
Housing material	Aluminum	x
- Window material	PMMA (plastic)	x
Weight	350 g	x
Enclosure rating	IP67	x
Mechanical shock load	EN 60068-2-27	x
Vibration load	EN 60068-2-6	x
Device specific accessories[c]		
- Lenses, focal length	4.3 mm	x
	6 mm	x
	10 mm	x
	16 mm	x
- Glass front filters[d]	Red (> 588 nm)	x
	Green (544 ± 53 nm)	x
	Blue (468 ± 62 nm)	x
- Dome	Optimal for 50 mm working distance	x

[a] Full resolution, full rotation in high-speed mode
[b] Rel. Humidity: 35 ... 85%, 95% at storage.
[c] Full accessory list at www.sick.com.
[d] > 60% transmission.

A.5 Accessories Ordering Information

Type	Order no.
Inspector angle bracket	2045167
Inspector light/filter adapter	2045397
Inspector universal adapter[a]	2045400
Universal arm[a]	2029022
Lens focal length 4.3 mm	2049491
Lens focal length 6 mm	2049668
Lens focal length 8 mm	2056692

Type	Order no.
Lens focal length 10 mm	2049415
Lens focal length 16 mm	2049418
Inspector Flex Color filter, red	2050675
Inspector Flex Color filter, green	2050677
Inspector Flex Color filter, blue	2050676
Inspector Flex Dome	2050678
Front window, Inspector flex (glass)	2052266
Front window, Inspector flex (PMMA)	2050690
Tool, front window Inspector flex	2050703

[a] Inspector universal adapter and Universal arm is used in combination and therefore should be ordered together.

For a complete list of accessories for the Inspector, including cabling and external lightings, please visit www.sick.com.

A.6 What's Included – Inspector P30

The boxed version of the Inspector P30 includes:

- Inspector P30
- product installation CD including user documentation in PDF format
- printed Quickstart
- 2 mm hex key
- Tool for exchange of lens
- two focused stickers

Languages: English, French, Italian, German, Spanish, and Chinese (simplified).

A.7 System Requirements

- Windows XP Professional (Service Pack 2) or Windows Vista Business Edition service pack 1 (32/64 bit) or Windows 7 Professional (32/64 bit)
- Pentium III 550MHz or higher
- For simulated device mode a Pentium 4 2.5GHz or higher should be used
- 512 MB of RAM (recommended 1024 MB)
- 1024 x 768 or higher screen resolution, minimum 256 colors (recommended 65536 colors)
- CD-ROM drive (450 MB free hard disk space)
- Ethernet: 100MBit/s recommended

B Ethernet Result Output

The content of the Ethernet result output is configured using an XML-based formatting string. To explain the XML terminology used in this section, here is a short example of a configuration that includes information about if an object was located or not, if one grip region passed or failed, and finally the score of the object locator:

```
<OBJECT_LOC>  ①
  <DECISION/>  ②
    <GRIP_REGION ③  name="Grip1" ④ >
    <DECISION/>  ⑤
  </GRIP_REGION>  ⑥
  <SCORE/>  ⑦
</OBJECT_LOC>  ⑧
```

① Container start tag
② Value tag within <OBJECT_LOC> tag
③ Container tag within <OBJECT_LOC> tag
④ Attribute of <GRIP_REGION> tag, used for selecting which grip region to get values from
⑤ Value tag within <GRIP_REGION> tag
⑥ Container end tag
⑦ Value tag within <OBJECT_LOC> tag
⑧ Container end tag

The available XML tags and their attributes are described in the following tables.

B.1 Tags - Container Specific

The table below lists the container specific value tags.

