



TECHNICAL DESCRIPTION

Industrial Vision Camera IVC-2D

SICK|IVP

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IVC-2D

1 Introduction

The IVC-2D is a Smart Camera that combines image acquisition and analysis into one camera housing. The product performs inspection, location or measurement of objects in order to enhance production yield, control production or perform quality control.

The IVC-2D is a configurable camera that can be programmed to perform many different applications. The program is set-up through a graphical user interface called IVC Studio.

The product package contains

- IVC-2D with about 100 image processing tools grouped in 11 different categories
- IVC Studio, the PC software to configure the camera and make application programs.

The system can hold up to 100 different programs which are easily switched by I/O signals or Ethernet connection.

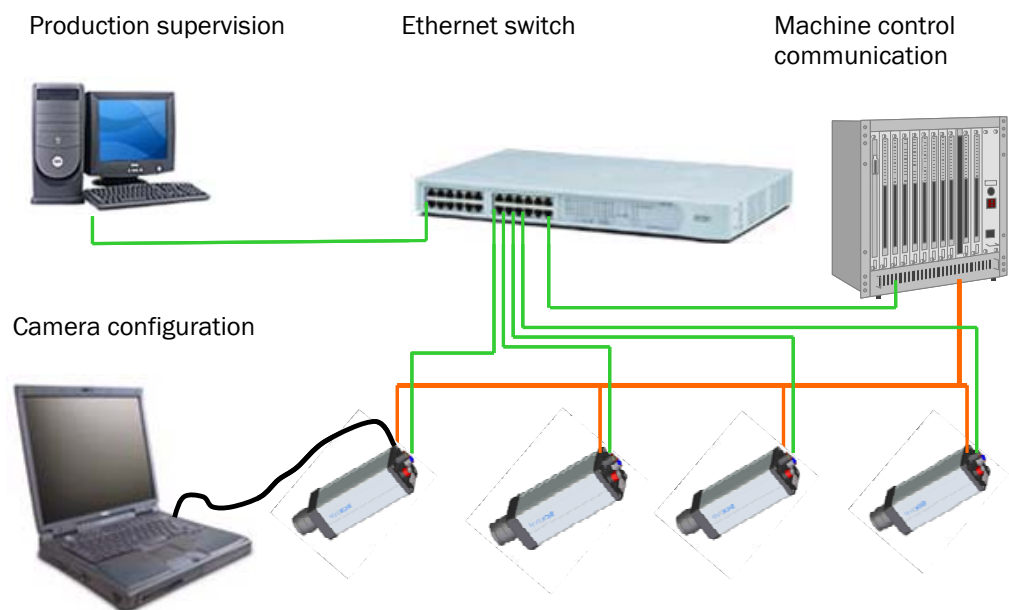


Figure 1.1 The IVC-2D communication overview from a developers and production line perspective.

2 IVC-2D Camera

The IVC-2D has a 640x480 pixel black and white sensor capable of 30 fps frame rate with global shutter functionality. The image processing operations is run on a GHz processor which along with an extensive SDRAM memory and a permanent flash memory builds a powerful smart camera. The camera also holds optimized pixel processing in FPGA.

The camera communicates over 10/100 MB Fast Ethernet using TCP/IP and UDP/IP protocols. It is connected to the local network or a PC via a standard network switch. The camera also has RS485 serial communication. There are 3 program control inputs and a trigger input. There are also 3 program control outputs and a fast illumination trigger output. The program control outputs are of npn/pnp type (B-type) and the inputs consider signals between 10-28 V as high, see technical specification in Ch. 4. The system also has a software controlled LED.

To trigger the IVC-2D the easiest way is to use as standard photoelectric switch with a pnp output, which can be directly connected to the inputs. The trigger input can be set in the software to work on falling or rising edges of the trigger signal.

2.1 Accessories

A full range of accessories are available to solve many applications. Apart from lenses and illumination described in the following chapters there are cables, photo-electric sensors brackets and IP protection items. All accessories are built for easy connection through T-coupling elements to the camera, or direct connection through your standard I/O connection boxes.

2.2 Illumination

Good illumination is essential for a robust machine vision application. SICK IVP offers a wide range of lighting modules which can be direct connected to the IVC-2D. All lighting modules can be triggered by direct connection to the camera power I/O connector via a T-coupling element.

Ring light

The ICL110 white ring light is a high-intensity robust lighting module that can be mounted on the IVC-2D using an adaptor plate. The working distance to the object range from 100 mm to 300 mm and illuminates an area of up to 200 mm diameter. The illumination times range from 100 μ s to 10 ms. ICL110 has IP65 protection class.

