REFERENCE MANUAL

# Inspector PI50

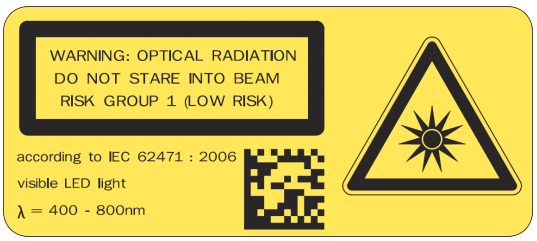
## Vision Sensor


SICK
Sensor Intelligence.

## WARNING

**VSPP-5F2113 (Inspector PI50), VSPP-5F2134 (Inspector PI50 ECAT)**

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

**VSPP-5F2413 (Inspector PI50-IR)**

The Inspector is equipped with an LED illumination that must be considered as a lamp system of Risk Group 0 / Free Group (exempt risk) according to IEC 62471:2006


NOTICE: IR EMITTED FROM THIS PRODUCT
RISK GROUP 0 (EXEMPT RISK) according to IEC 62471:2006
IR LED light λ = 850 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.

©SICK AG 2012-08-23
All rights reserved
8014694/2012-08
Subject to change without notice

0.1.0.166

# Table of Contents




©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

# Introduction

# 1 Introduction

The Reference Manual is a complement to the Operating Instructions for Inspector PI50 and covers the functionality of all product variants. See Technical Data section of the Operating Instructions for Inspector PI50 to see which features each product variant supports.

The Operating Instructions for Inspector PI50 describes how to set up and configure the interfaces via **SOPAS Single Device**.

The Reference Manual contains detailed information about the interfaces including syntax and available functionality. It focuses on Inspector PI50 specific topics and does not describe the basic technology behind each interface.

The details of the result output formatting and the contents and syntax of the command channel are shared by several interfaces. They are described in an appendix valid for all relevant interfaces.

## 1.1 Interfaces Overview

The Reference Manual contains detailed information for the following interfaces:

- **I/O Extension Box** is used to increase the number of available input and output connections
- **Web API** interface is intended for integration with external HMI implementations
- **Ethernet Raw** interface is intended for integration with external PLC equipment
- **EtherNet/IP** interface is intended for integration with external PLC equipment following the EtherNet/IP communication standard
- **EtherCAT** interface is intended for integration with external PLC equipment following the EtherCAT communication standard

See also Technical Data section of the Operating Instructions for Inspector PI50 for descriptions of which features each interface supports, and which interfaces that are available for each product variant.

## 1.2 Intended Readers

The intended readers of the Reference Manual are users working with integration between the Inspector PI50 and other equipment, for example PLC programmers and Custom HMI developers.

The readers are assumed to have knowledge about the Inspector PI50 product and features as described in the Operating Instructions for Inspector PI50. The readers are also assumed to have knowledge about the basic functionality of the technology of the interfaces used for the integration.


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

# Interfaces

# 2 I/O Extension Box

The Inspector PI50, VSPP-5F2113 and VSPP-5F2413, can be connected to an I/O extension box that increases the number of digital inputs and outputs. The I/O Extension box is available as an accessory from SICK. This section covers how the I/O extension box is connected to the Inspector PI50, and how it is configured. The I/O extension box is not available for the Inspector PI50 ECAT, VSPP-5F2134.

The following basic steps are required to use the I/O extension box with the Inspector PI50. Details about the steps are found in the subsequent sections.

1. Connect the I/O extension box to the network.
2. Configure the IP address of the I/O extension box to match the settings of the network, and the Inspector PI50.
3. Enter the IP address of the I/O extension box in the **SOPAS Single Device** application.
4. Activate the inputs and/or outputs on the I/O extension box depending on the application.

**Note**

The **SOPAS Single Device** application should be closed or set to offline when the power to the I/O box is disconnected. The I/O extension box needs to be restarted if the IP address is changed or if the connections to the inputs and output on the box are changed.

## 2.1 Physical Network Connection

To minimize network latency, it is recommended that the I/O extension box is connected directly to the Inspector PI50. The I/O box has a network switch so that a PC running **SOPAS Single Device** can be connected via the I/O box.

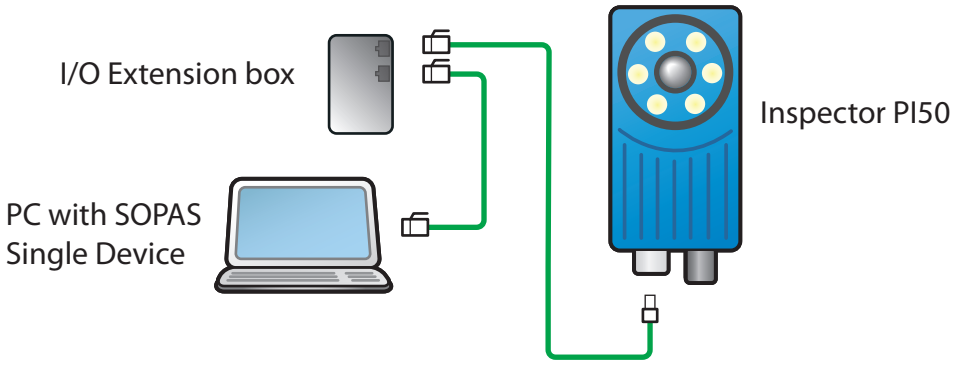



*Figure 2.1 Physical network connection*

## 2.2 Configuration of the IP Address on the I/O Extension Box

This section briefly describes how to configure the I/O extension box for operation with the Inspector PI50. For details, please refer to the user manual delivered with the I/O extension box.

The IP address of the I/O extension box must be compatible with the addresses of the Inspector PI50 and of the PC. For details of how to set and view the IP address of the Inspector PI50, please refer to the Operating Instructions for Inspector PI50.

The following is an example of how the IP addresses can be configured for the Inspector PI50, the I/O box and the PC.

| Inspector PI50 | I/O Extension Box | PC |
|---|---|---|
| 192.168.1.110 | 192.168.1.3 | 192.168.1.30 |


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

### 2.2.1 Basic Configuration of the IP address

The address selection switch on the I/O extension box configures the host part of the IP address, that is, the last of the four parts of the IP address. By default, the first three parts of the address (also known as the network address) are set to 192.168.1. If the switch is set to a value other than 0 (all switches set to Off) or 255 (all switches set to On), the I/O extension box will use the host part of the IP address assigned by the switch.

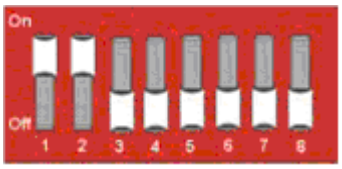



*Figure 2.2 Example*

The setting above configures the I/O extension box to have a host ID of 3 corresponding to the binary value “00000011” where switch 1 is bit 0 (LSB) and switch 8 is bit 7 (MSB). The I/O box will then have an IP address of 192.168.1.3.

**Advanced Configuration of the IP Address**

If the network part of the IP address must be changed from the default 192.168.1 for the I/O extension box, the internal web server of the I/O extension box can be used. For details please refer to the manual delivered with the I/O extension box.

## 2.3 Setup of the I/O Extension Box in the SOPAS Single Device Application

The communication with the I/O extension box is configured using the **Interfaces and I/O Settings** dialog from the **InspectorPI50** menu. Check the **Digital I/O** and **I/O extension** boxes in the **Interfaces** tab. The I/O extension box is disabled if **Ethernet** is enabled in the same tab.

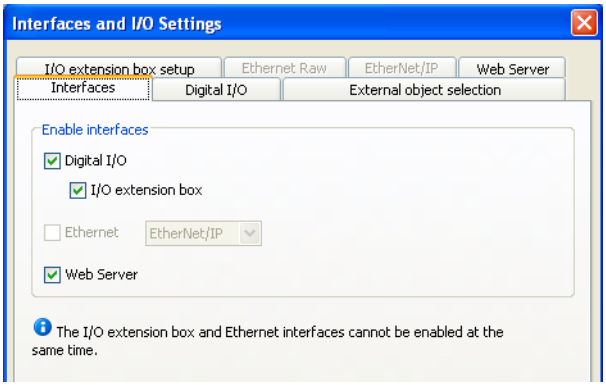



*Figure 2.3 I/O Extension Box setup*

**Communication Mode**

It is possible to adjust the way that the Inspector PI50 is communicating with the I/O extension box. The settings are made in the **I/O extension box setup** tab in the **Interfaces and I/O Settings** dialog from **InspectorPI50** menu. There are three modes available:

- Robust mode. This is the default communication mode, and it is the recommended one if the Inspector PI50 is connected to the **SOPAS Single Device** application during operation.
- Fast mode. This mode allows the Inspector PI50 to operate at a higher frame rate but there is a risk that some data in the communication with the I/O extension box is lost if there is high load on the network. This mode shall not be used if the Inspector PI50 is connected to the **SOPAS Single Device** application during operation.


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

- User mode. This is the advanced communication mode where it is possible to configure the number of retries that the Inspector PI50 performs, and the timeout for each retry. The timeout is the time (in milliseconds) that the Inspector PI50 is waiting for a reply from the I/O extension box for a request to set outputs or read inputs.

**IP Configuration**

To be able to connect to the I/O extension box, the IP address of the I/O extension box must be specified in the **SOPAS Single Device** application.

To specify the IP address of the I/O extension box:

1. Open the **Interfaces and I/O Settings** dialog from the **InspectorPI50** menu. Enter the selected IP address of the **I/O extension box setup** tab in the four fields separated with dots.
2. Click **Apply** to store the settings.

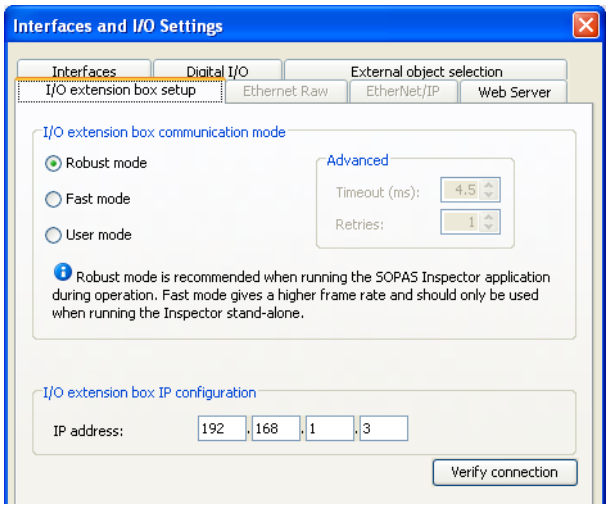



*Figure 2.4 Set up mode and IP address*

**Verify Connection**

It is possible to verify that the connection to the I/O extension box can be established by clicking the **Verify connection** button. The **SOPAS Single Device** application will then try to connect to the I/O extension box, and a message will be displayed informing if the I/O extension box was found.

**Note**

It is possible to configure the Inspector PI50 for use with the I/O extension box even when the I/O extension box is not available. As soon as the Inspector PI50 detects the I/O extension box on the network, it will connect to it and start using it as configured.

### 2.3.1 Enabling the I/O Extension Box

The use of the inputs and outputs on the I/O extension box is enabled on the **Digital I/O** tab of the **Interface and I/O Settings** dialog from the **InspectorPI50** menu.

## 2.4 Input and Output Connections

When delivered, the I/O extension box contains 4 digital inputs and 8 digital outputs. The digital outputs can be expanded to 16, and the digital inputs of the Inspector PI50 can be extended to 5.

Please refer to the manual delivered with the I/O extension box for details on how to connect the power supply to the box, and where to find the digital inputs and outputs.


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

### 2.4.1 Special Conditions During Startup

The following applies if the Inspector PI50 is configured to use the inputs of the I/O extension box for object selection:

If the I/O extension box is not available when the Inspector PI50 starts up, the Inspector PI50 will use the last reference object selected in the **SOPAS Single Device** application before saving to flash. Once the I/O extension box is available, the Inspector PI50 will read the inputs of the box, and select the corresponding reference object.

### 2.4.2 Connection to the I/O Extension Box lost During Operation

If the connection to the I/O extension box is lost during operation, the last status of the inputs on the box will be used until the connection is re-established.

### 2.4.3 Object Selection with I/O Extension Box

The status of the inputs on the I/O extension box is checked in the end of each inspection cycle. If the Inspector PI50 is configured to use external image trig, the status of the external inputs will only be checked when an image trig signal has been received.

### 2.4.4 Timing Issues

The digital outputs on the I/O extension box shall be read at minimum delay time as displayed in the **SOPAS Single Device** application.

### 2.4.5 Use of the Digital Outputs for Logic

The digital outputs on the I/O extension box are not guaranteed to be jitter-free. It is not recommended to use these outputs for direct control of other devices. The I/O extension box shall be connected to a PLC for process control.

### 2.4.6 Change of Modules in the I/O Extension Box

The Inspector PI50 supports I/O extension box configurations with up to 16 digital outputs and 5 digital inputs (The standard configuration of the I/O extension box contains 8 digital outputs and 4 digital inputs.). The configuration of an I/O extension box can be changed by adding/removing I/O modules to/from the I/O extension box. I/O modules are available as an accessory from SICK. For details about Accessories Ordering information see the Operating Instructions for Inspector PI50.

Perform the following steps to connect and use more I/O modules:

1. Close the **SOPAS Single Device** application.
2. Disconnect the power from the I/O extension box.
3. Connect the additional I/O modules (inputs and/or outputs) to the I/O extension box. Please refer to the manual delivered with the I/O extension box for details.
4. Re-connect the power to the I/O extension box.
5. Re-start the **SOPAS Single Device** application.

The additional digital outputs are now be available in the **SOPAS Single Device** application.

## 2.5 Troubleshooting

### 2.5.1 The I/O LED Flashes 10 Times

If the power to the I/O extension box has been disconnected for a longer period of time, the internal clock in the box will be reset. The I/O LED on the box will then flash 10 times in red. This is not a serious error, and the I/O extension box can still be used together with the Inspector PI50 without any problems.

### 2.5.2 No Contact with the I/O Extension Box

Ensure that the network card on the PC has the same network address, for instance 192.168.1, as the I/O extension box. The host part of the IP address (that is the last number in the IP address) must not be the same as for the I/O extension box or the Inspector PI50.


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

There are two tools available in Windows to check the network connection and the IP settings:

- **Ping**. Open the command prompt, and type **ping** followed by the IP address of the I/O extension box. If the I/O extension box is available the following text will be displayed: **Reply from x.x.x.x** (where x.x.x.x is the IP address of the I/O extension box). If the I/O extension box could not be found an error message is displayed, for instance **Request timed out** or **Destination host unreachable**.
  **Example**: ping 192.168.1.3
- **Ipconfig**. Open the command prompt and type **ipconfig**. The current status for the network cards on the PC will then be displayed. Ensure that the network settings are corresponding to the setting for the I/O extension box. The current IP address for the Inspector PI50 can be viewed by selecting Device Info from the **InspectorPI50** menu.

The web browser on the PC must be configured not to use a proxy when communicating with the web server in the I/O extension box.

### 2.5.3 High Number of Unanswered Requests to the I/O Extension Box

The advanced communication mode, User mode, can be used to fine tune the communication with the I/O extension box. It is recommended to try to increase the timeout as a first step, and if this does not work, try to increase the number of retries. Increasing the number of retries will reduce the inspection speed.

If the problem persists even if the timeout and the number of retries have been increased, verify that the network topology does not block the use of UDP packets.


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

# 3 Web Interface

## 3.1 Introduction

The Web Interface is available in two variants: the Web API and the Web Server. The Web API is used to create custom HMI solutions and offers a wide range of functions to control and monitor the Inspector PI50. A subset of these functions is employed by the Web Server, providing intuitive operation of the Inspector PI50 and high accessibility through a standard web browser.

The command channel, shared with other interfaces, is available through the Web API as well as specific functions to access images and to backup and restore configurations.

The Web Server interface is described in the Operating Instructions for Inspector PI50. The Web API is described in this manual.

## 3.2 Get Results via Web API

The Web API presents the inspection results as overlay graphics in the live image. It is not possible to get detailed inspection results through the Web API.

### 3.2.1 Live Image

The live image can be retrieved through the Web API by a live image request using the URL `http://<IP-address>/LiveImage.jpg` The response to the request is a data buffer containing a JPEG image.

If the image is not available, an empty image is returned with a smaller size than a normal image.

**Note**

The live image is not available when **SOPAS Single Device** or the Inspector Viewer is connected to the Inspector PI50.

Live image response can be much slower when activating the Send to FTP feature. The FTP image transfer function has higher priority.

**Example URLs**

Request a live image without overlay graphics:

`http://192.168.1.110/LiveImage.jpg`

The response to the request is a data buffer containing a JPEG image.

Request a live image with overlay graphics:

`http://192.168.1.110/LiveImage.jpg?ShowOverlay`

### 3.2.2 Logged Images

Logged images can be retrieved using the URL `http://<IP-address>/getP50LogImage?00` where the argument "00" is the image number. The image number is two digits in the range [00, 29]. The device keeps writing to the log and therefore the log first has to be locked to be able to retrieve an image. This is done by using the URL `http://<IP-address>/LockLog`

The response to the request is a data buffer containing a JPEG image. An empty image with a smaller size than a normal image is returned if no log image is available for a certain position.

**Example URL**

`http://192.168.1.110/LockLog`

`http://192.168.1.110/getP50LogImage?00`

To start logging images again the log has to be unlocked first and this is done by using the URL `http://<IP-address>/LockLog?Unlock`


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

**Example URL**

```
http://192.168.1.110/LockLog?Unlock
```

## 3.3 Control the Sensor via Web API

The Web API supports the command channel used to read and update parts of the device configuration.

The Web API also supports the functionality to do a backup of the device configuration to a file and to restore the configuration again. This is a convenient way to handle configurations without installing and using **SOPAS Single Device**.

### 3.3.1 Basic Principles

The command channel has a set of basic principles:

- Only one command at a time can be executed.
- Each command is followed by a return message (ACK) that includes the result of the command as well as error codes.
- The commands are not unique to a specific task, it is the commands together with its parameters that uniquely points to a specific configuration change (see list of command types and parameters in Appendix A,“*Command Channel*” (page 67)).
- Writing a parameter can typically only be done when the device is in Edit mode. Reading a parameter can be done in both Edit and Run mode.
- It is possible to block configuration changes by unchecking the **Allow changes via Web Server** checkbox in the **Web Server** tab in the dialog **Interfaces and I/O Settings** in **InspectorPI50** menu.

### 3.3.2 Command Syntax

The Web API command channel has the following syntax:

```
http://<IP-address>/CmdChannel?<command>_<identifier>_<argument 1>_<argument 2>..._<argument N>
```

The ACK message has the following syntax:

```
<ACK Command> <identifier> <errorCode> <returnValue1> <returnValue2> ... <returnValueN> <errorMessage>
```

The command is sent as an ASCII string. The combination of a command with its parameters will either change the device configuration or fetch information from the device. For more command examples see Section A.1, “*Command Syntax*” (page 67) and Section A.5, “*Command Examples*” (page 79).

**Note**

The command syntax differs from other interfaces where the initial part `http://<IP-address>/CmdChannel?` is added and all space characters (" ") are replaced by an underscore character ("_"). The ACK messages still contain spaces.

**Example URL**

The successful execution of the following command

```
http://192.168.1.110/CmdChannel?sINT_1_1
```

will perform the command (to select reference object with index 1) and then return an HTML page with a body containing the following string:

```
rsINT 1 0
```

while a failed command may return

```
rsINT 1 8100 Can not change ref bank in Run mode.
```


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

### 3.3.3 Current Reference Object

The reference image of the current reference object can be retrieved using the URL `http://<IP-address>/ActiveReferenceImage.jpg`

The response to the request is a data buffer containing a JPEG image.

**Example URL**

```
http://192.168.1.110/ActiveReferenceImage.jpg
```

### 3.3.4 Select Reference Object in Run mode

It is possible to select reference object also in Run mode.

The operation is a multiple step procedure that requires a login. The details of the procedure is described in Appendix B,“*Web API*” (page 83).

**Note**

It is also possible to select reference object in Edit mode using the command channel, see Section A.1, “*Command Syntax*” (page 67).

### 3.3.5 Backup and Restore Configuration

It is possible to backup and restore the device configuration through the Web API. This is the same functionality also available through the standard web pages of the Web Server interface.

The backup data contains the device name and reference objects including corresponding inspection and interface settings. Examples of data not included in the backup are IP address and chessboard calibration settings.

**Note**

The backup and restore functionality of the Web Server and the Web API corresponds to the **Save Device File** functionality of **SOPAS Single Device**. The file format created by the Web API is not compatible with the ".sdv" file format.

**Backup Configuration**

The URL to export a configuration is `http://<IP-address>/backup_config?config1`

**Example URL:**

```
http://192.168.1.110/backup_config?config1
```

The result of the request is a buffer containing the device configuration. This file can be stored in the file system of the receiving unit and used later in the restore procedure.