Table B.1 Container Output String Tags

Container tag	Value tag	Attribute	Range	Binary	Comment
OBJECT_LOC	X			REAL	X position of the reference point. Note that this can be outside the image and therefore negative.
	Y			REAL	Y position of the reference point. Note that this can be outside the image and therefore negative.
	ROTATION		[-180, 180]	REAL	In degrees or radians depending on the configured value in the **Ethernet output** settings window.
	SCALE		[0.8, 1.2]	REAL	Scale factor of analyzed live image compared to taught reference object.
	SCORE		[0, 100]	REAL	
	DECISION		{0, 1}	USINT	0=not found, 1=found
GRIP_REGION[a]		name	any string		Name attribute required if more than one GRIP_REGION exist
	PIXELS			REAL	Number of edge pixels inside the region.

Container tag	Value tag	Attribute	Range	Binary	Comment
	DECISION		{0, 1}	USINT	0=fail, 1=pass
BLOB_LOC		index	{0, 1, ..., 15, "all"}		Index of blob according to current blob sorting order. Index 0 is the first blob. Set to "all" for automatic iteration over all found blobs
	X			REAL	Blob center of gravity (x position).
	Y			REAL	Blob center of gravity (y position).
	ANGLE		[0, 180]	REAL	In degrees or radians depending on the configured value in the **Ethernet output** settings window.
	AREA			UDINT	Blob area (in pixels)
	EDGE_FLAG		{0, 1}	USINT	0 = blob fully within ROI, 1 = blob touches ROI border
	EDGE_PIXELS			UDINT	Structure value (number of edge pixels inside the blob).

[a]GRIP_REGION must be used inside a OBJECT_LOC container

B.2 General Tags

The table below lists value tags that can be used without a container tag.

Table B.2 Generic Output String Tags

Value tag	Attribute	Range	Binary	Comment
MESSAGE_SIZE			UINT	• Binary format: The size of the message in bytes • ASCII format: The number of characters in the message
FOUND_BLOBS			USINT	Number of found blobs. Not required to be inside a <BLOB> tag since this number typically should not be presented for each blob.
GUIDANCE			USINT	Guidance value: • 0 = Not located • 9 = Within pass region • 1 = Up • 2 = Up-Right • 3 = Right • 4 = Down-Right • 5 = Down • 6 = Down-Left • 7 = Left • 8 = Up-Left
LIVE_THRESHOLD_LOW			USINT	The lower threshold of the blob tool's intensity after applying ambient light compensation. Not required to be inside a <BLOB> tag since this

Value tag	Attribute	Range	Binary	Comment
				number typically should not be presented for each blob.
LIVE_THRESHOLD_HIGH			USINT	The upper threshold of the blob tool's intensity after applying ambient light compensation. Not required to be inside a <BLOB> tag since this number typically should not be presented for each blob.
IMAGE_NUMBER		[0, 2^{31}-1]	UDINT	Analyzed image's number (this number is reset when the device is rebooted)
IMAGE_DECISION		{0, 1, 2}	USINT	Overall image result regardless of chosen locator tool. For applications with pass region: • 0 = Not located • 1= Located outside pass region • 2 = Located inside pass region For applications without pass region: • 0 = Not located • 1 = NOT USED • 2 = Located
REF_OBJECT		[0, 15]	USINT	Reference object index
ASCII	value	[0, 255]	IGNORED[a]	Used to send single control characters
SPACE			IGNORED[a]	Same as <ASCII value="32">
TAB			IGNORED[a]	Same as <ASCII value="9">
LAB			IGNORED[a]	Left angular bracket, "<". Useful when generating XML-formatted output.
RAB			IGNORED[a]	Right angular bracket, ">". Useful when generating XML-formatted output.
NEWLINE			IGNORED[a]	Same as <ASCII value="10">
RETURN			IGNORED[a]	Same as <ASCII value="13">
TIME	timeUnit	{“s”, “ms”}	UDINT	Current time since device boot. Restarts from zero after ~10 years (using seconds) and ~49 days (using milliseconds)
SERIALCODE			UDINT	Device serial code.
FOCUS			REAL	Only valid while the device is in Edit mode. This is the focus value from the GUI image settings tab
TELEGRAM_COUNTER			UINT	A counter that increments for each telegram sent over the result channel. Resets at power-up or device reset.

