# Vision Sensors

**3**

## Vision sensors – Simple and intelligent

### SIMATIC MV220 color mark sensor

The SIMATIC MV220 compact color mark sensor is a complete image processing system for automatic inspection of colored objects. It is ideally suited for use under harsh industrial conditions due to its degree of protection IP65.

It is used for applications in manufacturing, the packaging industry and food and beverages industry. It is so easy to operate that no courses are necessary and the system is "trained" instead of programmed, so even non-experts can use it instantly. It is integrated in the plant automation using digital inputs and outputs.

### Highlights

**SIMATIC MV220 color mark sensor**

- Eminently suitable for use in harsh industrial environments thanks to degree of protection IP65
- Control of extremely high-speed processes possible thanks to the short inspection time of the sensor (approximately 30 inspections per second)
- Short changeover times thanks to simple model change
  - 16 inspection models can be taught
  - Inspection models are selected using digital inputs
- Flexible adaptation to the individual applications possible
  - Flexible adjustment of image window and operating distance
  - Flexible adjustment of parameters
- Fast commissioning
  - No image processing knowledge necessary
  - No programming necessary

### SIMATIC MV230 surface profile sensor

The SIMATIC MV230 compact surface profile sensor is a complete image processing system for the automatic inspection of objects based on their surface contour or profile. It is ideally suited for use under harsh industrial conditions due to its degree of protection IP65.

The application areas lie in production engineering, machine construction and the packaging industry. It is so easy to operate that no courses are necessary and the system is "trained" instead of programmed, so even non-experts can use it instantly. It is integrated in the plant automation using digital inputs and outputs.

### Highlights

**SIMATIC MV230 surface profile sensor**

- Eminently suitable for use in harsh industrial environments thanks to degree of protection IP65
- Shielding against ambient light is not usually necessary due to its high degree of immunity to ambient light
- Short changeover times thanks to simple model change
  - 16 inspection models can be taught
  - Inspection models are selected using digital inputs
- Flexible adaptation to the individual applications possible
  - Flexible adjustment of the laser line range that can be evaluated
  - Flexible adjustment of parameters
- Fast commissioning
  - No image processing knowledge necessary
  - No programming necessary
- Effective start-up and maintenance functions using diagnostics, checksums and statistical information
- Prevention of unauthorized operation through button disabling

### SIMATIC VS120 Vision Sensors

For inspection of small components for shape, type or position, our intelligent VS120 vision sensors are the perfect choice. The complete package comprises lighting, evaluation unit, sensor and cables. They are installed and commissioned with a flick of the wrist. It is so easy to operate that no courses are necessary and the system is "trained" instead of programmed, so even non-experts can use it instantly.

The compact design allows it to be used in a wide range of different infeed systems such as vibrating conveyors, conveyor belts or grippers. Thanks to standardized interfaces, the vision sensors can be flexibly integrated into the plant automation. For simple conveyor units, a stand-alone solution is available without an additional PLC.

### Highlights

**SIMATIC VS120 Vision Sensors**

- Simple configuration by presenting the "good" object to be detected.
- The "teach-in" is performed automatically when the training function of the device is activated.
- Parameters are assigned by means of a web-based user interface that is executable on different platforms to which the following requirements apply: Browser (IE5.5 and higher) or JAVA-VM (MS, SUN).
- The web-based user interface can also be used to control the device from an HMI device. The requirements regarding the browser and JAVA VM also apply here.
- Remote maintenance concept by means of web-based user interface.
- Remote control via integrated digital inputs, PROFIBUS or PROFINET IO.
- Supplied as a complete package in several variants for different object sizes