The Web Server standard web pages requires a login to perform a backup. A login is not required when doing a backup through the Web API.

**Restore Configuration**

The restore operation takes a device configuration created with the backup functionality and replaces the current configuration with the configuration in the backup file.

The operation is a multiple step procedure that requires a login. The details of the procedure is described in Appendix B,“*Web API*” (page 83).

The operation may take several minutes and the Inspector PI50 is automatically restarted after the configuration has been transferred to the Inspector PI50.

**Note**

During the restore operation the device is set in a special restore mode only expecting restore operation requests. Operations and requests via other interfaces like field buses, SOPAS Single Device, Inspector Viewer or Web browsers (other than) shall then be avoided since they may interfere with the restore operation.


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

## 3.4 Handle the Web API

The Web Server and Web API interfaces can be activated or deactivated. When activated, it is possible to select port number and to allow command channel changes. The same settings apply both to the Web Server and to the Web API. The Web interfaces are configured in the **Interfaces and I/O settings** dialog in the **InspectorPI50** menu.

The Web API is based on standard HTTP request and responses. Recommended request timeout time is 3 seconds to allow for images to be transferred properly.


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

# 4 Ethernet Raw

## 4.1 Introduction

To set up the connection and output results for Inspector PI50 using Ethernet Raw see Operating Instructions for Inspector PI50.

### 4.1.1 Port Interval

The default interval for the ports used by the communication channels is 2114-2116. This interval can be changed, e.g. if the controlling device does not support the default interval. The interval is controlled by the field **Start port** in the **Ethernet Raw** tab of the **Interface and I/O settings** dialog.

The ports are assigned according to the following:

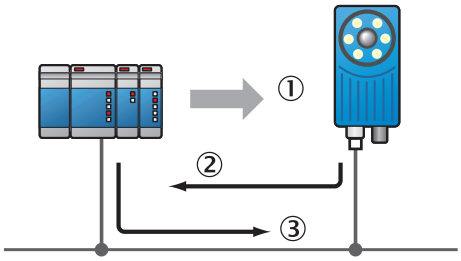
- Ethernet Result Output = start port (default 2114)
- Command channel = start port + 1
- Dedicated image trig = start port + 2

## 4.2 Get Results via Ethernet Raw

The following settings are done in the **Ethernet Result Output** dialog under **Inspector PI50** menu.

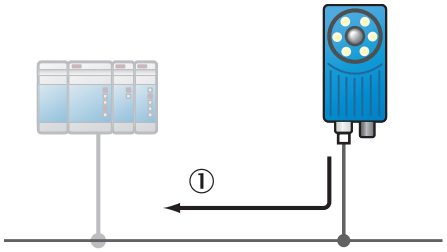
### 4.2.1 TCP versus UDP

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




***TCP:***

① PC/PLC initiates the connection
② Inspector PI50 sends results to the PC/PLC
③ PC/PLC acknowledges that results are received (built into the TCP protocol)




***UDP:***

① Inspector PI50 sends results to the specified IP address and port, without knowing if it has been received

**Note**

For TCP the default port number that the Inspector PI50 listens to is 2114.

### 4.2.2 ASCII versus Binary

The Inspector PI50 supports the possibility to choose whether the configured output is to 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 PI50. In binary mode all added text and text formatting, for example <SPACE/>, are ignored. Only the


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

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 Section 7.2, “*XML Formatting*” (page 59).

### 4.2.3 Attributes

Attributes are used to control the formatting and identification of inspections. Some of them can be controlled directly in the **Ethernet Result Output** dialog in the section **Message settings**. All available attributes are listed in the table in section XML Formatting in Section 7.2, “*XML Formatting*” (page 59).

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` |

Pixels/Millimeters — Choose if position coordinates should be sent in pixel or millimeter unit. **Note**: The device must be calibrated for it to be possible to use the “mm” attribute. An error message is given in the output string if the device is not calibrated and mm is chosen.

### 4.2.4 Default Formatting Strings

The auto-generated default string will look different depending on the configuration in the selected reference object. The intention with the default string is to give an idea of the available tags and to be a good starting point for creating the best format for the application that should be solved.

Below follow some short descriptions of default strings, or part of default strings, for different configurations. For more information about the XML formatting see Chapter 7, “*Result Output Formatting*” (page 59).


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

**Default string for configuration with only an Object locator**

```
<MESSAGE_SIZE/><NEWLINE/> ①
Image_number:<SPACE/><IMAGE_NUMBER/><NEWLINE/>  ②
Object_locator.<NEWLINE/> ③
<OBJECT_LOC> ④
Located:<SPACE/><DECISION/><NEWLINE/> ⑤
Score:<SPACE/><SCORE/><NEWLINE/> ⑥
Scale:<SPACE/><SCALE/><NEWLINE/> ⑦
Position_(X,Y):<SPACE/>(<X/>,<Y/>)<NEWLINE/> ⑧
Rotation:<SPACE/><ROTATION/><NEWLINE/>  ⑨
</OBJECT_LOC>  ⑩
```

① Size of the message, number of characters (ASCII) or bytes (binary)
② Explanatory text and analyzed images number
③ Explanatory text
④ Start of container for object locator
⑤ Explanatory text and value for locator decision; 0=not found, 1=found
⑥ Explanatory text and locator score value, in percent how well of the object is found in the object locator due to match settings
⑦ Explanatory text and locator scale value, factor of analyzed live image compared to taught reference object
⑧ Explanatory text and x and y position of the reference point. This can be outside the image and therefore negative. Shown in "pixels" or "mm"
⑨ Explanatory text and locator rotation, in degrees or radians depending on the configured value in the **Ethernet Result Output** settings dialog
⑩ End of container for object locator

**Result of validating output string with only an Object locator**

The result of validating the default formatting output string with output format ASCII will be as follows:

```
97
Image_number: 14471
Object_locator.
Located: 1
Score: 96.00
Scale: 1.00
Position_(X,Y): (291.52,238.55)
Rotation: 0.22
```

The result of validating the default formatting output string for only an object locator with output format binary will be as follows:

```
Binary output OK. Number of bytes: 27
```

**Part of default string for configuration with a Blob**

```
Blob_tool.<NEWLINE/>  ①
<BLOB index="0" name="Blob 1"> ②
Found_blobs:<SPACE/><FOUND_BLOBS/><NEWLINE/>  ③
------------------------<NEWLINE/>  ④
Blob_information:<NEWLINE/>  ⑤
Position_(X,Y):<SPACE/>(<X/>,<SPACE/><Y/>)<NEWLINE/>  ⑥
```


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

```
Area:<SPACE/><AREA/><NEWLINE/>  ⑦
Angle:<SPACE/><ANGLE/><NEWLINE/>  ⑧
Structure:<SPACE/><EDGE_PIXELS/><NEWLINE/>  ⑨
Touches_ROI_border:<SPACE/><EDGE_FLAG/><NEWLINE/>  ⑩
</BLOB>  ⑪
```

① Explanatory text
② Start of container for the blob tool named "Blob 1" and instruction to fetch the first (index="0") blob in accordance with the **Sort by** criteria
③ Explanatory text and number of found blobs in analyzed image
④ Separator
⑤ Explanatory text
⑥ Explanatory text and information of blob with index="0" concerning position and center of gravity (x and y position), in "pixels" or "mm"
⑦ Explanatory text and blob (index="0") area, in "pixels"
⑧ Explanatory text and blob (index="0") angle value, in degrees or radians depending on the configured value in the **Ethernet Result Output** settings dialog
⑨ Explanatory text and blob (index="0") structure value, number of edge pixels inside the blob
⑩ Explanatory text and blob (index="0") edge value, 0=blob fully within ROI, 1= blob touches ROI border
⑪ End of container for blob tool

**Result of validating output string with a Blob**

The result of validating the default formatting output string with output format ASCII will be as follows:

```
Blob_tool.
Found_blobs: 16
-------------------------
Blob_information:
Position_(X,Y): (177.00, 156.89)
Area: 75
Angle: 154.33
Structure: 0
Touches_ROI_border: 0
```

The result of validating the default formatting output string for a blob with output format binary will be as follows:

```
Binary output OK. Number of bytes: 28
```

**Part of default string for configuration with a Polygon**

```
Polygon1<POLYGON name="Polygon1"><NEWLINE/>  ①
Corners:<SPACE/><NUM_CORNERS/><NEWLINE/>  ②
<CORNERS corners="all">(X,Y):<SPACE/>(<X/>,<Y/>)<NEWLINE/>  ③
</CORNERS>  ④
</POLYGON>  ⑤
```

① Explanatory text and start of polygon container tag for the polygon tool named "Polygon 1"
② Explanatory text and number of polygon corners
③ Start of container tag for polygon corners with instruction to loop over all polygon corners, explanatory text, and corner position
④ End of container for polygon corners


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

⑤ End of container for polygon

**Result of validating output string with a Polygon**

The result of validating the default formatting output string with output format ASCII will be as follows:

```
Polygon_1
Corners: 4
(X,Y): (329.15,235.70)
(X,Y): (371.31,235.60)
(X,Y): (372.58,314.97)
(X,Y): (329.82,315.22)
```

The result of validating the default formatting output string for a polygon with output format binary will be as follows:

```
Binary output OK. Number of bytes: 39
```

## 4.3 Control the Sensor via Ethernet Raw

The command channel makes it possible to read and write a defined set of configuration parameters, and to trigger image acquisition, via UDP or TCP. This section describes how to setup image triggering and command channel settings in **SOPAS Single Device**, as well as the syntax of the command channel.

### 4.3.1 Basic Principles

The command channel has a set of basic principles:

- Only one command at a time can be executed.
- Each command is followed by a return message (ACK) that includes result of the command as well as error codes.
- The commands are not unique to a specific task, it is the commands together with their parameters that uniquely point to a specific configuration change (see list of command types and parameters in Appendix A,“*Command Channel*” (page 67)).
- Writing a parameter can typically only be done when the device is in Edit mode. Reading a parameter can be done in both Edit and Run mode.
- It is possible to block configuration changes by deselecting the setting **Allow changes via Ethernet Raw** in the **Ethernet Raw** tab in the dialog **Interfaces and I/O Settings** in **InspectorPI50** menu.

### 4.3.2 Command Syntax

The command channel has the following syntax:

```
<command> <identifier> <arg1> <arg2> ... <argN>
```

The ACK message has the following syntax:

```
<ACK Command> <identifier> <errorCode> <returnValue1> <returnValue2> ...
<returnValueN> <errorMessage>
```

The command is sent as an ASCII string. The combination of a command with its parameters will either change the devices configuration or fetch information from the device. For more command examples see Section A.5, “*Command Examples*” (page 79) and Section A.1, “*Command Syntax*” (page 67).

### 4.3.3 Select Reference Object

To enable reference object selection via **Ethernet Raw** do the following:

1. Choose **Interface and I/O Settings** from the **InspectorPI50** menu.
2. In the tab **Interface** choose **Ethernet** and **Ethernet Raw** in the listbox.


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

To select reference object via command channel change to **Edit** mode, `sMOD 1`, change the value to select the reference object, `sINT 1 <object index>` and then change back to **Run** mode `sMOD 0`. The object index that corresponds to each reference object can be found in the **Reference object** list in the **Main view**.

### 4.3.4 Image Trig

It is possible to trigger the image acquisition via Ethernet. The communication runs on UDP or TCP port 2116 (configurable). In order to use this function the triggering has to be enabled in **SOPAS Single Device**. In the **InspectorPI50** menu and **Interfaces and I/O settings** dialog check the **Ethernet** box and in the list **Ethernet Raw** in the **Interfaces** tab. For the selected reference object, choose **Triggered by Ethernet** in the **Image settings** tab.

### 4.3.5 Single Port Solution

In real-time applications, the sensor is controlled using three ports. However, it is possible to use only the command port (default 2115) to control the sensor. The single port solution is only recommended for applications where the cycle time is significantly larger than the image analysis time. One reason for this is that the image acquisition has a lower priority on the command port. Another reason is that the Ethernet Result string must be retrieved from the sensor, i.e. image trig and result handling cannot be performed in parallel when using the single port solution.

This is how the sensor is controlled by using only the command port:

- The image acquisition is performed by the TRIG command (with lower priority).
- The Ethernet Result Output string is retrieved explicitly by the controlling device, e.g. a PLC. This is done by the command gRES. The sensor does not send the result automatically on this port.
- All other commands on the command channel are available as in the standard three port solution


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

# 5 EtherNet/IP

## 5.1 Introduction

The Inspector PI50 can be controlled and results can be read out using the EtherNet/IP™ standard, see http://www.odva.org/. To be able to do this some settings have to be done first.

EtherNet/IP™ conformance tested

To set up the connection and output results for Inspector PI50 using Ethernet/IP see Operating Instructions for Inspector PI50.

## 5.2 Get Results via Ethernet/IP

The following settings are done in the **Ethernet Result Output** dialog in the **Inspector PI50** menu.

### 5.2.1 Attributes

Attributes are used to control the formatting and identification of inspections. Some of them can be controlled directly in the **Ethernet Result Output** dialog in the section **Message settings**. All available attributes are listed in the table in section XML Formatting in Section 7.2, "*XML Formatting*" (page 59).

| | |
|---|---|
| Degrees/Radians | Choose unit for the rotation for object locator and angle for blobs. |
| Pixels/Millimeters | Choose if position coordinates should be sent in pixel or millimeter unit. **Note**: The device must be calibrated for it to be possible to use the "mm" attribute. An error message is given in the output string if the device is not calibrated and mm is chosen. |

### 5.2.2 Example Formatting Strings

The auto-generated example string will look different depending on the configuration in the selected reference object. The intention with the default string is to give an idea of the available tags and to be a good starting point for creating the best format for the application that should be solved.

Below follow some short descriptions of example strings, or part of default strings, for different configurations. For more information about the XML formatting see Chapter 7, "*Result Output Formatting*" (page 59).

**Example string for configuration with only an Object locator**

```
<IMAGE_NUMBER dataType="DINT" pos="0"/> ①
<OBJECT_LOC> ②
<DECISION dataType="SINT" pos="0"/> ③
<SCORE dataType="REAL" pos="0"/> ④
<SCALE dataType="REAL" pos="1"/> ⑤
<X dataType="REAL" pos="2"/> ⑥
<Y dataType="REAL" pos="3"/> ⑦
<ROTATION dataType="REAL" pos="4"/> ⑧
</OBJECT_LOC> ⑨
```

① Analyzed image's number
② Start of container for object locator
③ Decision show if object is found (=1) or not found (=0)


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

④ Score shown in percent how well of the object is found in the object locator due to match setting
⑤ Scale is the factor of analyzed live image compared to taught reference object
⑥ Position (x) of the reference point of the object locator
⑦ Position (y) of the reference point of the object locator
⑧ Rotation of the object locator, in degrees or radians depending on the configured value in the **Ethernet Result Output** dialog
⑨ End of container for object locator

Attribute dataType — Casts to the specified datatype. When using EtherNet/IP the attribute dataType specifies the dataType section in the selected assembly. The attribute dataType can be SINT, INT, DINT or REAL. For more details about dataType and pos see table in Section 7.3.2, "*Attributes*" (page 65).

Attribute pos — Used by EtherNet/IP to determine a position in the dataType section in the selected assembly. The first position number of the dataType section is 0. The range of the attribute pos depends on which assembly is used. For example if assembly 1 and dataType section SINT is selected the range of position is 8, i.e. [0, 7]. For more details about dataType and pos see table in Section 7.3.2, "*Attributes*" (page 65).

Therefore the value of the attributes dataType and pos together specifies which parameter in the assembly the result value should be mapped to.

**Result of validating output string with only an Object locator**

The validating in **SOPAS Single Device** will give the following result:

```
EtherNet/IP assembly string OK.
```

**Result in PLC with only an Object Locator**

The table below describes how the Assembly 1's data structure will be populated when using the configuration example above.

| Position ref (pos) from XML configuration | Data type (dataType) | Offset byte | Variable from example above |
|---|---|---|---|
| 0 | SINT | 0 | DECISION |
| 1 | SINT | 1 | |
| 2 | SINT | 2 | |
| 3 | SINT | 3 | |
| 4 | SINT | 4 | |
| 5 | SINT | 5 | |
| 6 | SINT | 6 | |
| 7 | SINT | 7 | |
| 0 | INT | 8 | |
| 1 | INT | 10 | |
| 2 | INT | 12 | |
| 3 | INT | 14 | |
| 4 | INT | 16 | |
| 5 | INT | 18 | |
| 6 | INT | 20 | |
| 7 | INT | 22 | |


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

| Position ref (pos) from XML configuration | Data type (dataType) | Offset byte | Variable from example above |
|---|---|---|---|
| 0 | DINT | 24 | IMAGE_NUMBER |
| 1 | DINT | 28 | |
| 2 | DINT | 32 | |
| 3 | DINT | 36 | |
| 4 | DINT | 40 | |
| 0 | REAL | 44 | SCORE |
| 1 | REAL | 48 | SCALE |
| 2 | REAL | 52 | X |
| 3 | REAL | 56 | Y |
| 4 | REAL | 60 | ROTATION |

**Example string for configuration with only an Blob**

```
<IMAGE_NUMBER dataType="DINT" pos="0"/> ①
<BLOB index="0" name="Blob 1"> ②
<FOUND_BLOBS dataType="SINT" pos="0"/> ③
<X dataType="REAL" pos="0"/> ④
<Y dataType="REAL" pos="1"/> ⑤
<AREA dataType="DINT" pos="1"/> ⑥
<ANGLE dataType="REAL" pos="2"/> ⑦
<EDGE_PIXELS dataType="DINT" pos="2"/> ⑧
<EDGE_FLAG dataType="SINT" pos="1"/> ⑨
</BLOB> ⑩
```

① Analyzed image's number, attributes dataType and pos

② Start of container for blob, Index number of the found blob according to current blob sorting order. Index 0 is the first blob. Name refers to the blob tool's name in the **Tools** tab

③ Number of found blobs

④ Blob center of gravity (x position), "pixels" or "mm"

⑤ Blob center of gravity (y position), "pixels" or "mm"

⑥ Blob area in pixels

⑦ Angle of the blob, in degrees or radians depending on the configured value in the **Ethernet Result Output** dialog

⑧ Structure value (number of edge pixels inside the blob)

⑨ Edge flag: 0= the blob is fully within the ROI, 1=the blob touches ROI border

⑩ End of container for Blob

Attribute dataType — Casts to the specified datatype. When using EtherNet/IP the attribute dataType specifies the dataType section in the selected assembly. The attribute dataType can be SINT, INT, DINT or REAL. For more details about dataType and pos see table in Section 7.3.2, *"Attributes"* (page 65).

Attribute pos — Used by EtherNet/IP to determine a position in the dataType section in the selected assembly. The first position number of the dataType section is 0. The range of the attribute pos depends on which assembly is used. For example if assembly 1 and dataType section SINT is selected the range of position is 8, i.e.


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

[0, 7]. For more details about dataType and pos see table in Section 7.3.2, “*Attributes*” (page 65).

Therefore the value of the attributes dataType and pos together specifies which parameter in the assembly the result value should be mapped to.

**Result of validating output string with only an Blob**

The validating in **SOPAS Single Device** will give the following result:

```
EtherNet/IP assembly string OK.
```

**Result in PLC with only an Blob**

The table below describes how the Assembly 1's data structure will be populated when using the configuration example above.

| Position ref (pos) from XML configuration | Data type (dataType) | Offset byte | Variable from example above |
|---|---|---|---|
| 0 | SINT | 0 | FOUND_BLOBS |
| 1 | SINT | 1 | EDGE_FLAG |
| 2 | SINT | 2 | |
| 3 | SINT | 3 | |
| 4 | SINT | 4 | |
| 5 | SINT | 5 | |
| 6 | SINT | 6 | |
| 7 | SINT | 7 | |
| 0 | INT | 8 | |
| 1 | INT | 10 | |
| 2 | INT | 12 | |
| 3 | INT | 14 | |
| 4 | INT | 16 | |
| 5 | INT | 18 | |
| 6 | INT | 20 | |
| 7 | INT | 22 | |
| 0 | DINT | 24 | IMAGE_NUMBER |
| 1 | DINT | 28 | AREA |
| 2 | DINT | 32 | EDGE_PIXELS |
| 3 | DINT | 36 | |
| 4 | DINT | 40 | |
| 0 | REAL | 44 | X |
| 1 | REAL | 48 | Y |
| 2 | REAL | 52 | ANGLE |
| 3 | REAL | 56 | |
| 4 | REAL | 60 | |

**Part of default string for configuration with only an Polygon**

```
<IMAGE_NUMBER dataType="DINT" pos="0"/> ①
<POLYGON name="Polygon 1"> ②
```


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

```
<NUM_CORNERS dataType="SINT" pos="0"/> ③
<CORNERS corners="0"> ④
<X dataType="INT" pos="1"/> ⑤
<Y dataType="INT" pos="2"/> ⑥
</CORNERS> ⑦
</POLYGON> ⑧
```

① Analyzed image's number, attributes dataType and pos
② Start of container for Polygon, Name refers to the Polygon tool's name in the **Tools** tab
③ Number of corners used for this Polygon tool
④ Number 0 to 15 gives the properties of a single corner. The index of this corner is the order in which the polygon corner was added when the polygon was drawn
⑤ Polygon corner coordinate (x), "pixels" or "mm"
⑥ Polygon corner coordinate (y), "pixels" or "mm"
⑦ End of tag for corners
⑧ End of container for Polygon

| | |
|---|---|
| Attribute dataType | Casts to the specified datatype. When using EtherNet/IP the attribute dataType specifies the dataType section in the selected assembly. The attribute dataType can be SINT, INT, DINT or REAL. For more details about dataType and pos see table in Section 7.3.2, "*Attributes*" (page 65). |
| Attribute pos | Used by EtherNet/IP to determine a position in the dataType section in the selected assembly. The first position number of the dataType section is 0. The range of the attribute pos depends on which assembly is used. For example if assembly 1 and dataType section SINT is selected the range of position is 8, i.e. [0, 7]. For more details about dataType and pos see table in Section 7.3.2, "*Attributes*" (page 65). |

Therefore the value of the attributes dataType and pos together specifies which parameter in the assembly the result value should be mapped to.