Value tag	Attrib-ute	Range	Binary	Comment
USINT	intValue	[0, 255]	USINT	If the value attribute is not specified the default value will be zero and the tag can be used for padding.
UINT	intValue	[0, 65535]	UINT	If the value attribute is not specified the default value will be zero and the tag can be used for padding.
UDINT	intValue	[0, 2^{32}-1]	UDINT	If the value attribute is not specified the default value will be zero and the tag can be used for padding.

[a]ASCII text is not applicable for the binary output

B.3 Attributes

Attributes are used to control the formatting and identification of inspections. Some are available in the **Ethernet output** settings window under the section **Message settings**. Apart from these the table below describes the formatting attributes for Inspector P30.

Table B.3 Formatting attributes

Attribute	Range	Default value	Affects	Used in Binary format	Comment
index	{0, 1, ..., 15, "all"}	"all"	Blob	Yes	Index of blob according to current blob sorting order. Index 0 is the first blob. Set to "all" for automatic iteration over all found blobs.
scale	Any float	1.0	All values	Yes	Scales the values before they are printed. Can for example be used to express positions as integers in 1/10 pixel units
base	{"decimal", "octal", "hex"}	"decimal"	Integers	No	
timeUnit	{“s”, “ms”}	“s”	<TIME>	Yes	
name	any string	none	Identification of grip region inspections	Yes	
value	[0, 255]	0	<ASCII>	No	
intValue	[0, 255], [0, 65535], [0, 2^{32}-1]	0	<USINT>, <UINT>, <UDINT>	Yes	

C Support

C.1 Technical Support

C.1.1 Preparing for Technical Support

To effectivise and speed up technical support issues it is good to find out the following before contacting support;

- Find out the *SOPAS Version* and *Build number* (SOPAS GUI: **Help→Info**)
- Find out the *Product model*, *Application-*, *FPGA-* and *Monitor version* (SOPAS GUI: **Help→About Inspector**)
- Save a device file that can be sent to support;
  - If using SOPAS Inspector, **File→Save Device File**
  - If using SOPAS ET, **Project→Export Device**
- Save a system dump file that can be sent to support (SOPAS GUI: **InspectorP30→Device Info→Save system dump**)
- If possible, please also provide PASS/FAIL images (**InspectorP30→Record Live Images**, or logged images with/without graphics)

C.1.2 Web Support

Technical support is available on-line at;

`www.sick.com`→**Service&Support→Support→Support for Vision**

There is also a continuously updated FAQ document available at;

`http://sickivp.twinspot.net/download/FAQ%20Summary%20-%20Inspector.pdf`

C.1.3 First Line Support

Technical support is available to all users of the SICK Vision Technology. All 1st line technical support should always go to your *local SICK subsidiary* first hand. Below are contact information to dedicated 1st line support in USA, Canada and Germany. For the rest of the world, please contact your local SICK Subsidiary and ask for their vision specialist.

USA, Canada	Germany
`vision@sick.com`	`machine.vision@sick.de`

C.2 Further Information

More product and order information is also available on: `www.sick.com`.

Please see the online help in SOPAS for Inspector.