Back light

The IP67 classified red backlights generate a diffuse light that generally is directed towards the camera for detecting silhouette of a non-transparent object or interiors of transparent objects. For more information see ICL100 and ICL180 product information

Spot lights

There are ring shaped spot lights available in green. They provide a homogeneous high-intensity illumination to the scene. The spot lights have IP65 classification and are available in different fixed focal distances and field-of-views. For more information see ICL20 and ICL40 product information.

2.3 Lenses

There is a selection of lenses available from SICK IVP that fulfils a major part of the most common field-of-views. For IVC-2D CS-mount and C-mount standard lenses can be used, since a converter ring is attached to all cameras from factory. The converter ring should remain mounted together with a C-mount lens (see Figure 2.1). When a CS-mount lens is selected, the converter ring is easily removed.



Figure 2.1 C-mount lens with adapter ring.

The dimensions of the field-of-view at various object distances and three standard lenses are shown in Figure 2.3. The size of the image chip is 1/3" which is 3.6 mm x 4.8 mm. This information may be required when selecting a lens other than the above mentioned.

Use the following formulas to calculate the field-of-view of any other lens:

$$\text{height} \approx 3.6 \text{ mm} / f * \text{object distance}$$

$$\text{width} \approx 4.8 \text{ mm} / f * \text{object distance}$$

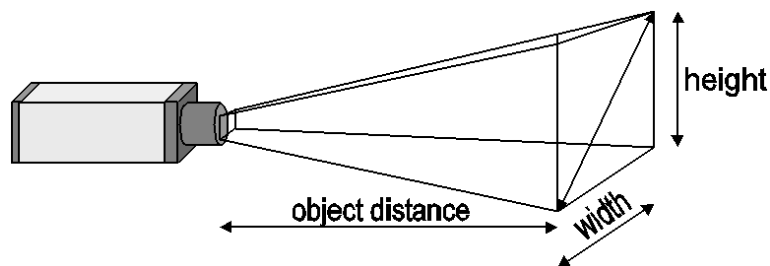


Figure 2.2 Field-of-view at a specific distance.

Note: If the object distances come in the range of the minimum object distance (MOD), an extension ring (accessory) should be used. Otherwise the image at those object distances might be out-of-focus. In Figure 2.3 the distances at which this extension ring should be used is marked blue.

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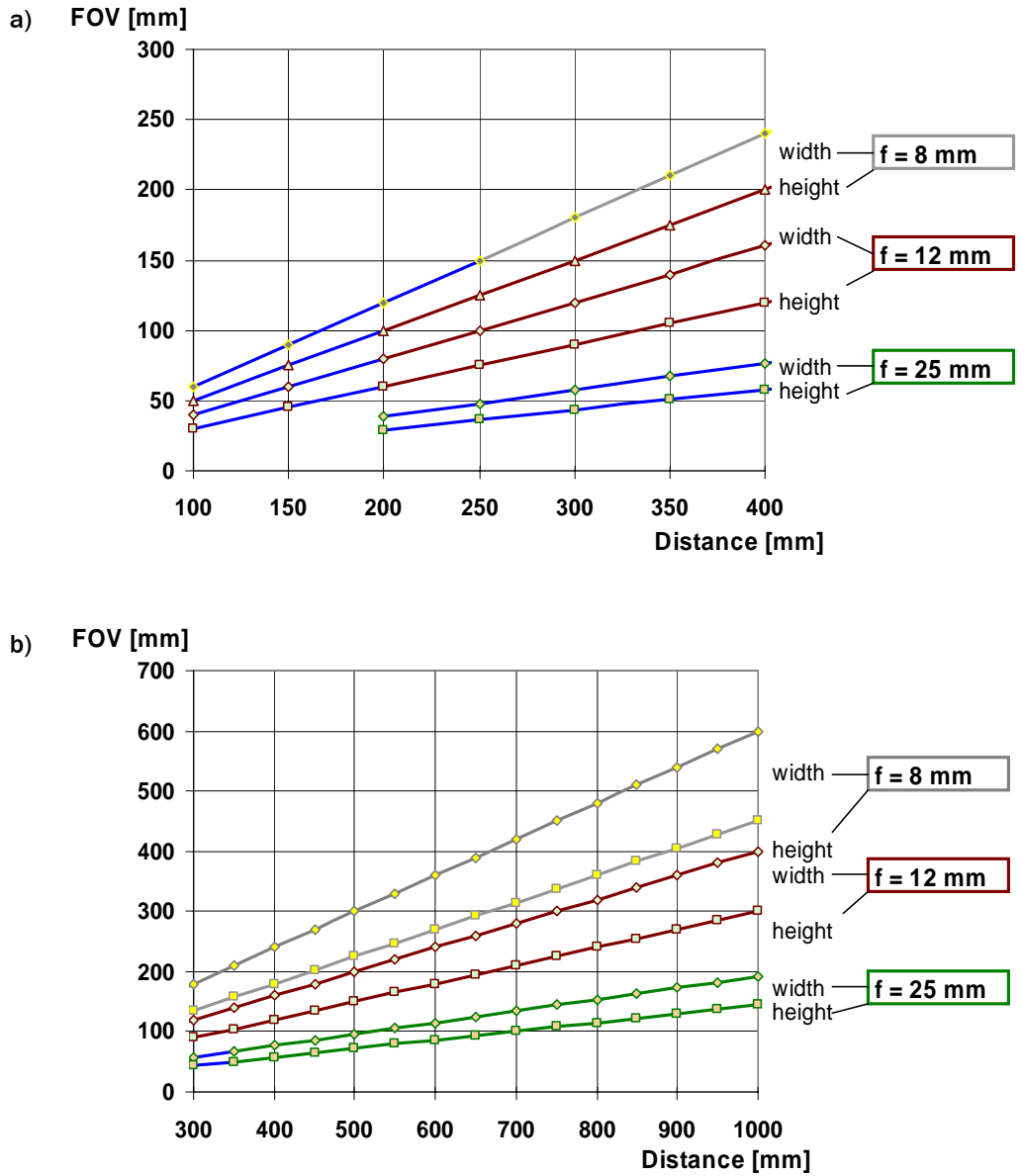