**Result of validating output string with only and Polygon**
The validating in **SOPAS Single Device** will give the following result:

```
EtherNet/IP assembly string OK.
```

If the used assembly is too small the validating will give the following result:

```
EtherNet/IP assembly string not OK. Out of slots for data type INT
```

Use a larger assembly to solve this problem . Choose a larger assembly in the dialog **Interfaces and I/O settings** in the **InspectorPI50** menu and the **EtherNet/IP** tab.

**Result in PLC with only an Polygon**
The table below describes how the Assembly 1's data structure will be populated when using the configuration example above.

| Position ref (pos) from XML configuration | Data type (dataType) | Offset byte | Variable from example above |
|---|---|---|---|
| 0 | SINT | 0 | NUM_CORNERS |
| 1 | SINT | 1 | |
| 2 | SINT | 2 | |
| 3 | SINT | 3 | |


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

| Position ref (pos) from XML configuration | Data type (dataType) | Offset byte | Variable from example above |
|---|---|---|---|
| 4 | SINT | 4 | |
| 5 | SINT | 5 | |
| 6 | SINT | 6 | |
| 7 | SINT | 7 | |
| 0 | INT | 8 | X |
| 1 | INT | 10 | Y |
| 2 | INT | 12 | |
| 3 | INT | 14 | |
| 4 | INT | 16 | |
| 5 | INT | 18 | |
| 6 | INT | 20 | |
| 7 | INT | 22 | |
| 0 | DINT | 24 | IMAGE_NUMBER |
| 1 | DINT | 28 | |
| 2 | DINT | 32 | |
| 3 | DINT | 36 | |
| 4 | DINT | 40 | |
| 0 | REAL | 44 | |
| 1 | REAL | 48 | |
| 2 | REAL | 52 | |
| 3 | REAL | 56 | |
| 4 | REAL | 60 | |

## 5.3 Control the Sensor via EtherNet/IP

The Inspector PI50 has the following EtherNet/IP characteristics:

- Device type: Communication adapter
  The Inspector PI50 relies on a Scanner device to set up the communication channel. The IP address of the Inspector PI50 can be found by choosing Device Info from the **InspectorPI50** menu.
- 

| Assemblies | Instance no. | Size (bytes) | Comment | Assembly no. |
|---|---|---|---|---|
| Output | 100 | 4 | Slim command channel | |
| Input | 101 | 36 | Command channel result | |
| Output | 102 | 32 | Command channel | |
| Input | 103 | 64 | Small result channel | 1 |
| Input | 105 | 124 | Medium result channel | 2 |
| Input | 107 | 248 | Large result channel | 3 |
| Input | 109 | 484 | Extra large result channel | 4 |

- Minimum RPI: > 16 ms.
  When retrieving inspection results via EtherNet/IP, the time between two inspections should be at least twice the RPI (Requested Packet Interval) specified for the communication channel.


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

With the shortest possible RPI, the highest recommended inspection rate is therefore approximately 30 Hz.

The EDS file for the Inspector PI50 can be found in the **Documentation** folder on the **Inspector** CD.

The Inspector PI50 has two Output assemblies that can be used for controlling the Inspector PI50. To do this the connection has to be set first, see Operating Instructions for Inspector PI50.

The slim command channel assembly (instance no. 100) is used for controlling the Inspector PI50 in the following ways:

- Select reference object
- Image trig

The command channel assembly (instance no. 102) is also used for controlling the Inspector PI50. With this assembly you have access to all functions in the command channel, see Section A.2, "*Command descriptions*" (page 68).

The two output assemblies are described in detail, see Section 5.3.6, "*Assemblies Command Channel*" (page 33).

### 5.3.1 Basic Principles

The command channel has a set of basic principles:

- In order to be able to change the configuration via Ethernet/IP this must be enabled. This is done In the dialog **Interfaces and I/O Settings** from the **InspectorPI50** menu. Check **Ethernet** and **EtherNet/IP** in the tab **Interfaces**. In the same dialog and tab **EtherNet/IP** check **Allow changes via EtherNet/IP**.
- It is possible to block configuration changes by deselecting the setting **Allow changes via Ethernet/IP** in the **Ethernet/IP** tab in the dialog **Interfaces and I/O Settings** in **InspectorPI50** menu.
- Writing a parameter can typically only be done when the device is in Edit mode. Reading a parameter can be done in both Edit and Run mode.
- The commands is sent with help of output assembly 102 and the result is received with input assembly 101.
- The result for a sent command can be received at the earliest in the next PLC cycle. The PLC program will have to wait for the result of an undefined number of seconds.
- Make sure that the PLC program waits for a response with the same command and ID as the sent command. If the command response never shows up a timeout must be implemented. This is done by sending another command for example gVER.

### 5.3.2 Command Syntax

To send commands through the command channel use the output assembly 102. The command channel has the following syntax:

| <command> | <identifier> | <arg1> | <arg2> | <arg3> | <arg4> | <arg5> | <arg6> |
|---|---|---|---|---|---|---|---|

Replace <command> with the commands id, see Table A.3, "Command ID numbers - for EtherNet/IP and EtherCAT" (page 68).

The result of a command, sent over output assembly 102, can be received through input assembly 101. The syntax for ACK message is:

| <command> | <identifier> | <error code> | <retVal1> | <retVal2> | <retVal3> | <retVal4> | <retVal5> | <retVal6> |
|---|---|---|---|---|---|---|---|---|

The combination of a command with its parameters will either change the devices configuration or fetch information from the device. For more command examples see Section A.1, "*Command Syntax*" (page 67) and Section A.5, "*Command Examples*" (page 79).


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

### 5.3.3 Select Reference Object

There are two ways to select reference object with EtherNet/IP and command channel.

**The first way to select reference object:**

To select the reference object via the slim command channel, change the value of `Select reference object` in the slim command channel assembly (instance no. 100). The object index that corresponds to each reference object can be found in the **Reference object** list in the **Main view**.

If the value in `Select reference object` does not correspond to any reference object, the Inspector PI50 will ignore the attempt to switch reference object.

**The second way to select reference object:**

To select reference object via command channel change to **Edit** mode, `0 0`, change the value to select the reference object, `2 1 <object index>` and then change back to **Run** mode `0 1` in the command channel assembly (instance no. 102). The object index that corresponds to each reference object can be found in the **Reference object** list in the **Main view**.

The time it takes to switch reference object depends on the number of inspections, inspection type, and sizes of the regions in the reference object. Typically it takes in the order of one second to switch reference object. For more information see Operating Instructions for Inspector PI50.

### 5.3.4 Image Trig

To enable triggering via EtherNet/IP, do the following:

1. Choose **Interfaces and I/O Settings** from the **InspectorPI50** menu.
2. In the tab **Interface** choose **Ethernet** and **EtherNet/IP** in the list box.
3. In the **Image settings** tab choose **Trig by EtherNet/IP**.

To trigger an image acquisition via EtherNet/IP, specify that the slim command channel (instance no. 100) is to be used here and set the value of `Trigger` to `1`. The image capture is made immediately, without any delays.

The Inspector PI50 will capture an image each time the value of `Trigger` is changed to `1` (i.e. rising edge). To trigger the next image caption, you must first set the value to `0`.

When triggering via EtherNet/IP, the time between two image captions should be at least 4 times the RPI. This means that the maximum triggering rate via EtherNet/IP is approximately 15 Hz.

### 5.3.5 Input Assemblies, Result Channel

There are four input assemblies, each assembly corresponds to respective assembly in the **EtherNet/IP** tab in the **Interfaces and I/O Settings** dialog. Each assembly has four different dataType sections, SINT, INT, DINT, and REAL. Each dataType section has a different number of positions, the number of positions depends on the assembly and the dataType selected. Example: The dataType SINT in assembly 1 has 8 positions [0, 7] and the dataType REAL in assembly 4 has 44 positions [0, 43]. The contents of the assembly are defined from the **Ethernet Result Output** dialog.

**Note**

On the installation CD there is an excel file with templates for the four result input assemblies (file name: AssemblyMappingPI50.xls). These can be used to document the mapping between position in data structure and what is configured in the **Ethernet Result Output** dialog.

**Assembly 1 - Small Result Channel**

Instance ID: 103

Size: 64 bytes


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

*Table 5.1 Input Assembly 1*

| Datatype | Number/ size | Offset (bytes) | Total size |
|---|---|---|---|
| SINT | 8/ 1 byte each | 0 | 8 bytes |
| INT | 8/ 2 bytes each | 8 | 16 bytes |
| DINT | 5/ 4 bytes each | 24 | 20 bytes |
| REAL | 5/ 4 bytes each | 44 | 20 bytes |

**Assembly 2 - Medium Result Channel**

Instance ID: 105

Size: 124 bytes

*Table 5.2 Input Assembly 2*

| Datatype | Number/ size | Offset (bytes) | Total size |
|---|---|---|---|
| SINT | 12/ 1 byte each | 0 | 12 bytes |
| INT | 12/ 2 bytes each | 12 | 24 bytes |
| DINT | 11/ 4 bytes each | 36 | 44 bytes |
| REAL | 11/ 4 bytes each | 80 | 44 bytes |

**Assembly 3 - Large Result Channel**

Instance ID: 107

Size: 248 bytes

*Table 5.3 Input Assembly 3*

| Datatype | Number/ size | Offset (bytes) | Total size |
|---|---|---|---|
| SINT | 24/ 1 byte each | 0 | 24 bytes |
| INT | 24/ 2 bytes each | 24 | 48 bytes |
| DINT | 22/ 4 bytes each | 72 | 88 bytes |
| REAL | 22/ 4 bytes each | 160 | 88 bytes |

**Assembly 4 - Extra Large Result Channel**

Instance ID: 109

Size: 484 bytes

*Table 5.4 Input Assembly 4*

| Datatype | Number/ size | Offset (bytes) | Total size |
|---|---|---|---|
| SINT | 44/ 1 byte each | 0 | 44 bytes |
| INT | 44/ 2 bytes each | 44 | 88 bytes |
| DINT | 44/ 4 bytes each | 132 | 176 bytes |
| REAL | 44/ 4 bytes each | 308 | 176 bytes |

### 5.3.6 Assemblies Command Channel

The Output assembly contains two parameters that are used for selecting reference object and trigger inspections.

The value that corresponds to each reference object can be found in the **Reference object** list in the **Main view**.


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

**Slim Command Channel**

Instance ID: 100

Size: 4 bytes

*Table 5.5 Slim Command channel*

| Data | Type | Offset (bytes) | Values |
|---|---|---|---|
| Select reference object | SINT | 0 | 0-31: Selected reference object |
| Trigger | SINT | 1 | 1: Trigger inspection.<br>Set to 0 before triggering next inspection. |
| Reserved | SINT | 2 | |
| Reserved | SINT | 3 | |

**Command Channel**

Instance ID: 102

Size: 32 bytes

*Table 5.6 102 output, Command channel*

| Data | Type | Offset (bytes) |
|---|---|---|
| Command | DINT | 0 |
| Identifier | DINT | 4 |
| Argument 1 | DINT | 8 |
| Argument 2 | DINT | 12 |
| Argument 3 | DINT | 16 |
| Argument 4 | DINT | 20 |
| Argument 5 | DINT | 24 |
| Argument 6 | DINT | 28 |

**Command Channel Result**

Instance ID: 101

Size: 36 bytes

**Note**

If a Class 1 connection has been made to the device it is recommended to use the gVer command as a Noop (no operation) command.

*Table 5.7 101 input Command channel result*

| Data | Type | Offset (bytes) |
|---|---|---|
| Command | DINT | 0 |
| Identifier | DINT | 4 |
| Error code | DINT | 8 |
| Returnvalue 1 | DINT | 12 |
| Returnvalue 2 | DINT | 16 |
| Returnvalue 3 | DINT | 20 |
| Returnvalue 4 | DINT | 24 |
| Returnvalue 5 | DINT | 28 |


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

| Data | Type | Offset (bytes) |
|---|---|---|
| Returnvalue 6 | DINT | 32 |


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

# 6 EtherCAT

## 6.1 Introduction

The Inspector PI50 ECAT can be operated as an EtherCAT® [a]slave device in an EtherCAT network. This means that the Inspector PI50 can be controlled and results can be read out in an EtherCAT network. For more general information about EtherCAT see http://www.ethercat.org/.

[a]EtherCAT® is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

The EtherCAT interface for the Inspector PI50 ECAT is always enabled and the specific settings for EtherCAT can be done in **SOPAS Single Device**, see Operating Instructions for Inspector PI50.

The Inspector PI50 ECAT has been verified in an EtherCAT network using the TwinCAT® 2.x Master from Beckhoff, see http://www.beckhoff.com. All examples in this manual uses TwinCAT as Master.

## 6.2 EtherCAT Function Overview

The Inspector PI50 ECAT interfaces an EtherCAT network in the following way:

*Table 6.1 EtherCAT function overview*

| Inspector PI50 ECAT feature | EtherCAT mapping |
|---|---|
| Inspection result | Process data, see section Section 6.4, “*Get Results via EtherCAT*” (page 38) |
| Illumination trig | Process data, see section Section 6.4.4, “*Illumination trig output*” (page 41) |
| Inspection trig | Process data, see section Section 6.5.1, “*Triggering of the Inspector*” (page 44) |
| Command channel | CoE (Command over EtherCAT), see section Section 6.5.2, “*Using the CoE command channel*” (page 45) |
| Web server/Web API | EoE (Ethernet over EtherCAT), see section Section 6.6, “*EoE - Web server/Web API*” (page 48) |
| Configuration handling (upload/download) | FoE (File access over EtherCAT), see section Section 6.7, “*FoE - Configuration Handling and Firmware Download*” (page 49) |
| Firmware handling (download) | FoE (File access over EtherCAT), see section Section 6.7, “*FoE - Configuration Handling and Firmware Download*” (page 49) |

How the different Inspector PI50 ECAT features are used in an EtherCAT network are described in following sections.


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

## 6.3 EtherCAT communication

### 6.3.1 EtherCAT Communication Specification

*Table 6.2 EtherCAT Communication Specification*

| Feature | Specification |
|---|---|
| Communication protocol | EtherCAT protocol (ETG.1000) |
| Modulation method | Baseband |
| Transmission speed | 100Mbps |
| Physical layer | 100BASE-TX (IEEE802.3) |
| Connector | Two M12. X1 EtherCAT in. X2 EtherCAT out. |
| Communication medium | CAT5 or higher |
| Communication distance | Distance between nodes (slaves): 100m or less |

### 6.3.2 EtherCAT LED:s

Figure 6.1, “EtherCAT LED on the Inspector PI50 ECAT” (page 37) shows the EtherCAT LED on the Inspector PI50 ECAT.

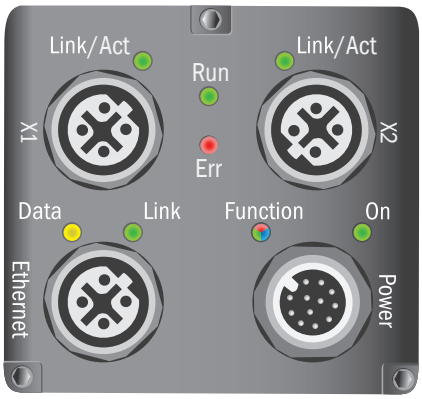



*Figure 6.1 EtherCAT LED on the Inspector PI50 ECAT*

*Table 6.3 EtherCAT Run indicator LED*

| Color | Status | Details |
|---|---|---|
| Green | Off | Device in INIT mode |
| | Blinking | Device in PRE-OPERATIONAL mode |
| | Single flash | Device in SAFE-OPERATIONAL mode |
| | On | Device in OPERATIONAL mode |

*Table 6.4 EtherCAT Err indicator LED*

| Color | Status | Details |
|---|---|---|
| Red | Off | No error |
| | Blinking | General configuration error |
| | Single flash | Local slave error |
| | Double flash | Application watchdog timeout |
| | On | Critical error |


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

*Table 6.5 EtherCAT Link/Act indicator LED for X1/X2*

| Color | Status | Details |
|---|---|---|
| Green | Off | Physical link layer not established |
| | Flashing | Physical link layer established and data is being sent |
| | On | Physical link layer established |

### 6.3.3 EtherCAT process data toggle indicators

For the EtherCAT process data objects (PDO:s) one toggle indicator is used for data between the Master and the Inspector (Rx Toggle bit for the RxPDO:s) and one toggle indicator for data between the Inspector and the Master (Tx toggle bit for the TxPDO:s). The Rx Toggle indicator is implemented as one single bit (toggle bit) and will toggle each time any of the RxPDO:s have been updated, and the Tx Toggle indicator is implemented as three bits and will toggle each time any of the TxPDO:s have been updated. See Section Section 6.10, "*PDO Overview*" (page 54) for a summary of PDO:s.

The purpose of the toggle indicators is to indicate that data have been updated and that it should be read by the Master or the Inspector respectively.

### 6.3.4 EtherCAT cycle time

The following two conditions have to be fulfilled related to the selected EtherCAT cycle time:

1. Minimum EtherCAT cycle time is 0.5ms. Verified using a single Inspector PI50 in an EtherCAT network running a typical inspection at an inspection cycle of 5Hz and using a process data size of 64bytes.
2. Assure that the EtherCAT cycle time is maximally one fourth of the Inspection cycle time. For example, running a fast inspection with an Inspection cycle time of 20ms (50Hz), results in a maximal EtherCAT cycle time of 20/4 = 5ms.

The EtherCAT cycle time is set by the EtherCAT Master.

## 6.4 Get Results via EtherCAT

The Inspector PI50 ECAT generates an inspection result every inspection cycle. The Inspection cycle time can be calculated from the **Frame rate** (Hz) found under the **Live image** in the **SOPAS GUI**. In an EtherCAT network the Inspection result is mapped to EtherCAT process data (PD) using a number of TxPDO:s (Tx Process Data Objects). Two types of result PDO:s exist, *mandatory* PDO:s and *optional* PDO:s.

### 6.4.1 Mandatory TxPDO:s

Five mandatory TxPDO:s are always used in the Inspector PI50 ECAT. This means that the inspection result sent to the Master in these PDO:s are always there, i.e. they cannot be deselected. The TxPDO:s used are *Status*, *Mode*, *Time Stamp*, *Early Time Stamp*, and *Image Number*. See section Section 6.10, "*PDO Overview*" (page 54) for a summary of TxPDO:s.

### 6.4.2 Optional TxPDO:s

By using the **Ethernet Result Output** dialog under **InspectorPI50ECAT** menu in **SOPAS Single Device** the user can select a set of inspection results that are output in each inspection cycle. An XML formatting string defines what inspection results to output in each inspection cycle. To output this user selectable inspection result in the EtherCAT network it is mapped to optional TxPDO:s. Depending on the total size of the inspection result selected by the XML formatting string, the EtherCAT user has to select the appropriate set of optional TxPDO:s to match the required size. That is, the size of the selected optional TxPDO:s has to be at least the size of the selected inspection result output.

There exist six different sized optional TxPDO:s that the user can select from, sizes are 16bytes, 32bytes, 64bytes, 128bytes, 256bytes, and 512bytes. Any combination of these differently sized optional TxPDO:s can be selected, but only one of the same size. This means


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

that the maximal size of the inspection result output selected by the XML formatting string is 16+32+64+128+256+512 = 1008bytes. That is, it is possible to select any total size between 0 and 1008bytes in step of 16bytes. Note that the selection of optional TxPDO:s are done from the EtherCAT Master side.