Glossary

Angle	The term angle is used together with the blob locator. For each located blob its corresponding angle is calculated and is available in the Results tab and as Ethernet output. The term rotation is used together with the object locator.
Background	Everything in the image that is not the object(s) that the Inspector Positioner is configured to locate.
Blob	An object with a free-form shape. A blob is found in the image if it lies within specified intensity and size ranges.
Blob locator	The tool used to locate free-form shapes in the image.
Capture image	To take an image. A captured image can either be used for object positioning or guidance in the live image or be used as a reference object in the reference image.
Center of gravity (COG)	The center of gravity for all found blobs are visualized in the SOPAS Inspector GUI and can be reported via Ethernet.
Color filter	An accessory that replaces the front window with a color filter front window to enhance contrast of certain color combinations. Red, green, and blue filters are available.
Contour	Another word for edge. The contours that the object locator finds on an object are marked green. The amount of contours is adjusted by the edge strength parameter.
Contrast	The difference in grey levels between dark and bright areas in the image.
Device data	Device data is all settings and information that the Inspector needs to make inspections. The device data consists of settings for each reference object (image settings, object locator settings, blob locator settings, output settings) and reference images.
Device file	A file that contains device data of a specific Inspector. File extension is .dsv.
Directional guidance	The digital output result from Inspector Positioner, signaling the recommended direction in which to move the Inspector to get into the object pass region. The angular resolution of the guidance is 45 degrees, meaning eight directions in total: left, right, up and down, plus all four diagonals.
Dome accessory	An Inspector Flex accessory that replaces the front window of the Inspector Flex. The Dome diffuses the internal lighting in order to be able to work with glossy (shiny) objects.
Edge	The line that is formed between a dark and a bright area in the image.
Edge strength	The minimum difference in intensity (grey scale values) between neighboring bright and dark areas that is required for the object locator to consider it an edge (contour).
Field of view (FOV)	The area which is currently seen by the Inspector, for example defined by its width and height in mm. The size depends on the working distance and the lens' focal length.
Focal length	The aspect of a lens that determines how large the field of view becomes at a given working distance. If the focal length is short, for example 6 mm, then the lens has a wide angle and sees a large scene. If the focal length is long, for instance 16 mm, then the lens has a narrow view angle (tele lens) and sees a small scene far away.
FOV (field of view)	See field of view
Free-form object/shape	An object whose shape is not defined, also referred to as blob. The object is distinguished from the background depending on its grey values and size (pixel area).

Free-running	The image capture mode where images are captured and analyzed as fast as is possible, all done at a constant rate.
Grey level	Another word for intensity. In Inspector Positioner, intensity values range from 0 (black) to 255 (white). Any value in between 0 and 255 is a grey level.
Grip region	Tool to be used together with the object locator in robot picking applications. The purpose is to ensure that the gripper can pick the object without hitting other objects that lie too close to the object to be picked.
Guidance	See Directional guidance.
Image log	See Logged image.
Image settings	The parameters that control: • The quality of the captured images (exposure, brightness, use of lighting). • When to capture images (free-running or triggered).
Image size	The size of the image captured by the Inspector, measured in pixels (width x height).
Intensity	See grey level.
Live image	A captured image that is inspected by the Inspector.
Locate	This is what the Inspector does to identify and find the position of the object in a captured image. Either of the methods object locator or blob locator can be used.
Log settings	The criteria for saving images in the image log.
Logged image	A captured image that is saved in the image log in the Inspector. The image log can contain up to 30 images.
Mask	A part of a region that shall be excluded from the image analysis. The mask can be used to exclude areas in the object locator search region or to avoid finding blobs in chosen areas of the blob locator search region.
Match	The required similarity between the object in the image and the reference object.
Match settings	Settings that affect when an object is considered located, for example similarity and rotation tolerance.
Object	What the Inspector Positioner shall locate. Also called target in guidance applications.
Object locator	The tool used to locate an object of known shape in the image.
Object pass region	A region in the image that defines when a target has reached its goal. The guidance is completed when the target's reference point is within the pass region.
Pass region	See Object pass region.
Pick point	A predefined point on the object, for example to be used as pick point in a robot picking application. Pick point terminology is used in robot applications, and it has the same meaning as reference point.
Positioning	Finding the location of an object and reporting the object's reference point.
Reference image	Image of an object that is used as reference object.
Reference object	An object that the Inspector Positioner has learned to locate.