Figure 2.3 Field of views for SICK IVP lenses from 100mm to 400mm (a) and 0.3m to 1m (b)

3 Image processing tools

To build an application the image processing tools contained in the camera are configured to a program using the IVC studio environment. An application program is created in following steps:

1. Using the interactive IVC Studio to create a step program
2. Test the program in a debug environment in the IVC Studio, with the laptop still connected
3. Run the program stand-alone in production
4. Check production statistics remote by using the web-tool

3.1 IVC Studio

The IVC studio is a graphical programming environment where the required image processing tools are selected by clicking on icons and setting parameters either by movement of the mouse or by entering values in parameter fields. The IVC studio is designed for professionals and provides a short development time through fast prototyping and debugging.

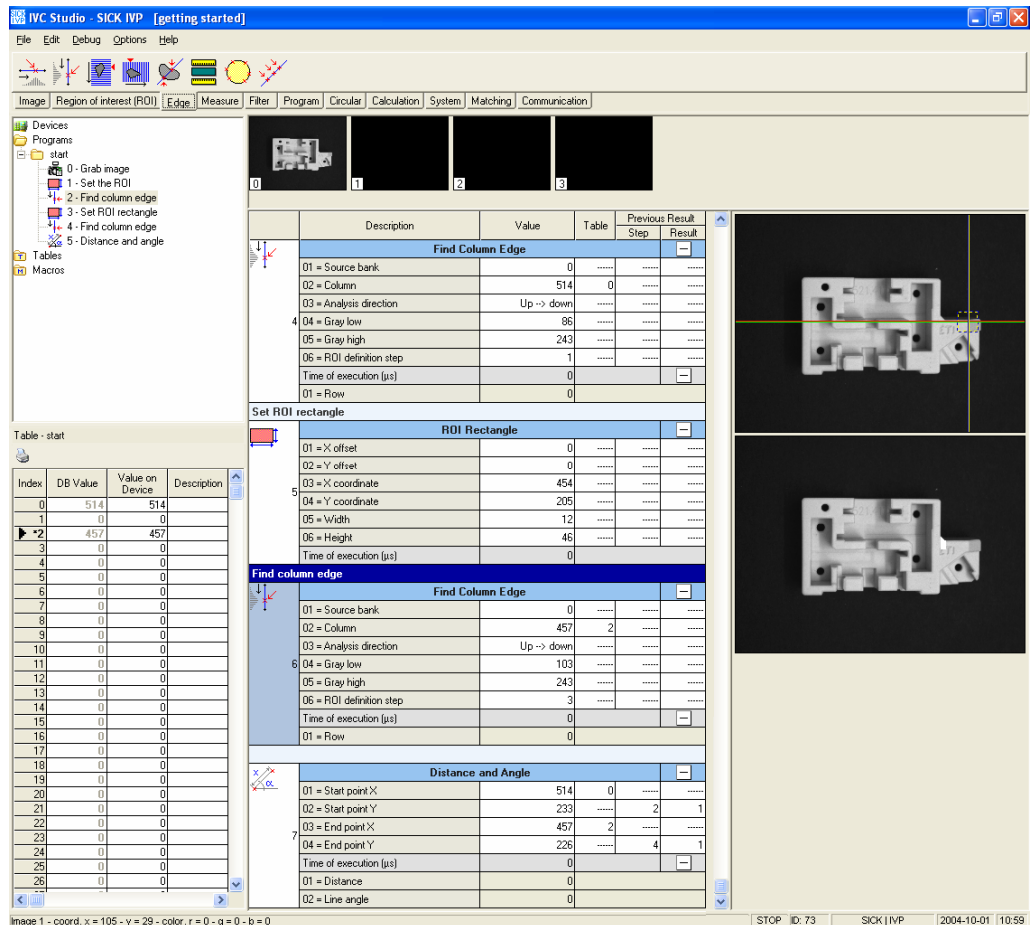


Figure 3.1 The programming view in IVC studio showing a few steps in a program.

3.2 IVC tools

There are about 100 advanced image processing tools in the standard version of IVC-2D.

Image

The image tool group contains tools that are used for grabbing and image to work with, to add graphics in the images and edit the image banks, which is the image memory in the camera.

Region of interest

The region of interest (ROI) tools are used to define an area where the other tools should work in. These tools speed up the image processing since the entire image is not treated.

Edge

The edge tools are used to find object edges in the pictures and the coordinates of the objects. It is possible to scan the image from all different directions and also to find multiple edges on one specific line

Measure

This category contain tools that measure area, center of mass, find and measure blobs and measure distance and angle.

Filter

The filter tools can be applied to enhance features in the image. There are erode and dilate tools as well as binarization tools to transform grayscale images to binary.

Calculation