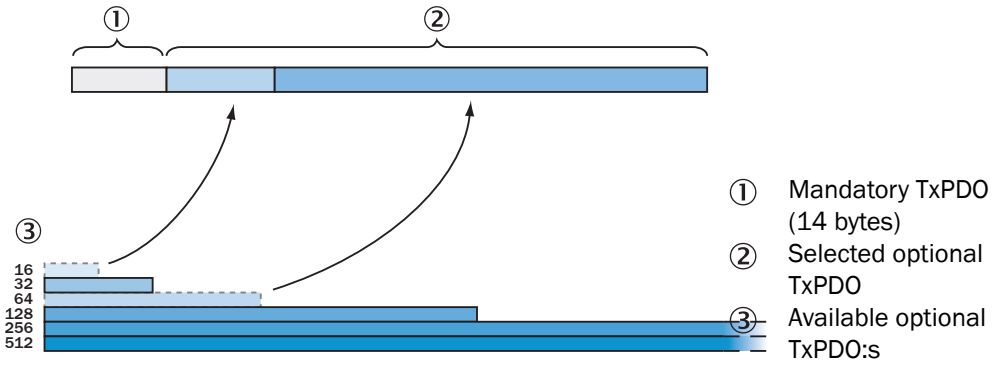
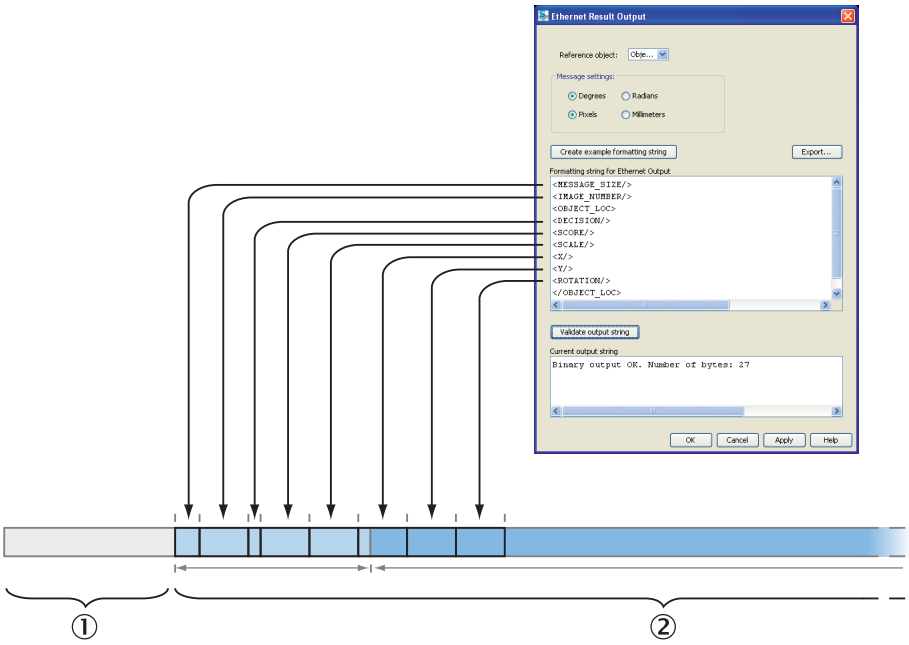



*Figure 6.2 Selecting optional TxPDO:s for the result*

The order the inspection results appear in the XML formatting string is also the order that they will appear in the selected set of optional TxPDO:s. The size in bytes of the selected inspection result can be found in Section 7.3, "*Container Specific Tags*" (page 60). To ease for the PLC programmer a function block generator is available that makes the mapping between the XML formatting string and variables in a PLC program, see Section Section 6.11, "*ESI file*" (page 57).

Figure 6.3, "Mapping results into the optional TxPDO" (page 39) shows an example how the XML formatting string maps data into a selected set of optional TxPDO:s along with the mandatory TxPDO:s.




① Mandatory TxPDO (14 bytes)
② Optional TxPDO (size set by EtherCAT master)

*Figure 6.3 Mapping results into the optional TxPDO*

See Section Section 6.10, "*PDO Overview*" (page 54) for a summary of TxPDO:s.


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

### 6.4.3 Results via EtherCAT - Work flow

Typically the following steps are done in order to map the XML formatting string specified inspection results to EtherCAT optional TxPDO:s.

**Configure your inspection**

Start with configuring your inspection, see Part 2, "How To" in the Operating Instructions.

**Select inspection results to output**

Open the dialog **Ethernet Result Output** under the **InspectorPI50ECAT** menu.

The active reference object is selected by default in the **Reference object** entry.

The **Message settings** represents the default units that will be used for inspection results.

| | |
|---|---|
| Degrees/Radians | Choose unit for the rotation for object locator and angle for blobs. |
| Pixels/Millimeters | Choose if position coordinates should be sent in pixel or millimeter unit. **Note**: The device must be calibrated for it to be possible to use the “mm” attribute. An error message is given in the output string if the device is not calibrated and mm is chosen. |

Note that the units can be individually changed for specific inspection results by the use of attributes to the result tag:s. All available attributes are listed in the table in section Section 7.2, “*XML Formatting*” (page 59).

Enter the result output formatting string in the **Formatting string for Ethernet Output** window or click the **Create example formatting string** button to create an example formatting string. Edit the string to adjust it if necessary.

**Validate and find the size of the XML output string**

In the **Ethernet Result Output** dialog click the **Validate output string** button. A text will now appear in the **Current output string** window that will indicate any syntax errors in the XML formatting string.

The text will also display the required size in bytes for the inspection result defined by the XML-string. That is, this is the size that the optional TxPDO:s have to match.

Below are three examples of validated output string in **SOPAS Single Device** when...

- The Master has selected a total size for the optional TxPDO:s that is too small. Optional TxPDO size is in this example 16bytes and the required size form the XML formatting string is 57bytes.

  ```
  Error: Result string too long. Max size: 16 Size: 57
  ```

- The Master has not any selected optional TxPDO:s

  ```
  Error: No PD containers selected from Master, formatting string
  cannot be used. Required size: 57 bytes
  ```

- The Master has not yet reported an optional TxPDO sizes yet (e.g. Master not on-line).

  ```
  Warning: Master has not reported PD size yet, cannot validate
  formatting string size.
  ```

  Note that the Master need to set the Inspector into OPERATIONAL mode in order for the optional TxPDO-size to be transferred to the Inspector.

**Select the correct TxPDO size on the EtherCAT Master**

Based on the reported size for the inspection result select a combination of optional TxPDO:s on the Master side that is at least equal to this size.

Example of validated output string in **SOPAS Single Device** when the TxPDO:s size is big enough to fit the XML formatting string selected inspection results.

```
EtherCAT binary output OK. Max size: 80 Size: 57
```


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

In the above example the 16byte and the 64byte optional TxPDO:s have been selected by the Master (totally 80bytes), and this is enough to fit the required 57bytes. Note that it also would have been sufficient to select only the 64byte optional TxPDO.

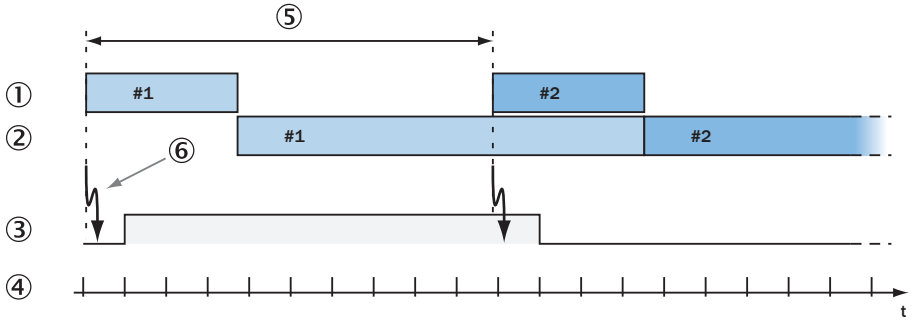
Note that the maximal size of XML formatting string inspection output is 1008bytes. If this limit is exceeded the following is displayed.

```
Error: Formatting string specifies more data than supported by the
Inspector (1008 bytes). Required size: 1024 bytes
```

### 6.4.4 Illumination trig output

The mandatory TxPDO *Status* (see Section Section 6.10, "*PDO Overview*" (page 54)) contains one bit for Illumination trig. This bit is typically used for triggering external illumination sources controlled by the EtherCAT Master when the Inspector is not triggered by the Master.

The Illumination trig bit is a toggle bit where every toggle of the bit indicates a time point from where there is a defined time left until the exposure of the next image will start. This is outlined in Figure 6.4, "Illumination trig" (page 41).




① Exposure
② Analysis
③ Illumination trig bit
④ EtherCAT cycles
⑤ Inspector's inspection cycle time
⑥ Illumination trig for the next exposure

*Figure 6.4 Illumination trig*

As seen in Figure 6.4, "Illumination trig" (page 41) the Inspector will trigger an EtherCAT Illumination trig that is valid for the next image at the same time as the current image starts its exposure. Note that since the EtherCAT cycle is not correlated to the inspection cycle the actual toggle of the Illumination trig bit can be delayed one or two EtherCAT cycles (depending on EtherCAT cycle time) before it reaches the Master. This means that when the Inspector initiate to send out the Illumination trig the time left until the exposure starts is the actual Inspector cycle time. In order to turn on the illumination in time before the exposure starts the user should account for the possible EtherCAT cycle delay.

**Note**

It is possible to read out the inspection cycle time via the CoE command channel. See Section A.2, "*Command descriptions*" (page 68).

### 6.4.5 Example Formatting Strings

The auto-generated example string will look different depending on the configuration in the selected reference object. The intention with the example string is to give an idea of the available tags and to be a good starting point for creating the best format for the application that should be solved.

Below follow some short descriptions of example strings for different configurations. For more information about the XML formatting see Chapter 7, "*Result Output Formatting*" (page 59).


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

It is possible to verify the actual size of the output result defined by the XML formatting string. This is done by validating the output string in the **Ethernet Result Output** dialog. Assign the appropriate Inspection Result PDO:s in the EtherCAT Master, see Table 6.9, “PDO overview” (page 55).

**Example string for configuration with only an Object locator**

```
<MESSAGE_SIZE/> ①
<IMAGE_NUMBER/> ②
<OBJECT_LOC> ③
<DECISION/> ④
<SCORE/> ⑤
<SCALE/> ⑥
<X/> ⑦
<Y/> ⑧
<ROTATION/> ⑨
</OBJECT_LOC> ⑩
```

① Size of the message (bytes)
② Analyzed images number
③ Start of container for object locator
④ Value for locator decision; 0=not found, 1=found
⑤ Locator score value, in percent how well of the object is found in the object locator due to match settings
⑥ Locator scale value, factor of analyzed live image compared to taught reference object
⑦ X position of the reference point. This can be outside the image and therefore negative. Shown in "pixels" or "mm"
⑧ Y position of the reference point. This can be outside the image and therefore negative. Shown in "pixels" or "mm"
⑨ Locator rotation, in degrees or radians depending on the configured value in the **Ethernet Result Output** settings dialog
⑩ End of container for object locator

**Result of validating output string with only an Object locator**
Example of validated output string in **SOPAS Single Device**:

```
EtherCAT binary output OK. Max size: 240 Size: 27
```

**Example string for configuration with only an Blob**

```
<MESSAGE_SIZE/> ①
<IMAGE_NUMBER/> ②
<BLOB index="0" name="Blob 1"> ③
<FOUND_BLOBS/> ④
<X/> ⑤
<Y/> ⑥
<AREA/> ⑦
<ANGLE/> ⑧
<EDGE_PIXELS/> ⑨
<EDGE_FLAG/> ⑩
</BLOB> ⑪
```


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

① Size of the message (bytes)
② Analyzed images number
③ Start of container for the blob tool named "Blob 1" and instruction to fetch the first (index="0") blob in accordance with the **Sort by** criteria
④ Number of found blobs in analyzed image
⑤ information of blob with index="0" concerning position and center of gravity (x position), in "pixels" or "mm"
⑥ information of blob with index="0" concerning position and center of gravity (y position), in "pixels" or "mm"
⑦ Blob (index="0") area, in "pixels"
⑧ Blob (index="0") angle value, in degrees or radians depending on the configured value in the **Ethernet Result Output** settings dialog
⑨ Blob (index="0") structure value, number of edge pixels inside the blob
⑩ Blob (index="0") edge value, 0=blob fully within ROI, 1= blob touches ROI border
⑪ End of container for blob tool

**Result of validating output string with only an Blob**
Example of validated output string in **SOPAS Single Device**:

```
EtherCAT binary output OK. Max size: 240 Size: 28
```

**Example string for configuration with only an Polygon**

```
<MESSAGE_SIZE/> ①
<IMAGE_NUMBER/> ②
<POLYGON name="Polygon 1"> ③
<NUM_CORNERS/> ④
<CORNERS corners="0"> ⑤
<X/> ⑥
<Y/> ⑦
</CORNERS> ⑧
<CORNERS corners="1"> ⑨
<X/> ⑩
<Y/> ⑪
</CORNERS> ⑫
<CORNERS corners="2">
<X/>
<Y/>
</CORNERS>
</POLYGON> ⑬
```

① Size of the message (bytes)
② Analyzed images number
③ Start of polygon container tag for the polygon tool named "Polygon 1"
④ Number of corners used for this polygon
⑤ Start of container tag for polygon corners with instruction to loop over all polygon corners
⑥ Corner position, X
⑦ Corner position, Y
⑧ End of container for polygon corners
⑨ Same as 5
⑩ Same as 6


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

⑪ Same as 7
⑫ Same as 8
⑬ End of container for polygon

**Result of validating output string with only an Polygon**
Example of validated output string in **SOPAS Single Device**:

```
EtherCAT binary output OK. Max size: 240 Size: 19
```

## 6.5 Control the Sensor via EtherCAT

The Inspector PI50 ECAT is controlled in an EtherCAT network in two ways.

1. Triggering of the Inspector
   Either in process data (*PD Trig*) or using the Distributed Clock (DC) feature of EtherCAT (*Programmable Trig*).
2. Using the CoE command channel
   The available commands used for the EtherCAT CoE command channel can be found in Appendix A,"*Command Channel*" (page 67).

   To allow changes via the command channel **Allow changes via EtherCAT** has to be checked in the tab **EtherCAT** in the dialog **Interfaces and I/O Settings**. This is enabled by default.

### 6.5.1 Triggering of the Inspector

In the **Image settings** tab under **Triggering** choose **Triggered by EtherCAT.**

An inspection can be triggered in an EtherCAT network in two ways. Either by a trigger bit in the mandatory RxPDO *Control* (PD Trig), see Section Section 6.10, "*PDO Overview*" (page 54)) or by the use of the Distributed Clock feature of EtherCAT (Programmable Trig).

**Note**

Note that the Inspector PI50 ECAT can still be triggered by the use of the digital input *in3* (if enabled).

**PD Trig**
A low-to-high transition on the Inspection Trig bit in the process data (RxPDO Control) will tell the Inspector to start an inspection cycle. Note that the PD Trig has a time resolution that is related to the used EtherCAT cycle. That is, the Trig can only occur at discrete times related to the beginning of each EtherCAT cycle. If better time resolution is required for the Trig the Programmable Trig feature should be used.

**Note**

Note that the Process data Trig (PD Trig) is always enabled.

**Programmable Trig**
With the Programmable Trig feature it is possible for the PLC programmer to set the time for the Trig to occur. The time is set with reference to the EtherCAT Distribute Clock (DC) time. DC mode of operation in the EtherCAT network has to be enabled by the Master.

The PLC programmer sets the time for the Trig to occur in the *StartTime* register, and then sets the *Activate* register. When the Trig has occurred the Activate register has to be set low, and the procedure starts over again. This means that the PLC programmer cannot program a new Trig time until the previously programmed Trig has occurred, i.e. there is no queue handling of Trig times.

**Note**

Note that the Process data Trig (PD Trig) is always enabled. It is not recommended to use the Programmable Trig at the same time as the PD Trig.


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

For more details see Section 6.8.2, “*Programmable Trig*” (page 52).

### 6.5.2 Using the CoE command channel

Basic principles:

- Writing a parameter can typically only be done when the device is in Edit mode. Reading a parameter can be done in both Edit and Run mode.
- A new command can not be sent until the previous command has been completed. It is possible to download and upload files (using FoE) though a command has not been completed.

#### CoE Command Syntax

The command channel uses the protocol CANopen over Ethernet (CoE), and the standard CoE Command Object is used (see ETG.1020, Command Object). The index used for the CoE object in the EtherCAT Master is 0x2000, **callCommandChannel**. The table below shows the used subindices for the Command Object.

*Table 6.6 CoE Command Object - subindex*

| Subindex | Description | Value |
|---|---|---|
| 01 | Command | Byte 0-n: Service Request Data<br>A write access to the command data will execute the command |
| 02 | Status | 1: Last command completed, no errors, reply there<br>3: Last command completed, error, reply there<br>255: Command is executing |
| 03 | Response | Byte 0: See subindex 2<br>Byte 1: Unused<br>2-n: Service Response Data[a] |

[a] See Figure 6.6, “Subindex 3, Response” (page 47)

The syntax for the EtherCAT CoE command channel (Command, Subindex 01) is shown in Figure 6.5, “Subindex 1, Command” (page 46).


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

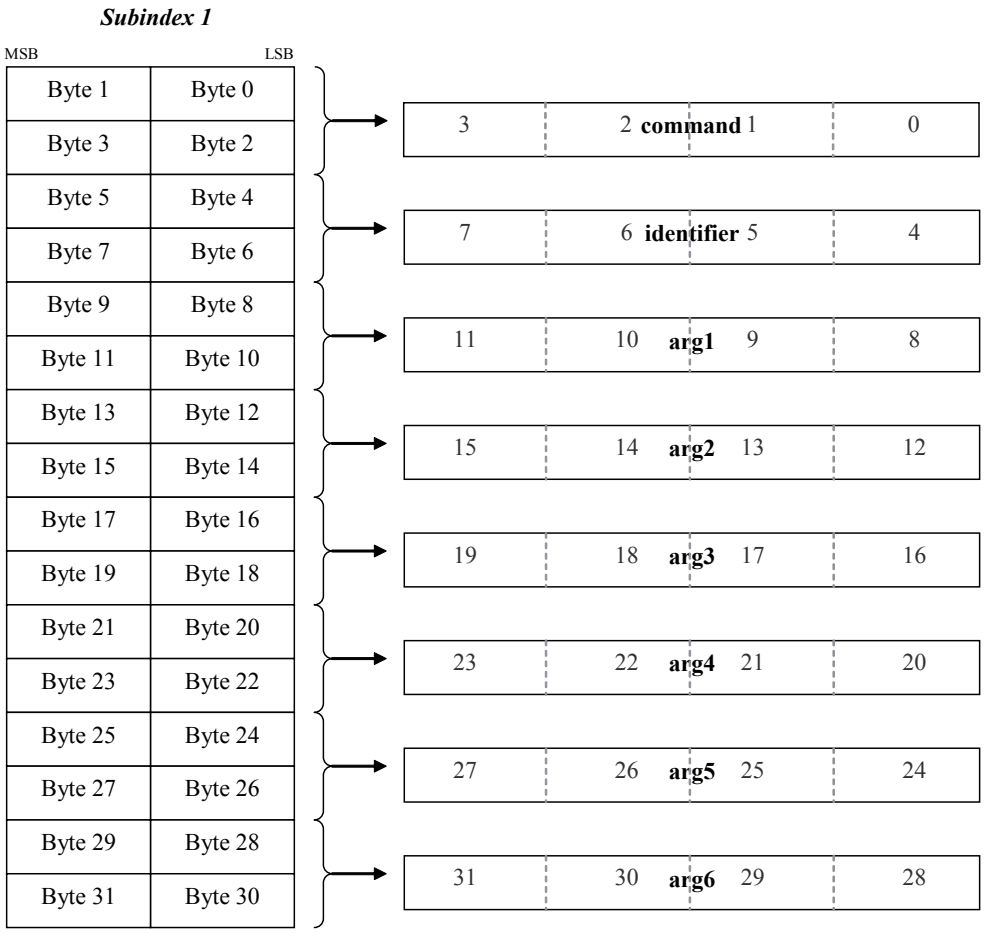



*Figure 6.5 Subindex 1, Command*

- *command*
  Replace *command* with the commands id, see Table A.3, “Command ID numbers - for EtherNet/IP and EtherCAT” (page 68).
- *identifier*
  Replace *identifier* with commands identifier found in Section A.2, “*Command descriptions*” (page 68).
- *arg1-arg6*
  Replace *arg1-arg6* with the argument required for the selected command. Unused arguments will be ignored and is therefore not necessary to set.

### CoE Response syntax

The syntax for the EtherCAT CoE command channel (Response, Subindex 03) is shown in Figure 6.6, “Subindex 3, Response” (page 47).