Reference point	A particular point on the object, for example to be used as pick point in a robot picking application. The default for the object locator is the center of the object locator region. The default for the blob locator is the center of gravity of the blob.
Region	An area of the image that is used for any of the locator tools for example grip or pass regions.
Rotation	The term rotation is used together with the object locator. The rotation of a located object relative the taught object is calculated and is available in the Results tab and as Ethernet output. The term angle is used together with the blob locator.
Search region	The region in the captured image in which the Inspector Positioner will try to locate the object or the blobs. For the object locator the default region is the whole field of view. For the blob locator the search region is drawn by the user at the time of creation. The Search region can be changed in the Reference image tab.
Structure	Surface characteristic of a blob, for example spots or large reflections inside a blob. The structure can be used to separate one object type from another. Structure corresponds to the number of edge pixels found inside a blob and it can be used as a selection criteria for the Blob locator, for example filtering out blobs with certain surface characteristics.
Target	Another word for object, especially in guidance applications.
Teach	What the user does to make the Inspector Positioner learn a new reference object.
Threshold	Another word for a limit that defines what is inside or outside a range. When there is sufficient contrast in an image, a well fitted threshold value can separate objects from the background.
Tool	A method or algorithm to accomplish an image analysis task, for example locating an object in an image.
Triggered	The image capture mode when images are taken on an external command, for example when a photoelectric switch goes high.
Working distance	The distance between the lens and the object, see field of view.

Index

8013720/2012-06 · A4 4c int37

Australia
Phone +61 3 9497 4100
1800 334 802 – tollfree
E-Mail sales@sick.com.au

Belgium/Luxembourg
Phone +32 (0)2 466 55 66
E-Mail info@sick.be

Brasil
Phone +55 11 3215-4900
E-Mail sac@sick.com.br

Canada
Phone +1(952) 941-6780
1 800-325-7425 – tollfree
E-Mail info@sickusa.com

Ceská Republika
Phone +420 2 57 91 18 50
E-Mail sick@sick.cz

China
Phone +852-2763 6966
E-Mail ghk@sick.com.hk

Danmark
Phone +45 45 82 64 00
E-Mail sick@sick.dk

Deutschland
Phone +49 211 5301-301
E-Mail kundenservice@sick.de

España
Phone +34 93 480 31 00
E-Mail info@sick.es

France
Phone +33 1 64 62 35 00
E-Mail info@sick.fr

Great Britain
Phone +44 (0)1727 831121
E-Mail info@sick.co.uk

India
Phone +91–22–4033 8333
E-Mail info@sick-india.com

Israel
Phone +972-4-999-0590
E-Mail info@sick-sensors.com

Italia
Phone +39 02 27 43 41
E-Mail info@sick.it

Japan
Phone +81 (0)3 3358 1341
E-Mail support@sick.jp

Magyarország
Phone +36 1 371 2680
E-Mail office@sick.hu

Nederlands
Phone +31 (0)30 229 25 44
E-Mail info@sick.nl

Norge
Phone +47 67 81 50 00
E-Mail austefjord@sick.no

Österreich
Phone +43 (0)22 36 62 28 8-0
E-Mail office@sick.at

Polska
Phone +48 22 837 40 50
E-Mail info@sick.pl

România
Phone +40 356 171 120
E-Mail office@sick.ro

Russia
Phone +7 495 775 05 30
E-Mail info@sick.ru

Schweiz
Phone +41 41 619 29 39
E-Mail contact@sick.ch

Singapore
Phone +65 6744 3732
E-Mail admin@sicksgp.com.sg

South Africa
Phone +27 11 472 3733
E-Mail info@sickautomation.co.za

South Korea
Phone +82-2 786 6321/4
E-Mail info@sickkorea.net

Slovenija
Phone +386 (0)1-47 69 990
E-Mail office@sick.si

Suomi
Phone +358-9-25 15 800
E-Mail sick@sick.fi

Sverige
Phone +46 10 110 10 00
E-Mail info@sick.se

Taiwan
Phone +886 2 2375-6288
E-Mail sales@sick.com.tw

Türkiye
Phone +90 216 528 50 00
E-Mail info@sick.com.tr

United Arab Emirates
Phone +971 4 8865 878
E-Mail info@sick.ae

USA/Canada/México
Phone +1(952) 941-6780
1 800-325-7425 – tollfree
E-Mail info@sickusa.com

More representatives and agencies
at **www.sick.com**

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