Calculation tools are used to find if values are in correct ranges, deviation of round objects from circles etc.

Circular

In the circular tool category a specific set of tools is available. It is possible to check perimeters of objects, diameters, the surface and outer shape of objects.

Matching

The IVC matching tools can be taught a rotation of an object and then match the object rotation to the stored original. The matching tools can also match, locate and count shapes of taught objects in the images.

Program

The step programming tools are used for defining loops and conditions in programs. Some of the available tools are: For, If, Else, If then goto, If in range goto, Run program, and Subroutine.

The subroutine is a powerful tool when optimizing the program. It increases the overview and readability of your program.

Communication

The communication tools are used to set outputs and read inputs, to send values over RS485 and Ethernet.

System

The system group contains tools to insert delays in the program, to save values or results to a permanent flash memory, and to write and read result or parameter values to a memory separate from the actual program (the Table).

4 Technical specification

Table 4.1 Technical data for IVC-2D

	IVC-2DM1111	Remarks
Imager	CCD, electronic shutter	
Lens adaptation	CS-mount and C-mount ¹⁾	
Pixel resolution	640 x 480	1/3" and 3.6 mm x 4.8 mm
Spectral response	approx. 400 nm ... 750 nm	
Exposure time	64µs to 500ms	
Power supply	DC 24 V ± 20%	
Current consumption	< 400 mA	without load; without lighting
Ripple	< 5V _{SS}	
Connectors	Power I/O: M12, 8-pin, male Ethernet: M12, 4-pin, D-coded, female RS485 I/O: M12, 8-pin, female	
Digital inputs	HIGH = 10V ... 28.8V	
Digital outputs	B - types; <100mA	100mA = total amount of all digital outputs
Serial Interfaces	RS485 Ethernet: 100Mbit/s	
Operating temperature	0 °C ... 50 ° C	
Storage temperature	-20° C ... 70° C	
Shock load	15g, 3 x 6 directions	
Vibration load	5 g, 58 ... 150 Hz	
Weight	approx. 505 g	
Dimensions	161 mm x 60 mm x 55 mm	L x W x D
Enclosure rating	IP 54 (with hood)	
Housing material	Aluminum, anodized; Connectors = nickel plated brass Front window of hood = PMMA	