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

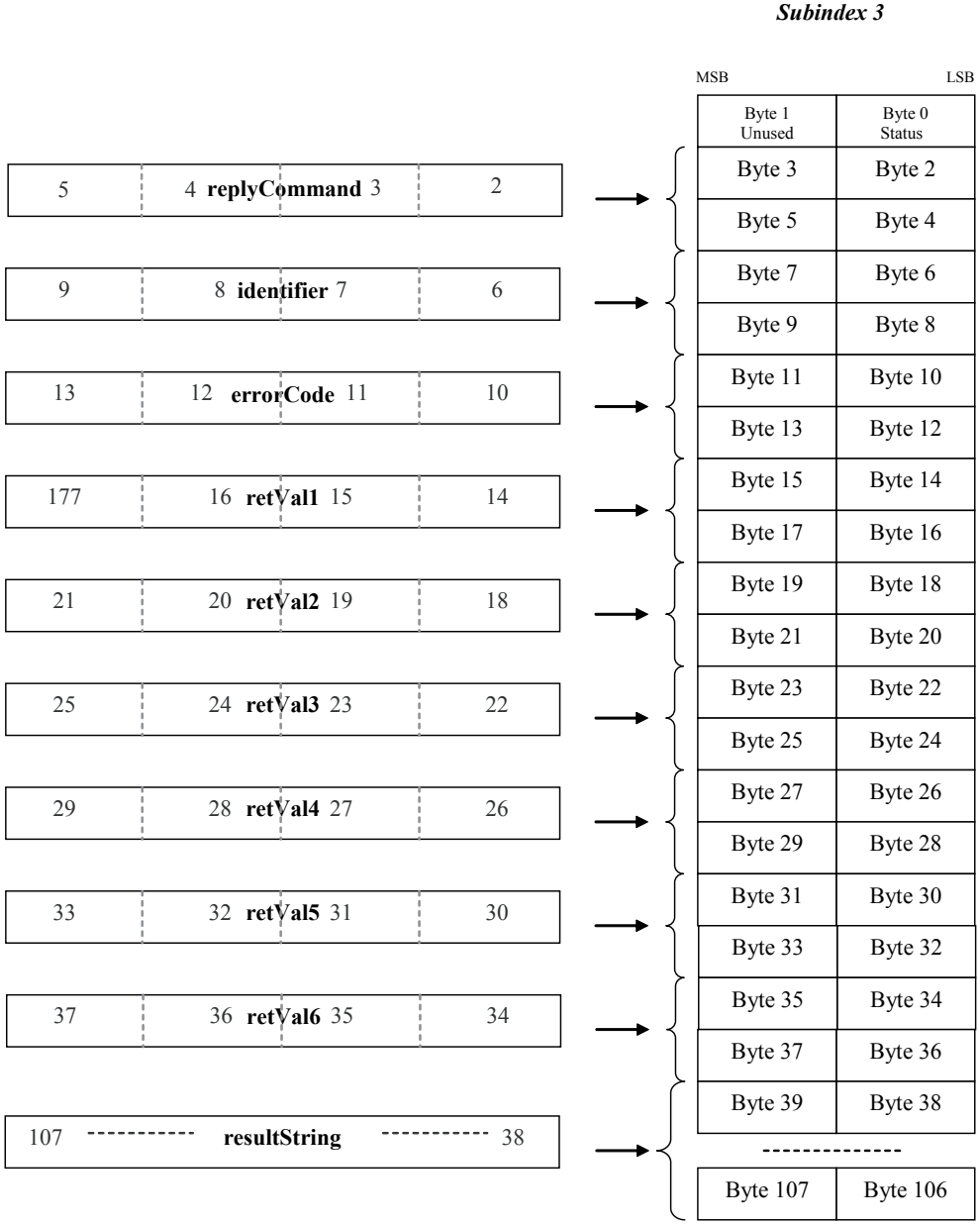



*Figure 6.6 Subindex 3, Response*

Byte 0 in the Response message is the Status byte (see Subindex 2 in Table 6.6, “CoE Command Object - subindex” (page 45)) and can be either 1= OK or 3 = not OK.

- *replyCommand*
  *An echo of the command sent.*
- *identifier*
  *An echo of the identifier sent.*
- *errorCode*
  In case the command ended with an error this is the reported error code, see Section A.3, “*Error Codes*” (page 77).
- *retVal1-retVal6*
  The return value, if such exists for the executed command, see Section A.2, “*Command descriptions*” (page 68).
- *resultString*
  In case the command ended with an error *resultString* is an ASCII description of the error.


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

For command examples see Section A.1, “*Command Syntax*” (page 67) and Section A.5, “*Command Examples*” (page 79).

## 6.6 EoE - Web server/Web API

By enabling the EtherCAT feature EoE, Web server/Web API traffic can be tunneled in the EtherCAT network instead of being routed in the Fast Ethernet interface (*Ethernet* connector). This means that you do not need to use the Fast Ethernet cable if the only usage for this cable is Web server/Web API traffic.

EoE can only be enabled or disabled in the EtherCAT Master and not in **SOPAS Single Device** or with any command in the command channel. The IP address used for EoE tunneling must not be the same as the IP address used for the Fast Ethernet interface. Further the EoE interface and the Fast Ethernet interface cannot be on the same sub-net.

**Note**

In this release the Web server has to run on the same computer as the EtherCAT Master runs, e.g. the PC that TwinCAT runs on. This means that it is not possible to connect a laptop computer to the Master computer and run the Web server on the laptop.

Figure 6.7, “Configuring IP address in TwinCAT System Manager for using EoE” (page 48) show an example of configuring EoE in TwinCAT System Manager.

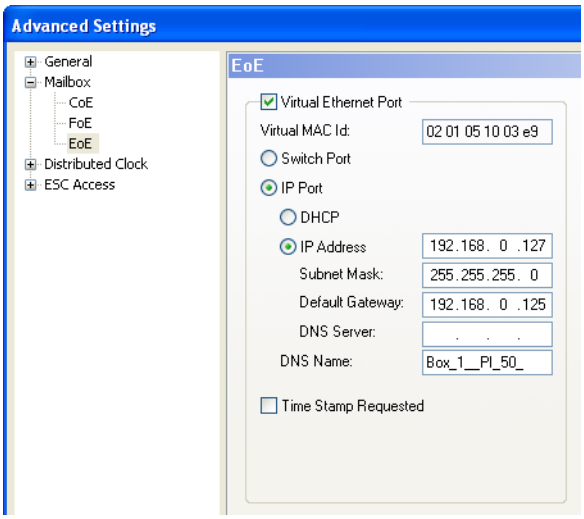



*Figure 6.7 Configuring IP address in TwinCAT System Manager for using EoE*

The IP address entered is the IP address used for the EoE traffic. That is, this is the IP address that the Web server should use to connect to the Inspector over EoE. Note that this is not the same IP address as the Inspector IP address used for the SOPAS connection.

The only Inspector PI50 ECAT traffic that can be tunneled via EoE is the Web server/Web API traffic, i.e. SOPAS Single device and Store images to FTP traffic only works on the Fast Ethernet interface.

**Note**

The fact that EoE has been disabled is not reported by TwinCAT to the Inspector PI50 ECAT. This means that the Inspector PI50 ECAT will still respond on the EoE channel.

**Note**

Depending on EtherCAT network settings and the Inspector configuration used, the Web server live image frame rate can be lower than the default vale of 1fps. If this happens no live image, or a sporadic live image, will be shown. Increase the **Refresh interval** to get a live image that is updated continuously.


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

### 6.6.1 Error Codes - EoE

The table below list error codes that may result from commands or configuration of the device. The error codes are valid for EoE.

*Table 6.7 Error codes valid for EoE*

| Error code propagated to EtherCAT Master | Description |
|---|---|
| 0x0 | No error |
| 0x1 | Error in IP address, could be one of:<br>• Trying to use the same IP address as the one already used for Fast Ethernet<br>• Trying to use a broad cast address as IP address<br>• Trying to use 0.0.0.0<br>• Trying to use the local host address, 127.0.0.1<br>• Trying to use a reserved address; 240.0.0.0/4 |
| 0x1 | Invalid subnet mask |
| 0x1 | Invalid gateway |
| 0x1 | Trying to enable DHCP which is not implemented |
| 0x1 | EtherCAT support in Inspector PI50 ECAT is not initialized. This usually points to a hard ware error |
| 0x1 | EtherCAT module internal error |

**Note**

Due to limitations in the Inspector PI50 ECAT EtherCAT slave controller implementation, all EoE errors reported from the Inspector PI50 ECAT is mapped to an unspecified error (0x1) on the EtherCAT Master side.

## 6.7 FoE - Configuration Handling and Firmware Download

In the EtherCAT Master it is possible to download (to the Inspector) a *device configuration file* or a *firmware file* to the Inspector PI50 ECAT. It is also possible to upload (to the Master) a device configuration file using the FoE mechanism. To be able to do file transfers the Inspector PI50 ECAT has to be set into BOOTSTRAP mode.

**Note**

To be able to go into BOOTSTRAP mode the Inspector has to be in **Edit** mode. Edit mode can be set via the CoE command channel or the SOPAS GUI.

An FoE transfer can take in the range of minutes. As an example a 3.6Mbyte large file takes 90seconds when having an EtherCAT cycle time of 2ms.


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

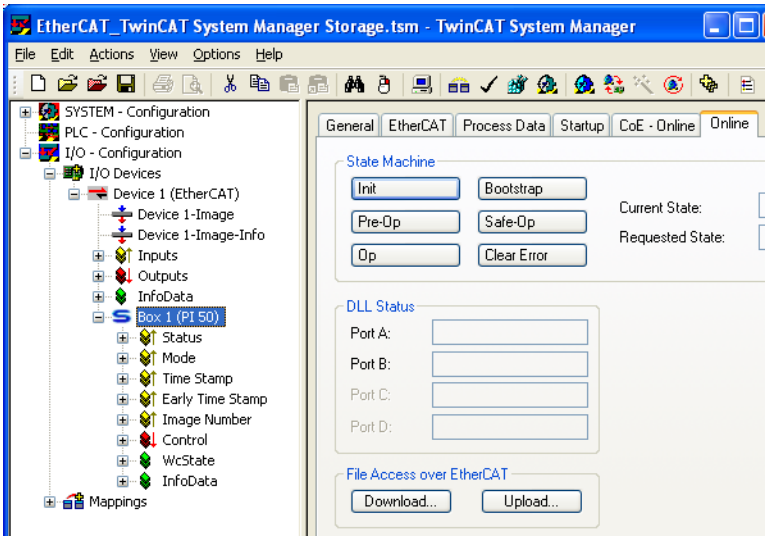



*Figure 6.8 File transfers in TwinCAT System Manager*

### 6.7.1 FoE Download (to Inspector)

To start a FoE download supply the file name and the FoE password (a 32bit integer). Factory default setting for the FoE password is "0". One FoE password is used for all types of FoE transfers. The password can be set via an EtherCAT command, see Table A.5, “Command channel - only for EtherCAT” (page 69). In TwinCAT System Manager an FoE download is started by clicking the **Download...** button in Figure 6.8, “File transfers in TwinCAT System Manager” (page 50). A file selection dialog then appears where the desired file for download is selected. After that a new dialog appears where the FoE-password must also be supplied. Note that TwinCAT has in this dialog stripped the file extension so it has to be entered back by hand.

A file downloaded with the file extension .s0 will be regarded as a firmware download, and all other file extensions will be regarded as a configuration download. If a downloaded configuration file is invalid the device will automatically be re-booted, and the last configuration saved in Flash will be used.

A device configuration file created with the **Backup** command in the Web server/Web API (see Section 3.3.5, “*Backup and Restore Configuration*” (page 17)) can be used for FoE configuration download. Vice versa, an FoE saved configuration file can be used by the Web server/Web API **Restore** command.

**Note**

When downloading a configuration to the Inspector, the Inspector will automatically be restarted after the configuration has been stored in flash. When downloading new FW to the Inspector the FW is stored in flash, but the user himself have to reset the Inspector in order for the new FW to be used.

### 6.7.2 FoE Upload (to Master)

A configuration file can be uploaded to the EtherCAT Master, i.e. saved in the file system of the EtherCAT Master. To start an upload supply the file name to use and the FoE password (same password as for downloads). In TwinCAT System Manager an FoE upload is started by clicking the **Upload...** button in Figure 6.8, “File transfers in TwinCAT System Manager” (page 50). A file selection dialog then appears where the desired file for download is selected. After that a new dialog appears where the FoE password must be supplied. Note that TwinCAT has in this dialog also stripped the file extension but the file will still be named as selected in the initial dialog.


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

### 6.7.3 FoE Error Codes

Below is a list of the used EtherCAT FoE error codes. Note that FoE is only allowed in BOOTSTRAP mode.

*Table 6.8 Error codes valid for FoE*

| Error code propagated to EtherCAT Master | Description |
|---|---|
| 0x00000000 | No error |
| 0x00008000 | When writing the firmware file (Application, FPGA, EtherCAT) to the Inspector PI50 ECAT Flash memory an error occurred |
| 0x00008002 | The password provided for FoE access does not match the password stored for FoE usage |
| 0x00008004 | This error occurs if an FoE transfer is attempted in Run mode or if the FoE file format is wrong. The file format can be wrong due to the following reasons:<br>• Wrong file extension. Use "*.s0" for firmware files (Application, FPGA, EtherCAT)<br>• "*.s0" header indicated wrong firmware file type, i.e. not Application, FPGA, or EtherCAT<br>• Wrong product type code in the "*.s0" firmware file |
| 0x00080008 | Inspector PI50 ECAT is not in BOOTSTRAP mode which is required for the FoE operation |
| 0x0000800B | FoE file checksum error. The checksum of the transferred file could not be validated on the Inspector PI50 ECAT. |

Note! If using TwinCAT the error codes are not propagated to the GUI or PLC level due to the implementation of TwinCAT.

## 6.8 DC - Distributed Clock (DC) features

EtherCAT Distributed Clock (DC) mode has to be enabled in the EtherCAT Master before this feature can be used.

The *Time Stamp* feature and *Programmable Trig* feature utilizes the DC feature of the EtherCAT network.

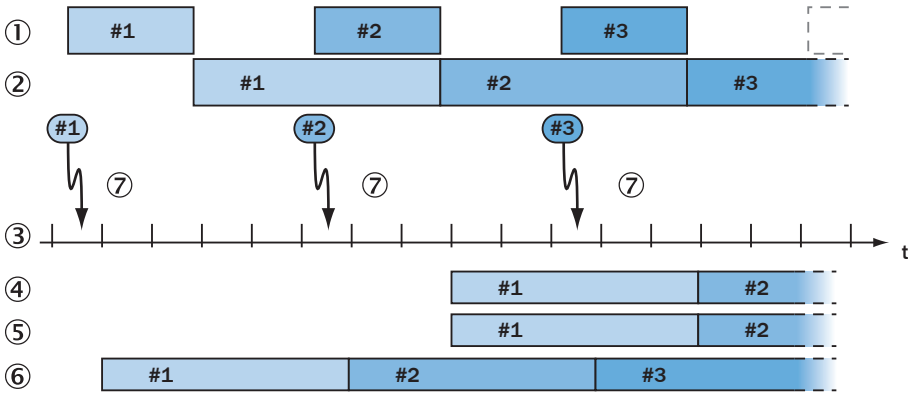
The DC features in an EtherCAT network assures that all slaves supporting DC has a common reference time. One of the DC capable slaves in the EtherCAT network holds the Reference Clock and the other DC capable slaves each holds a Local Clock to which drift and offset compensation are applied in order to align to the common Reference Clock.

Normally the Reference Clock is a 64bit value representing the offset from a Jan 1 2000, where one bit (tick) represents 1ns. A 64bit value will then give a wrap-around time of about 500years. Due to limitations in the EtherCAT Slave Controller in the Inspector this value is instead a 32bit value. Therefore the wrap-around time is about 4.2seconds in the Inspector. This has to be handled by the PLC programmer.

### 6.8.1 Time Stamp

The Time Stamp feature is a way to know at which DC time the image started its exposure. After the exposure of the image the inspection result will be calculated, and finally the inspection result is sent out. The inspection result will be paired with the corresponding 32bit Time Stamp value and sent out in the TxPDO *Time Stamp*. Another TxPDO, *Early Time Stamp*, will send out the time stamp value as fast as possible on the EtherCAT network. Figure 6.9, "Time Stamp and Early Time Stamp" (page 52) shows an example of this.


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice




① Exposure
② Analysis
③ EtherCAT cycles
④ Inspection result TxPDO
⑤ Time stamp TxPDO
⑥ Early time stamp TxPDO
⑦ The Inspector updates the time stamp when starting a new inspection

*Figure 6.9 Time Stamp and Early Time Stamp*

### 6.8.2 Programmable Trig

The Programmable Trig feature is a way for the user to program an EtherCAT Distributed Clock (DC) time when he wants the Inspector to be triggered. In this way the user is not bound to trigger the Inspector upon an EtherCAT cycle basis, i.e. as part of the process data (see PD Trig), instead the trigger time can freely be chosen. The Programmable Trig feature is a *single shot* feature, meaning that you actively have to set the DC time for each trigger event.

From an EtherCAT network perspective the Programmable Trig feature is implemented by using the EtherCAT Distributed Clock single shot SYNC0 event.

#### Enable Programmable Trig

The DC feature used to implement the Programmable Trig feature has to be enabled by the Master. In TwinCAT SystemManager this is done by selecting the Inspector box and in the **DC** tab select the **Operation Mode DC Single Shot event**. Also make sure that the **Distributed Clock** dialog in the **Advanced Settings...** on the **DC** tab has the following settings:

- Operation Mode: **DC Single Shot Event** and **Enable** selected
- SYNC 0: **Enable SYNC 0**
  SYNC 0 - Cycle Time: **User Defined** selected.

Programmable Trig is by default disabled in the Inspector. Programmable Trig is enabled in the **EtherCAT** tab in the **Interfaces and IO settings** dialog in the **Inspector PI50 menu** in SOPAS by checking the box **Enable Programmable Trig**.

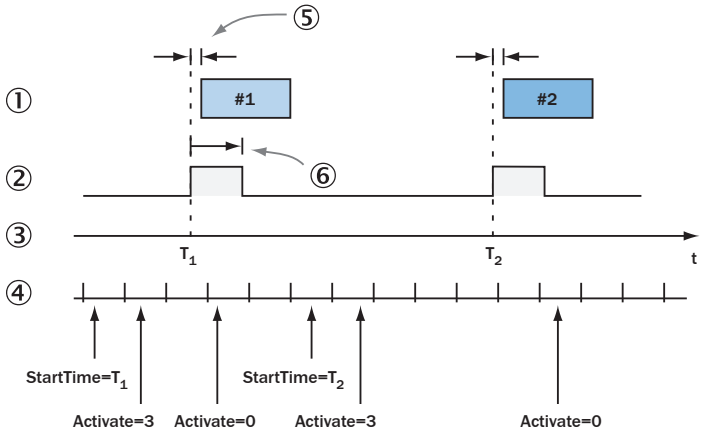
**Note**

The use of the Programmable Trig feature and the Trig bit in the process data are allowed simultaneously. However it is recommended to only use one of the features in a configuration.

#### Using Programmable Trig

The Programmable Trig feature is programmed using the two EtherCat Slave Controller (ESC) registers StartTime (0x990) and Activate (0x981) on the Inspector. The PLC programmer accesses these registers by using the **PDO DC Sync Activate** and **PDO DC Sync Start** PDO:s, see Section 6.10, “*PDO Overview*” (page 54).


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice




① Imager exposure
② Programmable Trig signal
③ DC time
④ EtherCAT cycles
⑤ Delay from Programmable Trig to Imager exposure
⑥ Pulse width of Programmable Trig, fix value of 500 µs

*Figure 6.10 Illumination trig*

Figure 6.10, “Illumination trig” (page 53) shows how the Programmable Trig feature is used. The following procedure can be used:

1. Make sure the Activate register is set to 0x0.
2. Set the time, T1, when you want the Trig to occur in the StartTime register (0x990).
3. In the next EtherCAT cycle, set the Activate register (0x981) to 0x3.
4. When the rising edge of the Trig has occurred set the Activate register to 0x0. Go back to step "2".

Note that when the Programmable Trig occurs (the StartTime equals the Distributed Clock time) there is a delay of approximately 60µs until the exposure of the image starts, indicated as Trig to exposure delay in Figure 6.10, “Illumination trig” (page 53). This delay varies to some extent and the maximum measured delay is 90µs and the minimum delay is 50µs. If SOPAS is connected to the Inspector the delay is increased to approximately 70µs with a maximum delay of 120µs and a minimum delay of 50µs.

**Note**

Note that the DC time of the Inspector is kept in a 32bit register and thus have a wrap-around of approximately 4.2 seconds. This has to be handled in the PLC program.

## 6.9 EtherCAT related constants and variables

### 6.9.1 Station Alias

In an EtherCAT network, slaves are automatically assigned addresses based on their position in the network. But when the device must have a positive identification that is independent of cabling, a Station Alias is needed. For Inspector PI50 ECAT, the Station alias is configured in the EtherCAT Master and stored in the Inspector PI50 ECAT. When the Inspector PI50 ECAT is reset to factory default, the Station Alias will also be reset to its default value, but a reboot of the Inspector PI50 ECAT is needed for the default value to take effect.

The default Station Alias value is "0".


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

### 6.9.2 Vendor Id

The Vendor Id is 0x01000056 for SICK AG. The Vendor Id is available at CoE index 0x1018, subindex 1. The Vendor Id will never change.

### 6.9.3 Revision Number

The Revision Number is used to match the ESI-file to the EtherCAT Slave Controller firmware version. If the Revision Number in the ESI-file does not match the Revision Number in the EtherCAT Slave Controller the Master will signal an error. The Revision Number is available as a constant at CoE index 0x1018, subindex 3.

### 6.9.4 Serial Number

The Serial Number is the serial number of the Inspector PI50 ECAT. It can be read out as a constant at CoE address 0x1018, subindex 4.

### 6.9.5 Device Type

The EtherCAT device type is set to 0x0. The Device Type is available as a constant at CoE index 0x1000.

### 6.9.6 Manufacturer Hardware Version

The hardware version number, available as a constant at CoE index 0x1009.

### 6.9.7 Manufacturer Software Version

The EtherCAT Slave Controller software version, available as a constant at CoE index 0x100A.

## 6.10 PDO Overview

Note! When using trigged mode it is necessary to send a trig or change mode to update the content of the PDO:s.

Note! All PDO:s (Process Data Object) contain one single *PDO entry*. This means that the size of the PDO is always equal to the size of the PDO entry. Some PDO entries define bits that have different meanings. For example, the mandatory Time stamp TxPDO is four bytes and the PDO entry is also four bytes representing the time stamp only. Whereas the mandatory Status TxPDO is one byte and the PDO entry (also one byte) defines different meanings for the bits in the byte.


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

*Table 6.9 PDO overview*

| Direction | PDO | PDO entry - details | Size of PDO entries |
|---|---|---|---|
| Receive from EtherCAT Master (RxPDO) | PDO Control (1 byte)[a] | Rx Toggle Bit (bit 0) | 1 bit |
| | | Inspection Trig (bit 1), PD Trig | 1 bit |
| | | Bit 2-7 not used | 6 bits |
| | PDO DC Sync Activate (1 byte) | Activate (bit2-bit7 not used) | 1 byte |
| | PDO DC Sync Start (4 bytes) | Start Time | 4 bytes |
| Transmit from Inspector PI50 ECAT (TxPDO) | PDO Status (1 byte) [a] | Tx Toggle Bits (bit 0-2) | 3 bit |
| | | Illumination Trig (bit 3) | 1 bit |
| | | All Passed (bit 4) | 1 bit |
| | | Not Located (bit 5) | 1 bit |
| | | Detail Inspection Failed (bit 6) | 1 bit |
| | | Bit 7 not used | 1 bit |
| | PDO Mode (1 byte) [a] | Mode | 1 byte |
| | PDO Time Stamp (4 bytes) [a] | Time Stamp | 4 bytes |
| | PDO Early Time Stamp (4 bytes) [a] | Early Time Stamp | 4 bytes |
| | PDO Image Number (4 bytes) [a] | Image Number | 4 bytes |
| | PDO Sys Time (4 bytes) [a] | System Time | 4 bytes |
| | PDO Inspection Result 16 (16 bytes) | Byte0...Byte15 | 16 bytes |
| | PDO Inspection Result 32 (32 bytes) | Byte0...Byte31 | 32 bytes |
| | PDO Inspection Result 64 (64 bytes) | Byte0...Byte63 | 64 bytes |
| | PDO Inspection Result 128 (128 bytes) | Byte0...Byte127 | 128 bytes |
| | PDO Inspection Result 256 (256 bytes) | Byte0...Byte255 | 256 bytes |
| | PDO Inspection Result 512 (512 bytes) | Byte0...Byte511 | 512 bytes |

[a]Mandatory PDO

**Process Data from EtherCAT Master to Inspector (RxPDO)**

Detailed explanation:

PDO Control — Control byte. Contains *Rx Toggle bit* and *Inspection Trig* (PD Trig). One toggle bit for all RxPDO:s. All PDO entries in Control are mandatory process data.

Rx Toggle bit — Toggle flag. The RX Toggle bit has to be toggled each time the RxPDO has been updated or changed. Bit 0 in the Control byte.


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

| | |
|---|---|
| Inspection Trig (PD Trig) | Contains the inspection trigger. Changing the Inspection Trig-bit from 0 to 1 will trigger the Inspector PI50 ECAT. Bit 1 in the Control byte. |
| PDO DC Sync Activate | This is the Activate register for the Programmable Trig feature. See Section 6.8, "*DC - Distributed Clock (DC) features*" (page 51). |
| PDO DC Sync Start | This is the programmed DC StartTime for the Programmable Trig feature. See Section 6.8, "*DC - Distributed Clock (DC) features*" (page 51). |

**Process Data from Inspector to EtherCAT Master (TxPDO)**

Detailed explanation:

| | |
|---|---|
| PDO Status | Status byte. Contains Tx Toggle Bits, Illumination Trig, All Pass, Not Located and Detail Inspection Failed. All PDO entries in Status are mandatory process data. |
| Tx Toggle bits | The three-bit word changes value each time any TxPDO has been updated. Bit 0-2 in the Status byte. |
| Illumination Trig | The toggling of this bit will represent an illumination trig. Illumination trig is only sent in free-running mode. To use illumination trig the **External lighting** has to be set in **SOPAS Single Device**. Check the box for **External** in **Image settings tab** under **Lighting**. Bit 3 in the Status byte. See Figure 6.4, "Illumination trig" (page 41) for the timing of Illumination trig. |
| All Passed | 1= The object was located and all detailed inspection passed as well. Bit 4 in the Status byte. |
| Not Located | 1=The object was not located or a detailed inspection was out of view. Bit 5 in the Status byte. |
| Detail Failed | 1= The object was located but at least one of the detailed inspections failed. Bit 6 in the Status byte. |
| PDO Mode | The mode of the Inspector PI50 ECAT. 0=Run, 1=Edit. This is a mandatory PDO. |
| PDO Time Stamp | The Time Stamp is sent out with the corresponding inspection result for an image. The Time Stamp represents the time when the imager started its acquisition for the inspected image. The Time Stamp is only valid if the EtherCAT DC (Distributed Clock) mode is enabled. If DC mode is not used or the Inspector is in Edit mode the Time Stamp value is undefined. This is a mandatory PDO. |
| PDO Early Time Stamp | Early Time Stamp carries the same information as the Time Stamp. The difference is that the Early Time Stamp is sent out as soon as possible after the start of image acquisition. That is, the Early Time Stamp is sent out before the corresponding inspection result. As with the Time Stamp, the Early Time Stamp is only defined in the EtherCAT DC mode and when the Inspector is in Run mode. This is a mandatory PDO. |
| PDO Sys Time | System Time in the Inspector, 32bit representation. |
| PDO Image Number | Contains the image number. The image number is restarted at 0 for each boot of the Inspector PI50 ECAT and each reset to factory defaults. Image number reflects each image taken. Mandatory process data. Note that there will be no image number if there are no refer- |


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

| | |
|---|---|
| | ence objects in **SOPAS Single Device**. This is a mandatory PDO. |
| PDO Inspection Result (16...512) | Choose which PDO entries to use for the inspection result defined by the XML formatting string. It is possible to choose one or more Inspection Result PDO. Each Inspection Result PDO can only be chosen once. The assignments for each Inspection Result PDO is done in the EtherCAT Master. These are optional PDO:s.<br>The total size of the selected Inspection Result PDO:s is only updated in **SOPAS Single Device** when the Inspector PI50 ECAT does the transition PREOP to SAFEOP or PREOP to OP. The total size of the selected Inspection Result PDO:s is needed when validating the XML output format string in the dialog **Ethernet Result Output** in **SOPAS Single Device**. |

## 6.11 ESI file

The ESI (EtherCAT Slave Information) file for the Inspector is located on the CD in the **/documentation**-folder and is named **Inspector PI50 ECAT.ESI.xml**. Copy the ESI-file to the location required by the EtherCAT Master.


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

# Appendix

# 7 Result Output Formatting

## 7.1 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 PI50:

| Container tag | Explanation |
|---|---|
| OBJECT_LOC | Used to present values concerning the **Object locator** |
| BLOB | Used to present values for a found blob in a blob ROI. The index points out the found blob in accordance with the blob sorting order. If no index is given this is the same as index = 0. |
| PIXEL_COUNTER, PATTERN, EDGE_PIXEL_COUNTER | Used to present values concerning inspections. |
| POLYGON | Used to present values concerning a defined **Polygon** |
| CORNERS | Container tag within the <POLYGON> tag for presenting values concerning the polygon corners. See example:<br><POLYGON><br><CORNERS><br><X/>,<Y/><br></CORNERS><br></POLYGON> |

The XML based formatting string is entered in the **Formatting string for Ethernet Output** part of the **Ethernet Result Output** dialog. To get a default string for the current chosen reference object click **Create default formatting string.** Click **Validate output string** to validate the formatting string. The output that will be sent over Ethernet or errors are reported in the **Current output string** part of the **Ethernet Result Output** dialog.

**Note**

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 or not.

The maximum size of the XML buffer is 7900 ASCII characters. This means it will not be possible to e.g. paste a XML string into to the input field if it's too large. For a larger configuration it might not be possible to configure as much output information as wanted due to this limitation.

## 7.2 XML Formatting

The content of the Ethernet output is configured using an XML-based formatting string. The available tags can be categorized into two groups:

- container tags: <OBJECT_LOC>, <POLYGON>, <BLOB>
- value tags: <X/>, <PIXELS/>, <NEWLINE/>, <TIME/>,...


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

The value tags are replaced with a value whereas the container tags are used to group 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.

Attribute value must always be enclosed in quotes.

There are three integer tags (<UINT1/>, <UINT2/>, <UINT3/>) for which the values can be changed (in both Edit and Run mode) using the Command channel.

The <BLOB> container tag contains special functionality for presenting values for a certain blob. The index value specifies which blob ROI:s result to present. The index order is the order specified by the Sort by property configured on the **Tools** tab. The texts and value tags within the <BLOB> 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. See Section 7.3, "*Container Specific Tags*" (page 60).

## 7.3 Container Specific Tags

All tags are listed in the table below. For each container tag, the available value tags are listed. The binary column states the used data type when using binary output format. Some parts of the formatting string, such as characters and ASCII tags, are only applicable for the ASCII format and will be ignored when using binary format, this is also stated in the binary column.

**Note**

The Binary column in the tables below describes how the data should be interpreted when received from the device.

*Table 7.1 Container Output String Tags*

| Container tag | Value tag | Attribute | Range | Binary | Comment |
|---|---|---|---|---|---|
| OBJECT_LOC | X | coordUnit | | REAL | X position of the reference point. Note that this can be outside the image and therefore negative. In "pixels" or "mm" depending on attribute "coordUnit" or configured value in the **Ethernet Result output** dialog. |
| | Y | coordUnit | | REAL | Y position of the reference point. Note that this can be outside the image and therefore negative. In "pixels" or "mm" depending on attribute "coordUnit" or configured value in the **Ethernet Result output** dialog. |
| | ROTATION | unit | [-180, 180] | REAL | In degrees or radians depending on the configured value in the **Ethernet Result output** dialog. |
| | SCALE | | [0.8, 1.2] | REAL | Scale factor of analyzed live image compared to taught reference object. |
| | SCORE | | [0, 100] | REAL | Score view in percent how well of the object is found in the object locator due to match setting |
| | DECISION | | {0, 1} | USINT | 0=not found, 1=found |
| EDGE_ | | name | any string | | Name attribute required if more than one Edge Pixel Counter exist |


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

| Container tag | Value tag | Attribute | Range | Binary | Comment |
|---|---|---|---|---|---|
| PIXEL_ COUNTER | PIXELS | | | UDINT | Number of found edge pixels, expressed in pixels of the inspection region area. The **No. of edge pixels** interval in the **Tools** tab is specified as number of pixels within the inspection region. If the located object is scaled, the number of pixels is adjusted to be the number of matching pixels that should have been found if the located object had the same size as the reference object. |
| | DECISION | | {0, 1} | USINT | 0=fail, 1=pass |
| PIXEL_ COUNTER | | name | any string | | Name attribute required if more than one Pixel Counter exist |
| | PIXELS | | | UDINT | Number of found pixels, expressed in pixels of the inspection region area. The **No. of pixels in range** interval in the **Tools** tab is specified as number of pixels within the inspection region. If the located object is scaled, the number of pixels is adjusted to be the number of matching pixels that should have been found if the located object had the same size as the reference object. |
| | DECISION | | {0, 1} | USINT | 0=fail, 1=pass |
| PATTERN | | name | any string | | Name attribute required if more than one Pattern inspection exists |
| | SCORE | | [0, 100] | REAL | Pattern matching score. |
| | DECISION | | {0, 1} | USINT | 0=fail, 1=pass |
| POLYGON | | name | any string | | Name attribute required if more than one Polygon exists |
| | NUM_ CORNERS | | [2, 16] | USINT | Number of corners used for this polygon tool. |
| | DECISION | | [0, 2] | USINT | 0=not found, 1=defect, 2 = pass |
| | SCORE | | [0, 100] | REAL | Polygon matching score. |
| | NUM_ PIXELS | | | UDINT | Number of defect pixels inside crack detection region in polygon. Undefined for single edge tool. |
| | CORNER_ OUTSIDE | | {0,1} | USINT | 0=polygon completely inside image, 1=one or more polygon corner(s) are outside image. Cannot be used for single edge tool. |
| | DEFECT_X | coordUnit | | REAL | Coordinate of the first found pixel that was within the defect thresholds. In “pixels” or “mm” depending on attribute “coordUnit” |


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

| Container tag | Value tag | Attribute | Range | Binary | Comment |
|---|---|---|---|---|---|
| | | | | | or configured value in the **Ethernet Result output** dialog.<br>Return -1 if defect detection is not actived or no defect found. Undefined for single edge tool. |
| | DEFECT_Y | coordUnit | | REAL | Coordinate of the first found pixel that was within the defect thresholds. In “pixels” or “mm” depending on attribute “coordUnit” or configured value in the **Ethernet Result output** dialog.<br>Return -1 if defect detection is not actived or no defect found. Undefined for single edge tool. |
| CORNERS[a] | | corners | {0, 1, ...,15, all} | | "All" [b]iterates over all polygon corners. Number 0 to 15 gives the properties of a single corner. The index of this corner is the order in which the polygon corner was added when the polygon was drawn. |
| | X | coordUnit | REAL | REAL[c] | Polygon corner coordinate. “pixels” or “mm” depending on attribute “coordUnit” or configured value in the **Ethernet Result output** dialog.<br>For a polygon with two corners (single edge) the estimated corner positions are the intersection between the found edge and the left and right borders of the search region. The search region is defined by the user drawn edge and the position search parameter. See also Operating Instructions for Inspector PI50 about Single edge tool. |
| | Y | coordUnit | REAL | REAL[c] | Polygon corner coordinate. “pixels” or “mm” depending on attribute “coordUnit” or configured value in the **Ethernet Result output** dialog.<br>For a polygon with two corners (single edge) the estimated corner positions are the intersection between the found edge and the left and right borders of the search region. The search region is defined by the user drawn edge and the position search parameter. See also Operating Instructions for Inspector PI50 about Single edge tool. |


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

| Container tag | Value tag | Attribute | Range | Binary | Comment |
|---|---|---|---|---|---|
| BLOB | | name | any string | | Name attribute required if more than one Blob tool exists. The name refers to the Blob tool's name in the tool tab |
| | | index | [0, 15] | | Index of found blob according to current blob sorting order. Index 0 is the first blob |
| | X | coordUnit | | REAL | Blob center of gravity (x position). “pixels” or “mm” depending on attribute “coordUnit” |
| | Y | coordUnit | | REAL | Blob center of gravity (y position). “pixels” or “mm” depending on attribute “coordUnit” |
| | FOUND_BLOBS[d] | | | USINT | Number of found blobs. |
| | LIVE_THRESHOLD_LOW[d] | | | USINT | The lower threshold of the Blob tool's intensity after applying ambient light compensation. |
| | LIVE_THRESHOLD_HIGH[d] | | | USINT | The upper threshold of the Blob tool's intensity after applying ambient light compensation. |
| | ANGLE | unit | [0, 180] | REAL | In degrees or radians depending on attribute “unit” or configured value in the **Ethernet Result output** dialog. |
| | 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 calculation value (number of edge pixels inside the found blob) |

[a]This tag must be used inside the <POLYGON> container

[b]Only available for Ethernet Raw.

[c]For EtherNet/IP the position is represented as an INT value. USe the scale attribute to get more decimals

[d]This tag must be used inside the <BLOB> container. The value are given for each Blob ROI (not for each found blob)

**Note**

When a tool is related to the object locator and the object locator is not found in the live image the presented results for the related tools are undefined.


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

### 7.3.1 General Tags

*Table 7.2 Generic Output String Tags*

| Value tag | Attribute | Range | Binary | Comment |
|---|---|---|---|---|
| MESSAGE_SIZE | | | UINT | • Binary format: The size of the message in bytes<br>• ASCII format: The number of characters in the message |
| IMAGE_NUMBER | | | UDINT | Analyzed image's number (Resets at power-up or device reset) |
| IMAGE_DECISION | | [0, 3] | USINT | 0=Not located, 1=Detail failed, 2=All passed 3=Not located and detail failed[a] |
| REF_OBJECT | | [0, 31] | USINT | Reference object index |
| ASCII | value | [0, 255] | IGNORED | Used to send single control characters |
| SPACE | | | IGNORED | Same as <ASCII value="32"> |
| TAB | | | IGNORED | Same as <ASCII value="9"> |
| LAB | | | IGNORED | Left angular bracket, "<". Useful when generating XML-formatted output. |
| RAB | | | IGNORED | Right angular bracket, ">". Useful when generating XML-formatted output. |
| NEWLINE | | | IGNORED | Same as <ASCII value="10"> |
| RETURN | | | IGNORED | 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 | | [0, 100] | REAL | Only valid while the device is in Edit mode. This is the focus value from the **Image settings** tab |
| TELE-GRAM_COUNTER | | | UINT | A counter that increments for each telegram sent over the result channel. Resets at power-up or device reset. |
| USINT | intValue | [0, 255] | USINT | If the intValue 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 intValue 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 intValue attribute is not specified the default value will be zero and the tag can be used for padding. |
| UINT1 | intValue | [0, 65535] | UINT | Value can be changed through the command channel. |
| UINT2 | | [0, 65535] | UINT | Value can be changed through the command channel. |


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

| Value tag | Attribute | Range | Binary | Comment |
|---|---|---|---|---|
| UINT3 | | [0, 65535] | UINT | Value can be changed through the command channel. |

[a] If a tool is fixed in field of view and not relative to the object locator, the Image_decision will report the value 3 in cases when the object locator does not locate the object and the result of the unrelated tool is failed.

### 7.3.2 Attributes

Attributes are used to control the formatting and identification of inspections. The table below describes the formatting attributes for Inspector PI50. Some attributes can also be set, for the whole formatting string, in the **Ethernet Result Output** dialog in the **InspectorPI50** menu in the section **Message settings**. The attributes operate in a hierarchical way using inheritance. So if **Number of decimals** has been set to 3 in the **Ethernet Result Output** dialog, all REAL will be printed with 3 decimals unless they are inside a tag that states otherwise. Some attributes can also be set from the **Ethernet Result Output** dialog from the **InspectorPI50** menu in **SOPAS Single Device**, see also Section 4.2.3, “*Attributes*” (page 20).

*Table 7.3 Formatting attributes*

| Attribute | Range | Default value | Affects | Used in Binary format | Comment |
|---|---|---|---|---|---|
| index | [0, 15] | 0 | Blob | Yes | Index of blob according to current blob sorting order. Index 0 is the first blob. |
| scale | Any REAL | 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 tools | Yes | |
| value | [0, 255] | 0 | <ASCII> | No | |
| intValue | [0, 255], [0, 65535], [0, $2^{32}$-1] | 0 | <USINT>, <UINT>, <UDINT> | Yes | Integer value to be sent. |
| digits | [0, 9] | 0 | Integers and REAL | No | Minimum number of characters. |
| decimals | [0, 9] | 2 | REAL | No | Number of decimals. |
| corners | [0, 15] | | <CORNERS> | Yes | "All" [a] iterates over all polygon corners. Number 0 to 15 gives the properties of a single corner. The index of this corner is the order in which the polygon corner was added when the polygon was drawn. |
| coordUnit | {pixels, mm} | pixels | Object locator, Blob and Polygon coordinates | Yes | Gives result coordinates in pixel or millimeter format. [b] |


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

| Attribute | Range | Default value | Affects | Used in Binary format | Comment |
|---|---|---|---|---|---|
| dataType | {SINT, INT, DINT, REAL} | | All values | Yes | Casts to the specified datatype. When using EtherNet/IP the attribute DataType specifies the dataType section in the selected assembly. |
| pos | [0, 43] | | All values | No | Used by EtherNet/IP to determine a position in the dataType section in the selected assembly. The first position number of the dataType section is 0. The range of the attribute pos depends on which assembly is used. |
| unit | {radians, degrees} | degrees | Angles | Yes | |

[a] Only available for Ethernet Raw.