IVC-2D

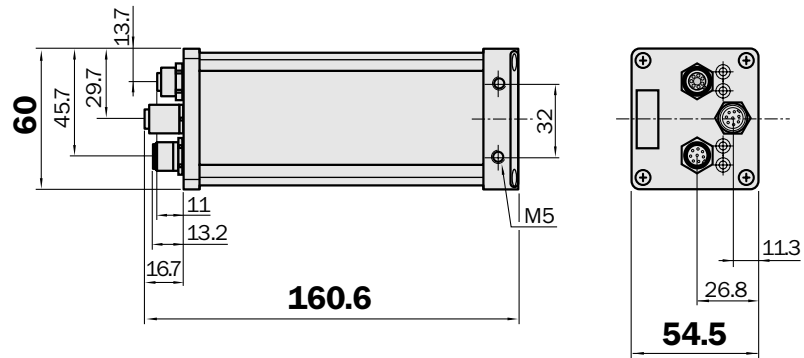


Figure 4.1 Camera IVC-2D without adapter plate for ring light.

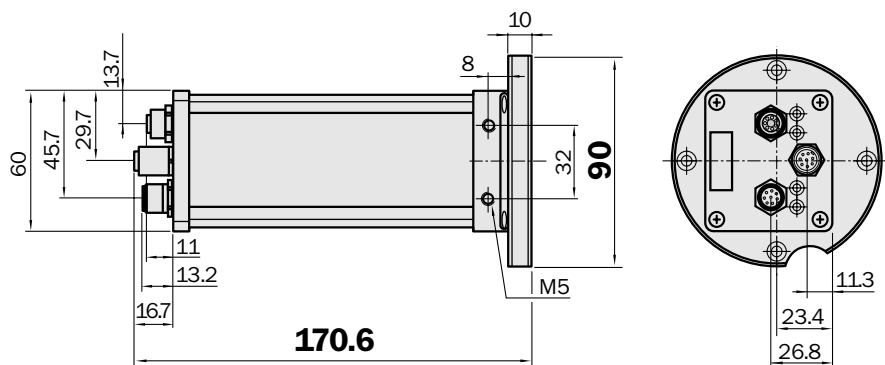





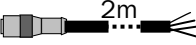
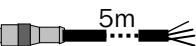

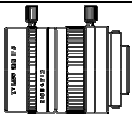
Figure 4.2 Camera IVC-2D with adapter plate for ring light

5 Ordering information

IVC-2D components




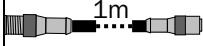
Part Number	Type	Graphic	Description
1027190	IVC-2DM1111		Camera for taking 2D images
8 010 923	-		CD-ROM with IVC Studio software and manual
8 010 924	-		Short introductory description for getting started

Accessories

Part Number	Type	Graphic	Description
6 020 633	DOL-1208-G02MA		M12, 8-pin, female plug with cable, 2m, for power and I/O
6 020 993	DOL-1208-G05MA		M12, 8-pin, female plug with cable, 5m, for power and I/O
6 029 630	SSL-2J04-G03ME		M12, 4-pin (D-coded) to RJ45 Ethernet cable, 3m
5 314 041	-		lens, 8 mm focal length
5 314 042	-		lens, 12 mm focal length
5 314 043	-		lens, 25 mm focal length

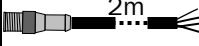
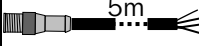



Lighting

In order to run the IVC-2D in a stable operation mode it is necessary to use an intense light source, especially designed for machine vision. A selection of such lights can be seen in chapter "Illumination selection guide". When using the illumination ICL 110-F142 the following table shows the required parts:

Part Number	Type	Graphic	Description
1 027 286	ICL 110-F142		Ring light for IVC-2D with 12 high power LEDs, white, for working distances from 100 to 300 mm.
4 040 930	-		adapter plate for ring light 1027286
6 026 503	SBO-02F12-SF		T-splitter, M12, 8-pin, for external light connection
6 026 625	DSL-1208-G01MB		M12 - M12, 8-pin connector for external light

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Optional as accessories

Part Number	Type	Graphic	Description
6 029 330	STL-1208-G02MA	 2m	M12, 8-pin, male with 2m cable for RS485 and secondary I/O
6 029 331	STL-1208-G05MA	 5m	M12, 8-pin, male with 5m cable for RS485 and secondary I/O
2 032 753	BEF-GH-IVC2D		mounting bracket
2 032 637			hood for covering the lens with screws and additional small screws for fixing the rings on the lenses (long hand driven screws of lenses to be removed)
2 032 968			hood for covering the lens if the ICL110 is mounted on the camera
4 041 112	-		extension ring, d = 0.6mm, for small MOD's (Minimum Object Distances)