[b] The device must be calibrated for it to be possible to use the “mm” attribute.

*Table 7.4 Sizes of datatypes*

| Datatype | Size | Range | Encoding |
|---|---|---|---|
| USINT | 1 byte | [0, 255] | [a] |
| SINT | 1 byte | [-128, 127] | [a] |
| UINT | 2 bytes | [0, 65535] | [a] |
| INT | 2 bytes | [-32768, 32767] | [a] |
| UDINT | 4 bytes | $[0, 2^{32}-1]$ | [a] |
| DINT | 4 bytes | $[-2^{31}, 2^{31}-1]$ | [a] |
| REAL | 4 bytes | Represented as IEEE 754 binary 32 | [a] |

[a] See Section 4.2.3, “*Attributes*” (page 20).


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

# A Command Channel

The Command Channel is used to read and update a selected set of device parameters.

This section describes the Command Channel from a generic point of view. The Command Channel is available via several of the device interfaces: Ethernet Raw, EtherNet/IP, EtherCAT, Web API. There are differences depending on the possibilities each interface provides. The differences are described in the chapters about each interface.

It is possible to block changes via the command channel individually for each interface using a setting in the interface configuration, as described in the Operating Instructions for Inspector PI50. This makes it possible to allow changes via a PLC oriented interface while blocking changes via the Web API.

## A.1 Command Syntax

The tables below describe the different command types as well as ACK messages and their syntax. The basic principle is that there are three major types of commands (sINT, gINT, and aACT) and some special commands.

*Table A.1 Command syntax*

| Command format | Explanation |
|---|---|
| gVER | Get protocol version that is supported by the addressed device |
| sMOD [mode] | Set device mode (0 = Run, 1 = Edit) |
| gMOD | Get the current device mode from the device |
| sINT [identifier] [arg1] [arg2] ... [argN] | Set “integer” parameter in the device |
| gINT [identifier] [arg1] | Get “integer” parameter from the device |
| aACT [identifier] [arg1] [arg2] ... [argN] | Action commands |
| TRIG | Trig an image acquisition and analysis |
| gRES | Retrieve the latest available Ethernet Result Output string |

*Table A.2 Command response*

| ACK message | Explanation |
|---|---|
| rgVER [errorCode] [protocolVersion] | Response to protocol version including the version that is supported by the device |
| rsMOD [errorCode] [errorMessage] | Response to set mode (Run/Edit) including error code and error message |
| rgMOD [errorCode] [mode] [errorMessage] | Response to fetch current mode (Run/Edit) including the mode, error code, and error message |
| rsINT [identifier] [errorCode] [errorMessage] | Response to set integer parameter and action commands including error code and error message |
| rgINT [identifier] [errorCode] [ret1] [ret2] ...[retN] [errorMessage] | Response to fetch integer parameter including parameter value, error code and error message |
| raACT [identifier] [errorCode] [errorMessage] | Response to the action command including error code and error message |
| rTRIG [errorCode] [errorMessage] | Response to the trig command including error code and error message |


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

If returned errorCode is 0 no errorMessage will be shown. For explanation of errorCode and errorMessage see Section A.3, “*Error Codes*” (page 77).

### A.1.1 Commands ID numbers for EtherNet/IP and EtherCAT

Table with command ID numbers to be used as replacement for the normal command strings for interfaces where strings not are possible or preferred.

*Table A.3 Command ID numbers - for EtherNet/IP and EtherCAT*

| Description | Command | ID |
|---|---|---|
| Set mode | sMOD | 0 |
| Get mode | gMOD | 1 |
| Set integer | sINT | 2 |
| Get integer | gINT | 3 |
| Get version | gVER | 7 |
| Action command | aACT | 8 |
| Trig device | TRIG | 9 |

## A.2 Command descriptions

The way to configure the device through the Ethernet based command channel is based on the set of commands described above with parameters depending on what the user wants to do. See tables below with a complete list of command channel actions and functions.

The index argument in the command descriptions below refers to tool's index when configured in **SOPAS Single Device**. The index can be found in the **Tools** tab in **SOPAS Single Device**. Hold the mouse pointer over the current tool to get the index number.

*Table A.4 Command channel - actions*

| Description | Command | Identifier | Usable in Run mode | Arguments | Return values | Range |
|---|---|---|---|---|---|---|
| Save settings in flash | aACT | 1 | No | | | - |
| Re-teach reference object | aACT | 2 | Yes, only in Run mode. | int autoExp | | 0=use exposure settings, 1=auto adjust |
| Perform calibration[a] | aACT | 3 | No | int boxSize[b] | - int calibrationCoverage[c] | >0 [0,100] |
| Remove calibration | aACT | 4 | No | | | |
| Apply IP settings[d] | aACT | 5 | Yes | int useDHCP | | 0=use manual settings, 1=use DHCP |
| Reset the Inspector[e] | aACT | 6 | Both in run and edit mode | | | |

[a] In order to run this command the device must be set to Calibration mode (sINT 20 1).

[b] The argument must be given in mm.

[c] Returned value is the calibration target coverage in percent.

[d] After the aACT 5 command has been executed the Inspector need to be restarted (e.g. using aACT 6) before the new IP settings are in use.

[e] The aACT 6 command will make the device being temporarily disconnected.


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

*Table A.5 Command channel - only for EtherCAT*

| Description | Command | Identifier | Usable in Run mode | Arguments | Return values | Range |
|---|---|---|---|---|---|---|
| Set FoE password[a] | sINT | 140 | | int old, int new | | |

[a]The FoE password use big endian.

*Table A.6 Command channel functions - Device settings*

| Description | Command | Identifier | Usable in Run mode | Arguments | Return values | Range |
|---|---|---|---|---|---|---|
| Set interface permission | sINT | 112 | Yes | int interface<br>int permission | | Interface: 0=Ethernet Raw, 1=HTTP, 2=Ethernet/IP<br>Permission: 1=enable, 0=disable |
| Get interface permission | gINT | 112 | Yes | int interface | int permission | Interface: 0=Ethernet Raw, 1=HTTP, 2=Ethernet/IP |
| Set device IP address[a] | sINT | 120 | Yes | int a, int b, int c, int d | | Address format: a.b.c.d[b] |
| Get device IP address | gINT | 120 | Yes | | int a, int b, int c, int d | Address format: a.b.c.d |
| Set device netmask[a] | sINT | 121 | Yes | int a, int b, int c, int d | | Address format: a.b.c.d[b] |
| Get device netmask | gINT | 121 | Yes | | int a, int b, int c, int d | Address format: a.b.c.d |
| Set gateway[a] | sINT | 122 | Yes | int a, int b, int c, int d | | Address format: a.b.c.d[b] |
| Get gateway | gINT | 122 | Yes | | int a, int b, int c, int d | Address format: a.b.c.d |

[a]In order for the settings to take effect the aACT 5 command needs to be sent to the device

[b]There should be **no** dots in the argument

*Table A.7 Command channel functions - general*

| Description | Command | Identifier | Usable in Run mode | Arguments | Return values | Range |
|---|---|---|---|---|---|---|
| Get used protocol version | gVER | - | Yes | | int version | 3=PI50 1.0, 4=PI50 ECAT 1.0, 5=PI50 1.1 |
| Set device mode | sMOD | - | Yes | int mode | | 0=Run, 1= Edit |
| Get device mode | gMOD | - | Yes | | int mode | 0=Run, 1= Edit |
| Trig device | TRIG | - | No[a] | | | - |
| Select reference object | sINT | 1 | Yes | int object | | [0, 31] |
| Get active reference object | gINT | 1 | Yes | | int object | [0,31] |


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

| Description | Command | Identifier | Usable in Run mode | Arguments | Return values | Range |
|---|---|---|---|---|---|---|
| Get number of configured reference objects | gINT | 2 | Yes | - | int object | [0,31] |
| Change exposure[b] | sINT | 14 | No | int exp*100 | | [10,10000] |
| Get exposure | gINT | 14 | Yes | | int exp*100 | [10, 10000] |
| Change gain | sINT | 15 | No | int gain | | [0, 400] |
| Get gain | gINT | 15 | Yes | | int gain | [0, 400] |
| Switch trigger mode(free-running, trig) | sINT | 16 | No | int mode | | 0=free-running, 1=trig |
| Get trigger mode | gINT | 16 | Yes | | int trigMode | 0=free-running, 1=trig |
| Change value of integer tags in result output (UINT1-3) | sINT | 18 | Yes | int index, int value | | [0, 2], [0,65535] |
| Get value of integer tags in result output (UINT1-3) | gINT | 18 | Yes | | int index, int value | [0, 2], [0,65535] |
| Get frame period time [microseconds] | gINT | 19 | Yes | | int framePeriod | |
| Enter/leave calibration mode | sINT | 20 | No | int mode | | 0=normal mode, 1=calibration mode |
| Get calibration parameters | gINT | 20 | Yes | int parameter | int parameterResult | 0=calibration/normal mode[c], 1=calibrated[d], 2=scaling[e], 3=origin[f], 4=rotation[g] |
| Set external trig delay | sINT | 21 | No | int type, int delay (milliseconds*10 or ticks)[h] | | [0=ms, 1=tick], [1,50000] resp [0 ticks, 200000 ticks] |
| Get external trig delay | gINT | 21 | Yes | | int type, int delay (milliseconds*10 or ticks) | [0=ms, 1=tick], [1,50000] resp [0 ticks, 200000 ticks] |
| Set digital output delay | sINT | 22 | No | int outputIndex, int type, int delay (milliseconds*10 or ticks) | | [0,19], [0=ms, 1=tick], [(Min delay time)*10,50000] resp [0 ticks, 200000 ticks] |
| Get digital output delay | gINT | 22 | Yes | int outputIndex | int type, int delay (milliseconds*10 or ticks) | [0,19], [0=ms, 1=tick], [1,50000] resp [0 |


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

| Description | Command | Identifier | Usable in Run mode | Arguments | Return values | Range |
|---|---|---|---|---|---|---|
| | | | | | | ticks, 200000 ticks] |
| Set digital output active time | sINT | 23 | No | int outputIndex, int type, int time (milliseconds*10 or ticks) | | [0,19], [0=ms, 1=tick], [1,10000] resp [0 ticks, 200000 ticks] |
| Get digital output active time | gINT | 23 | Yes | int outputIndex | int type, int time (milliseconds*10 or ticks) | [0,19], [0=ms, 1=tick], [1,10000] resp [0 ticks, 200000 ticks] |

[a]Possibility to trig device in Run mode available on most interfaces, but implemented differently for each interface.
[b]The exposure is expressed in ms multiplied by 100 i.e. 3.8 ms is expressed as 380
[c]The result is 0= normal mode or 1= calibration mode.
[d]The result is 0= not calibrated or 1= calibrated.
[e]The result is expressed in mm/pixel x 10000.
[f]The result is expressed in pixels for x and y.
[g]The result is expressed in degrees.
[h]The delay is expressed in ms multiplied by 10 i.e. 1.5 ms is expressed as 15

*Table A.8 Command channel functions - Object locator*

| Description | Command | Identifier | Usable in Run mode | Arguments | Return values | Range |
|---|---|---|---|---|---|---|
| Change object locator match threshold | sINT | 32 | No | int threshold | | [0, 100], percent |
| Get object locator match threshold | gINT | 32 | Yes | | int threshold | [0, 100], percent |
| Change object locator rotation search mode | sINT | 33 | No | int mode | | 0=off, 1=on |
| Get object locator rotation search mode | gINT | 33 | Yes | | int mode | 0=off, 1=on |
| Change object locator rotation search limit | sINT | 34 | No | int limit | | [0, 180] degrees |
| Get object locator rotation search limit | gINT | 34 | Yes | | int limit | [0, 180] degrees |
| Change object locator scale search mode | sINT | 35 | No | int mode | | 0=off, 1=on |
| Get object locator scale search mode | gINT | 35 | Yes | | int mode | 0=off, 1=on |
| Change object locator robustness | sINT | 36 | No | int rob | | 0=High robustness, 1=Normal, 2=High speed |


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

| Description | Command | Identifier | Usable in Run mode | Arguments | Return values | Range |
|---|---|---|---|---|---|---|
| Get object locator robustness | gINT | 36 | Yes | | int rob | 0=High robustness, 1=Normal, 2=High speed |
| Change object locator accuracy | sINT | 37 | No | int acc | | 0=High accuracy, 1=Normal, 2=High speed |
| Get object locator accuracy | gINT | 37 | Yes | | int acc | 0=High accuracy, 1=Normal, 2=High speed |
| Move and rotate object locator | sINT | 38 | No | int x, int y, int angle | | x, y = pixels, angle = degrees. Arguments are delta values as compared to the current position and angle. These can be negative |
| Get object locator position and rotation | gINT | 38 | Yes | | int x, int y, int angle | x, y = pixels, angle = degrees. Return values are absolute values. These can be negative as compared to the origin |

*Table A.9 Command channel functions - Blob*

| Description | Command | Identifier | Usable in Run mode | Arguments | Return values | Range |
|---|---|---|---|---|---|---|
| Change blob intensity thresholds | sINT | 48 | No | int index, [a]<br>int min,<br>int max | | [0, 7],<br>[0, 255], min<=max<br>[0, 255], min<=max |
| Get blob intensity thresholds | gINT | 48 | Yes | int index | -<br>int min,<br>int max | [0, 7],<br>[0, 255],<br>[0, 255] |
| Change blob area thresholds | sINT | 49 | No | int index,<br>int min,<br>int max | | [0, 7],<br>[9, 307200] pixels, min<=max,<br>[9, 307200] pixels, min<=max |
| Get blob area thresholds | gINT | 49 | Yes | int index | -<br>int min,<br>int max | [0, 7],<br>[9, 307200] pixels,<br>[9, 307200] pixels |
| Change blob angle thresholds | sINT | 50 | No | int index,<br>int angle,<br>int angletolerance | | [0, 7],<br>[0, 180],<br>[0, 90] |


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

| Description | Command | Identifier | Usable in Run mode | Arguments | Return values | Range |
|---|---|---|---|---|---|---|
| Get blob angle thresholds | gINT | 50 | Yes | int index | -<br>int ref,<br>int tol | [0, 7],<br>[0, 180],<br>[0, 90] |
| Change structure criteria thresholds | sINT | 53 | No | int index,<br>int min,<br>int max | | [0, 7],<br>[0, 100000], min<=max,<br>[0, 100000], min<=max |
| Get structure criteria thresholds | gINT | 53 | Yes | int index | -<br>int min,<br>int max | [0, 7],<br>[0, 100000],<br>[0, 100000] |
| Change blob edge strength | sINT | 54 | No | int index,<br>int strength | | [0, 7],<br>[0, 100] percent |
| Get blob edge strength | gINT | 54 | Yes | int index | -<br>int strength | [0, 7],<br>[0, 100] percent |
| Change ambient light compensation mode | sINT | 55 | No | int index,<br>int mode | | [0, 7],<br>0=off, 1=on |
| Get ambient light compensation mode | gINT | 55 | Yes | int index | -<br>int mode | [0, 7],<br>0=off, 1=on |
| Change blob search method | sINT | 56 | No | int index,<br>int method | | [0, 7],<br>0=High quality, 1=Normal, 2=High speed |
| Get blob search method | gINT | 56 | Yes | int index | -<br>int method | [0, 7],<br>0=High quality, 1=Normal, 2=High speed |
| Move and rotate blob locator | sINT | 58 | No | int index,<br>int x, int y, int angle | | [0, 7],<br>x, y = pixels, angle = degrees. Arguments are delta values as compared to the current position and angle. These can be negative |
| Get blob ROI position and rotation | gINT | 58 | Yes | int index | -<br>int x, int y, int angle | [0, 7]<br>x, y = pixels, angle = degrees. Return values are absolute values. These can be negative as compared to the origin. |
| Set number of blobs | sINT | 59 | No | int index<br>int min<br>int max | | [0, 7]<br>[0, 16] min<=max<br>[0, 16] min<=max |


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

| Description | Command | Identifier | Usable in Run mode | Arguments | Return values | Range |
|---|---|---|---|---|---|---|
| Get number of blobs | gINT | 59 | Yes | int index | -<br>int min,<br>int max | [0, 7]<br>[0, 16] min<=max<br>[0, 16] min<=max |

[a]The blob index argument corresponds to the order in which the blobs are listed in the **Tools** tab in the **SOPAS Single Device**, starting with 0

*Table A.10 Command channel functions - Polygon*

| Description | Command | Identifier | Usable in Run mode | Arguments[a] | Return values | Range |
|---|---|---|---|---|---|---|
| Change polygon position search tolerance | sINT | 64 | No | int index,<br>int tol | | [0, 7],<br>[1, 400] pixels for single edge<br>[5, 100] pixels for polygon |
| Get polygon position search tolerance | gINT | 64 | Yes | int index | -<br>int tol | [0, 7],<br>[1, 400] pixels for single edge<br>[5, 100] pixels for polygon |
| Change polygon flexibility search tolerance | sINT | 65 | No | int index,<br>int tol | | [0, 7],<br>[0, 100] pixels |
| Get polygon flexibility search tolerance | gINT | 65 | Yes | int index | -<br>int tol | [0, 7],<br>[0, 100] pixels |
| Change polygon score threshold | sINT | 66 | No | int index,<br>int threshold | | [0, 7],<br>[0, 100] pixels |
| Get polygon score threshold | gINT | 66 | Yes | int index | -<br>int threshold | [0, 7],<br>[0, 100] pixels |
| Change polygon margin | sINT | 67 | No | int index,<br>int margin | | [0, 7],<br>[0, 20] pixels |
| Get polygon margin | gINT | 67 | Yes | int index | -<br>int margin | [0, 7],<br>[0, 20] pixels |
| Change polygon defect detection width | sINT | 68 | No | int index,<br>int width | | [0, 7],<br>[0, 100] pixels |
| Get polygon defect detection width | gINT | 68 | Yes | int index | -<br>int width | [0, 7],<br>[0, 100] pixels |
| Change polygon defect intensity range thresholds | sINT | 69 | No | int index,<br>int min,<br>int max | | [0, 7],<br>[0, 255], min<=max,<br>[0, 255], min<=max |


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

| Description | Command | Identifier | Usable in Run mode | Arguments[a] | Return values | Range |
|---|---|---|---|---|---|---|
| Get polygon defect intensity range thresholds | gINT | 69 | Yes | int index | - int min, int max | [0, 7], [0, 255], [0, 255] |
| Change polygon max defects threshold | sINT | 70 | No | int index, int max | | [0, 7], [0, 100] pixels |
| Get polygon max defects threshold | gINT | 70 | Yes | int index | - int max | [0, 7], [0, 100] pixels |
| Change polygon defect detection mode | sINT | 71 | No | int index, int mode | | [0, 7], 0=off, 1=on |
| Get polygon defect detection mode | gINT | 71 | Yes | int index | - int mode | [0, 7], 0=off, 1=on |
| Move polygon | sINT | 72 | No | int index, int x, int y | | [0, 7], x, y = pixels, Arguments are delta values. These can be negative as compared to the origin. |
| Reserved for future use | gINT | 72 | - | - | - | - |
| Move polygon corner | sINT | 73 | No | int corner, int delta-x, int delta-y | | [0, 7], delta-x, delta-y = pixels, corner= [0-15] |
| Get polygon corner | sINT | 73 | Yes | - | int corner, int x, int y | [0-7], x, y = pixels |

[a]The polygon index argument corresponds to the order in which the polygons are listed in the **Tools** tab in the **SOPAS Single Device**, starting with 0

*Table A.11 Command channel functions - Pixel counter*

| Description | Command | Identifier | Usable in Run mode | Arguments[a] | Return values | Range |
|---|---|---|---|---|---|---|
| Change pixel counter intensity range thresholds | sINT | 80 | No | int index, int min, int max | | [0, 31], [0, 255], min<=max, [0, 255], min<=max |
| Get pixel counter intensity range thresholds | gINT | 80 | Yes | int index | - int min, int max | [0, 31], [0, 255], [0, 255] |
| Change No. of pixels in range thresholds | sINT | 81 | No | int index, | | [0, 31], |


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

| Description | Command | Identifier | Usable in Run mode | Arguments[a] | Return values | Range |
|---|---|---|---|---|---|---|
| | | | | int min,<br>int max | | [0, ROI size[b]] pixels ,<br>min<=max,<br>[0, ROI size[b]] pixels,<br>min<=max |
| Get No. of pixels in range thresholds | gINT | 81 | Yes | int index | -<br>int min,<br>int max | [0, 31],<br>[0, ROI size[b]] pixels,<br>[0, ROI size[b]] pixels |

[a]The index argument corresponds to the order in which the pixel counter, edge pixel counter and pattern are listed in the **Tools** tab in the **SOPAS Single Device**, starting with 0. The type of tool (pixel counter, edge pixel counter or pattern) does not matter, i.e. if two Pattern tool are listed above a Pixel counter tool, the Pixel counter tool has index 2. If a tool (pixel counter, edge pixel counter or pattern) in the beginning of the list is deleted, the following tool (pixel counter, edge pixel counter or pattern) will be updated with a new index

[b]ROI size is the size of the pixel counter ROI in the reference object. Value can be fetched with the command gINT 87

*Table A.12 Command channel functions - Edge pixel counter*

| Description | Command | Identifier | Usable in Run mode | Arguments[a] | Return values | Range |
|---|---|---|---|---|---|---|
| Change edge pixel counter edge strength | sINT | 82 | No | int index,<br>int strength | | [0, 31],<br>[0, 100] |
| Get edge pixel counter edge strength | gINT | 82 | Yes | int index | -<br>int strength | [0, 31],<br>[0, 100] |
| Change No. of edge pixels thresholds | sINT | 83 | No | int index,<br>int min,<br>int max | | [0, 31],<br>[0, ROI size[b]] pixels,<br>min<=max<br>[0, ROI size[b]] pixels,<br>min<=max |
| Get No. of edge pixels thresholds | gINT | 83 | Yes | int index | -<br>int 10000*min,<br>int 10000*max | [0, 31],<br>[0, ROI size[b]] pixels,<br>min<=max<br>[0, ROI size[b]] pixels,<br>min<=max |

[a]The index argument corresponds to the order in which the pixel counter, edge pixel counter and pattern are listed in the **Tools** tab in the **SOPAS Single Device**, starting with 0. The types of the tools (pixel counter, edge pixel counter or pattern) do not matter, i.e. if two Pattern tool are listed above a Pixel counter tool, the Pixel counter tool has index 2. If a tool (pixel counter, edge pixel counter or pattern) in the beginning of the list is deleted, the following tool (pixel counter, edge pixel counter or pattern) will be updated with a new index

[b]ROI size is the size of the edge pixel counter ROI in the reference object. Value can be fetched with the command gINT 87

*Table A.13 Command channel functions - Pattern*

| Description | Command | Identifier | Usable in Run mode | Arguments[a] | Return values | Range |
|---|---|---|---|---|---|---|
| Change pattern position tolerance | sINT | 84 | No | int index,<br>int tolerance | | [0, 31],<br>[0, 4] pixels |


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

| Description | Command | Identifier | Usable in Run mode | Arguments[a] | Return values | Range |
|---|---|---|---|---|---|---|
| Get pattern position tolerance | gINT | 84 | Yes | int index | - int tol | [0, 31], [0, 4] pixels |
| Change pattern score threshold | sINT | 85 | No | int index, int thr | | [0, 31], [0, 100] percent |
| Get pattern score threshold | gINT | 85 | Yes | int index | - int thr | [0, 31], [0, 100] percent |

[a]The index argument corresponds to the order in which the pixel counter, edge pixel counter and pattern are listed in the **Tools** tab in the **SOPAS Single Device**, starting with 0. The types of the tools (pixel counter, edge pixel counter or pattern) do not matter, i.e. if two Pattern tool are listed above a Pixel counter tool, the Pixel counter tool has index 2. If a tool (pixel counter, edge pixel counter or pattern) in the beginning of the list is deleted, the following tool (pixel counter, edge pixel counter or pattern) will be updated with a new index

The table below lists the move commands for the Pixel counter, Edge pixel counter and Pattern tools.

*Table A.14 Command channel functions - Common commands for Pixel counter, Edge pixel counter and Pattern*

| Description | Command | Identifier | Usable in Run mode | Arguments[a] | Return values | Range |
|---|---|---|---|---|---|---|
| Move and rotate inspection | sINT | 86 | No | int index, int x, int y, int angle | | [0, 31], x, y = pixels, angle = degrees. Arguments are delta values. These can be negative as compared to the origin. |
| Get inspection position and rotation | gINT | 86 | Yes | int index | - int x, int y, int angle | [0, 31], x, y = pixels, angle = degrees. Return values are absolute values. These can be negative as compared to the origin. |
| Get number of pixels in ROI, Pixel Counter and Edge Pixel Counter | gINT | 87 | Yes | int index | - int pixels | [0, 31], Number of pixels in the reference object's ROI |

[a]The index argument corresponds to the order in which the pixel counter, edge pixel counter and pattern are listed in the **Tools** tab in the **SOPAS Single Device**, starting with 0. The types of the tools (pixel counter, edge pixel counter or pattern) do not matter, i.e. if two Pattern tool are listed above a Pixel counter tool, the Pixel counter tool has index 2. If a tool (pixel counter, edge pixel counter or pattern) in the beginning of the list is deleted, the following tool (pixel counter, edge pixel counter or pattern) will be updated with a new index

## A.3 Error Codes

The tables below list error codes that may result from commands or configuration of the device. The error codes are valid for Ethernet/IP, Ethernet Raw, EtherCAT and Web Server. Both error code and an explaining text are shown when using Ethernet Raw for configuring the device through the command channel. When using EtherNet/IP for configuring the device through the command channel will only view the error code.


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

*Table A.15 Error codes - Command errors*

| Error code | Description |
|---|---|
| 0 | No error |
| 8000 | Index out of bounds, for example trying to use an image bank above 32 |
| 8001 | Incorrect number of arguments, too many or too few arguments are supplied |
| 8002 | A parameter value is out of bounds, for example it was not in the allowed range as described in the command list |
| 8003 | Command with no valid identifier, for example sINT 200 |
| 8004 | An invalid mode was supplied sMOD, for example sMOD 2 |
| 8005 | The device is performing an operation and cannot accept new command |
| 8006 | Set commands are disabled for this interface |

*Table A.16 Error codes - Configuration errors*

| Error code | Description |
|---|---|
| 0 | No error |
| 8100 | Operation is not allowed in current mode |
| 8101 | The reference bank is not used on the device |
| 8102 | Operation is not allowed, for example trying sINT 20 0 when not in calibration mode |
| 8103 | Calibration mode is not enabled when trying to perform calibration or trying to remove non-existent calibration |
| 8104 | No object locator is available in current reference bank |
| 8105 | No blob tool with this index exists |
| 8106 | Polygon defect detection is not enabled |
| 8107 | No polygon with supplied index exists |
| 8108 | No pixel counter with supplied index exists |
| 8109 | No edge pixel counter with supplied index exists |
| 8110 | No pattern inspection with supplied index exists |
| 8111 | The move or rotation caused the ROI to appear outside of the FOV |
| 8112 | Trig is not activated |
| 8113 | The specified IP address was invalid, or an invalid combination of addresses was used |
| 8113 | The specified network mask was invalid |
| 8113 | The specified gateway address was invalid |
| 8113 | The combination of IP settings was invalid |
| 8114 | Calibration failed |
| 8115 | Interface not available. Only interfaces that exist in the product can be enabled/disabled |

## A.4 Version information

The command channel is continually extended with new commands. The intention is to always keep the command set backwards compatible with earlier versions. This table lists the available versions and the updates between each version.


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

*Table A.17 Command channel versions*

| Version | Released in | Comments |
|---|---|---|
| 3 | PI50 1.0 | First official version |
| 4 | PI50 ECAT | Added possibility to move a Polygon (sINT 72, sINT/gINT 73). Added SAVE and TRIG commands. Added PI50 ECAT specific command gINT 19 |
| 5 | PI50 1.1 | Added commands for controlling image trig delay and output delay (sINT/gINT 21, 22, 23). Added command gRES to retrieve Ethernet Output String. TRIG made availble in Run mode on the command port. |

## A.5 Command Examples

### A.5.1 Command Examples Ethernet Raw

*Table A.18 Commands Ethernet Raw - general examples*

| Description | Command | ACK message |
|---|---|---|
| Switch to Run mode | sMOD 0 | rsMOD 0 |
| Switch to Edit mode | sMOD 1 | rsMOD 0 |
| Get device mode | gMOD | rgMOD 0 1 |
| Set trigger mode to free-running | sINT 16 0 | rsINT 16 0 |
| Set trigger mode to triggered | sINT 16 1 | rsINT 16 0 |
| Get trigger mode | gINT 16 | rgINT 16 0 0 – if free-running<br>rgINT 16 0 1 – if triggered by Ethernet |
| Set defect intensity thresholds to 200-255 for polygon 2 | sINT 69 2 200 255 | rsINT 69 0 |
| Get defect intensity thresholds for polygon 2 | gINT 69 2 | rgINT 69 0 200 255 – if OK<br>rgINT 69 8107 polygon does not exist – if not OK |

*Table A.19 Commands Ethernet Raw - device settings and actions examples*

| Description[a] | Command(s) | ACK message |
|---|---|---|
| Set device IP address<br>Apply IP settings | sINT 120 192 168 1 110<br>aACT 5 0[b] | rsINT 120 0<br>raACT 5 0 |
| Set device netmask<br>Apply IP settings | sINT 121 255 255 255 0<br>aACT 5 0[b] | rsINT 121 0<br>raACT 5 0 |
| Set device gateway (optional)<br>Apply IP settings | sINT 122 192 168 1 1<br>aACT 5 0[b] | rsINT 122 0<br>raACT 5 0 |
| Enter calibration mode<br>Perform calibration | sINT 20 1<br>aACT 3 6 | rsINT 20 0<br>raACT 3 0 75[c] |

[a]The below examples can also be done by sending the set device IP address, set device netmask and set device gateway in a sequence and then send the aACT 5 command to activate all these settings

[b]The aACT 5 command will make the device being temporarily disconnected while the new settings are applied. After this command the new IP address will have to be used in order to connect to the devic

[c]Returned value is the calibration target coverage in percent


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

### A.5.2 Command Examples EtherCAT

**Example 1: Switch from Run mode to Edit mode**

Command string:

00 00 00 00 00 00 00 00 01 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

*Table A.20 Command: Switch from Run mode to Edit mode*

| | | | |
|---|---|---|---|
| **Command** | Byte [0-3] | 00 00 00 00 | 0: sMOD |
| **Identifier** | Byte [4-7] | 00 00 00 00 | 0: - |
| **Param1** | Byte [8-11] | 01 00 00 00 | 1: edit mode |
| **Param2** | Byte [12-15] | 00 00 00 00 | not used |
| **Param3** | Byte [16-19] | 00 00 00 00 | not used |
| **Param4** | Byte [20-23] | 00 00 00 00 | not used |
| **Param5** | Byte [24-27] | 00 00 00 00 | not used |
| **Param6** | Byte [28-31] | 00 00 00 00 | not used |

Response string:

01 00 00 00 00 00 00 00 00 00 00 00 00 00 01 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 72 73 4D 4F 44 ...

*Table A.21 ReplyCommand: Switch from Run mode to Edit mode*

| | | | |
|---|---|---|---|
| **Status** | Byte [0] | 01 | Status: OK |
| **Unused** | Byte [1] | 00 | not used |
| **ReplyCommand** | Byte [2-5] | 00 00 00 00 | 0: rsMOD |
| **Identifier** | Byte [6-9] | 00 00 00 00 | 0: - |
| **ErrorCode** | Byte [10-13] | 00 00 00 00 | 0: no error |
| **retVal1** | Byte [14-17] | 01 00 00 00 | 1: edit mode |
| **retVal2** | Byte [18-21] | 00 00 00 00 | not used |
| **retVal3** | Byte [22-25] | 00 00 00 00 | not used |
| **retVal4** | Byte [26-29] | 00 00 00 00 | not used |
| **retVal5** | Byte [30-33] | 00 00 00 00 00 | not used |
| **retVal6** | Byte [34-37] | 00 00 00 00 00 | not used |
| **resString** | Byte [38-106] | 72 73 4D 4F 44 ... | ”rsMOD”... |

**Example 2: Set triggered mode to triggered**

Command string:

02 00 00 00 10 00 00 00 01 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

*Table A.22 Command: Set triggered mode to triggered*

| | | | |
|---|---|---|---|
| **Command** | Byte [0-3] | 02 00 00 00 | 2: sINT |
| **Identifier** | Byte [4-7] | 10 00 00 00 | 16: switch to trigger mode |
| **Param1** | Byte [8-11] | 01 00 00 00 | 1: triggered mode |
| **Param2** | Byte [12-15] | 00 00 00 00 | not used |
| **Param3** | Byte [16-19] | 00 00 00 00 | not used |
| **Param4** | Byte [20-23] | 00 00 00 00 | not used |
| **Param5** | Byte [24-27] | 00 00 00 00 | not used |
| **Param6** | Byte [28-31] | 00 00 00 00 | not used |

Response string (if the Inspector PI50 is in Edit mode):

01 00 02 00 00 00 10 00 00 00 00 00 00 00 01 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 72 73 49 4E 54 ...

*Table A.23 ReplyCommand: Set triggered mode to triggered (Inspector PI50 in Edit mode)*

| | | | |
|---|---|---|---|
| **Status** | Byte [0] | 01 | Status: OK |
| **Unused** | Byte [1] | 00 | not used |
| **ReplyCommand** | Byte [2-5] | 02 00 00 00 | 2: rsINT |
| **Identifier** | Byte [6-9] | 10 00 00 00 | 16: swtich trigger mode |
| **ErrorCode** | Byte [10-13] | 00 00 00 00 | 0: no error |
| **retVal1** | Byte [14-17] | 01 00 00 00 | 1: triggered mode |
| **retVal2** | Byte [18-21] | 00 00 00 00 | not used |
| **retVal3** | Byte [22-25] | 00 00 00 00 | not used |
| **retVal4** | Byte [26-29] | 00 00 00 00 | not used |
| **retVal5** | Byte [30-33] | 00 00 00 00 00 | not used |
| **retVal6** | Byte [34-37] | 00 00 00 00 00 | not used |
| **resString** | Byte [38-106] | 72 73 49 4E 54 ... | ”rsINT”... |

Response string (if the Inspector PI50 is in Run mode):

03 00 02 00 00 00 10 00 00 00 A4 1F 00 00 01 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 72 73 49 4E 54...


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

*Table A.24 ReplyCommand: Set triggered mode to triggered (Inspector PI50 in Run mode)*

| | | | |
|---|---|---|---|
| **Status** | Byte [0] | 03 | Status: NOK |
| **Unused** | Byte [1] | 00 | not used |
| **ReplyCommand** | Byte [2-5] | 02 00 00 00 | 2: rsINT |
| **Identifier** | Byte [6-9] | 10 00 00 00 | 16: swtich trigger mode |
| **ErrorCode** | Byte [10-13] | A4 1F 00 00 | 8001: Operation not allowed in Run mode |
| **retVal1** | Byte [14-17] | 01 00 00 00 | 1: triggered mode |
| **retVal2** | Byte [18-21] | 00 00 00 00 | not used |
| **retVal3** | Byte [22-25] | 00 00 00 00 | not used |
| **retVal4** | Byte [26-29] | 00 00 00 00 | not used |
| **retVal5** | Byte [30-33] | 00 00 00 00 00 | not used |
| **retVal6** | Byte [34-37] | 00 00 00 00 00 | not used |
| **resString** | Byte [38-106] | 72 73 49 4E 54 ... | ”rsINT”... |


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

# B Web API

## B.1 Select Reference Object in Run Mode

The operation to select reference object in Run mode require a login and consists of several steps.

1. Create a session cookie
2. Login
3. Select reference object
4. Logout

### B.1.1 Create a Session Cookie

A session cookie is used to handle operations requiring login with user name and password. The session cookie is created before performing the login operation and the cookie must then be supplied in the login operation and for all following operations.

**Operations**

```
CREATE COOKIE
```

### B.1.2 Login

A login with the user name "Maintenance" is required to change settings on the device. The password is the password stored on the device. Default password is "Inspector".

The response to the login request is an HTML page indicating a successful login.

**Operations**

```
CREATE SOCKET
CONNECT TO SOCKET(<IP address>, port = 80)
SEND HTTP POST REQUEST (to="/HandleConfig", data = "sopas_username=Maintenance&sopas_password=<login_password>")
CLOSE SOCKET
```

**URL template (replace items in "<>")**

```
POST /HandleConfig HTTP/1.1\r\nHost: <IP address>\r\nConnection: Keep-Alive\r\nCookie: <Session cookie>\r\n\r\nsopas_username=Maintenance&sopas_password=<login_password>
```

### B.1.3 Select Reference Object

Send reference object index to select reference object. The index is entered after the string "%3FrefBank%3D".

The response to the select reference object request is an HTML page with a presentation of the name of the currently selected reference object.

**Note**

The reference object index range is [0, 31]. Sending reference object index >32 in the command may cause the device to restart.

**Operations**

```
CREATE SOCKET
CONNECT TO SOCKET(<IP address>, port = 80)
SEND HTTP POST REQUEST (to="/ReferenceObject", data = "bankList=%3FrefBank%3D<reference_object_index>&applyBank=Apply")
```


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

```
CLOSE SOCKET
```

**URL template (replace items in "<>")**

```
POST /HandleConfig HTTP/1.1\r\nHost: <IP address>\r\nContent-Type: ap-
plication/x-www-form-urlencoded\r\nConnection: Keep-Alive\r\nCookie:
<Session cookie>\r\n\r\nbankList=%3FrefBank%3D<reference_object_index>&ap-
plyBank=Apply
```

### B.1.4 Logout

Logout to free resources on the device.

**Operations**

```
CREATE SOCKET
CONNECT TO SOCKET(<IP address>, port = 80)
SEND HTTP GET REQUEST (to="/HandleConfig?logout=1")
CLOSE SOCKET
```

**URL template (replace items in "<>")**

```
GET /HandleConfig?logout=1 HTTP/1.1\r\nHost: <IP address>\r\nConnection:
close\r\nCookie: <Session cookie>\r\n\r\n
```

## B.2 Restore Configuration

The restore configuration operation takes a device configuration created with the backup functionality and replaces the current configuration with the configuration in the backup file. The operation is a multiple step procedure with the following steps:

1. Create session cookie
2. Login
3. Prepare restore mode
4. Transfer restore file to device
5. Device restart

The restore operation will remove the previous configuration and replace it with a new configuration. The IP address and the chessboard calibration will not be updated by the restore operation. It is not possible to use the device for other purposes during the restore operation. The operation may take several minutes to perform and the time is partly depending on the size of the backup file.

### B.2.1 Create Session Cookie

A session cookie is used to handle operations requiring login with user name and password. The session cookie is created before performing the login operation and the cookie must then be supplied in the login operation and for all following operations.

**Operations**

```
CREATE COOKIE
```

### B.2.2 Login

A login with the user name "Maintenance" is required to change information on the device. The password is the password stored on the device. Default password is "Inspector".

**Operations**

```
CREATE SOCKET
CONNECT TO SOCKET(<IP address>, port = 80)
```


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

```
SEND HTTP POST REQUEST (to="/HandleConfig", data = "sopas_username=Main-
tenance&sopas_password=<login_password>")
CLOSE SOCKET
```

**URL template (replace items in "<>")**

```
POST /HandleConfig HTTP/1.1\r\nHost: <IP address>\r\nConnection: Keep-
Alive\r\nCookie: <Session cookie>\r\n\r\nsopas_username=Mainten-
ance&sopas_password=<login_password>
```

### B.2.3 Prepare Restore Mode

This operation will terminate normal device operation and set the device to focus on receiving the backup file contents.

After the completion of this step, the device is in transfer file mode. All other interaction with the device except the transfer file requests may interfere with the transfer file operation and should be avoided.

**Operations**

```
CREATE SOCKET
CONNECT TO SOCKET(<IP address>, port = 80)
SEND HTTP GET REQUEST (to="/SelectRestore?prepare_on")
CLOSE SOCKET
```

**URL template (replace items in "<>")**

```
GET /SelectRestore?prepare_on HTTP/1.1\r\nHost: <IP address>\r\nConnec-
tion: Keep-alive\r\nCookie: <Session cookie>\r\n\r\n
```

### B.2.4 Transfer Restore File to Device

During the transfer phase the contents of the backup file is transferred to the device.

**Operations**

```
CREATE SOCKET
CONNECT TO SOCKET(<IP address>, port = 80)
SEND HTTP POST REQUEST (to="/RestoreConfig", data=<full path to backup
file>)
CLOSE SOCKET
```

**URL template (replace items in "<>")**

```
POST /RestoreConfig HTTP/1.1\r\nContent-Length: <File size>\r\nHost: <IP
address>\r\nCookie: <Session cookie>\r\nConnection: Keep-Alive\r\nContent-
Type: multipart/form-data; bound-
ary=cd07053eab074616b9c4703b70584d7dwH!aE1l@?dP/K:Pd--
cd07053eab074616b9c4703b70584d7d\r\nContent-Disposition: form-data;
name="datafile"; filename="<full path to backup file>"\r\nContent-Type:
text/plain; charset=utf-8\r\n\r\nFormatVersion=RAW01.00 <Data and more
data>
```

### B.2.5 Device Restart

When the transfer is completed, the parameters on the device are updated and the configuration is stored permanently on the flash file system. The device is then restarted.


©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

# Index




©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

## S



## T



## V



## W



## X




©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

©SICK AG • Advanced Industrial Sensors • www.sick.com • All rights reserved
Subject to change without notice

8014694/2012-08 · 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**



SICK
Sensor Intelligence.