## Application

| Fields of application for the vision sensors | |
|---|---|
| **Object inspection with SIMATIC MV220** | |
| Inspection task | Color inspection tasks in manufacturing and assembly systems |
| Applications | Manufacturing, packaging industry and food and beverages industry |
| Type of parts to be inspected | e.g. completeness of colored parts, blister packs, cups, bottles, labels and covers |
| **Object inspection with SIMATIC MV230** | |
| Inspection task | Inspection of surface contours and profiles in production engineering and assembly |
| Applications | Production engineering, the packaging industry and machine construction |
| Type of parts to be inspected | Inspection, parts recognition and position checking of parts based on their geometric surface contour or profile |
| **Object inspection with SIMATIC VS120** | |
| Inspection task | Correctness, lack of damage and position of a part or pattern; position of the part with x/y coordinate and angle of rotation in degrees |
| Applications | Conveyor belts, workholder carousels, gripper units, production machines |
| Type of parts to be inspected | e.g. screws, bolts, molded parts, pharmaceutical products, confectionery, logos, patterns ... |

## Technical specifications

| Type | MV220 | MV230 | VS120 |
|---|---|---|---|
| Main task | Object inspection (color) | Object inspection | Object inspection |
| Sensor type | CMOS sensor (color), 640 x 480 pixels | CMOS sensor, 750 x 480 pixels | CCD chip, 640 x 480 quadratic pixels |
| Image capture | Digital, max. 33 frames/second | Digital, 20 frames/second | Triggered frame transfer |
| Sensor head type | Variable display field size | Fixed display field size | 2 x fixed focus with fixed display field size, 1 x C/CS-Mount with variable display field size |
| • Available versions | Complete system | | |
| • Enclosure | see below | see below | Extruded aluminum enclosure |
| • Degree of protection | IP65 | IP65 | IP65 |
| Parts size (W x H) | Display field size (infinitely) adjustable  • For object distance of 50 mm: Display field size 40 x 30 mm  • For object distance of 250 mm: Display field size 200 x 150 mm | • For object distance of 310 mm: Display field size 75 x 100 mm | • Objects up to 60 x 40 mm, inspection window: 70 x 50 mm  • Objects up to 34 x 24 mm, inspection window: 40 x 30 mm  • Variable size of object with C/CS-Mount |
| Ambient temperature | 0 … 45 °C, no condensation | 0 … 45 °C, no condensation | 0 … 50 °C, without fans |
| Lighting | | | |
| • Illuminant | Integrated white LEDs | Laser diode, red light | Red LEDs |
| • Enclosure | see below | see below | Plastic ring light with plastic diffusing panel |
| • Degree of protection | IP65 | IP65 | IP65 |
| Evaluation unit | | | |
| • Operator controls | 4-character text display with 4 operator buttons | 4-character text display with 4 operator buttons | LCD display panel (4 lines with 10 characters each) and 6 operator buttons for menu operation |
| • Number of types to be saved | up to 16 | up to 16 | up to 64 |
| • Triggering inspection | External | External or internal freewheeling trigger | External |
| • Permissible parts rate | 33 inspections/s | 20 inspections/s | 20 items/s (object-dependent) |
| Infeed direction | | | |
| - For external triggering | Any | Any | Any |
| - For automatic triggering | - | Any | - |
| Enclosure (degree of protection) | Plastic, aluminum (IP65) | Plastic, aluminum (IP65) | Plastic, suitable for cabinetless installation (IP40) |
| Interfaces on evaluation unit | | | |
| • Digital inputs for 24 V DC | 6 (including 1 trigger input) | 6 (including 1 trigger input) | 8 (including 1 trigger input) |
| • Digital outputs for 24 V DC | 5 | 4 | 6 |
| • Integrated interface | - | - | PROFIBUS DP/Ethernet/PROFINET IO |
| • Sensor head interface | - | - | Digital interface |
| • Supply voltage | 24 V DC | 24 V DC | 24 V DC |
| Current consumption, max. | 2 A | 2 A | 4 A |

# Vision Sensors
## SIMATIC MV220

## Overview



- Compact image processing sensor for automatic inspection of colored objects
- A synthesis of high-performance image processing technology with simple, compact sensors
- For applications in manufacturing, the packaging industry and food and beverages industry
- Process-oriented implementation thanks to degree of protection IP65
- Integration in plant automation using digital inputs and outputs
- Quick familiarization with task thanks to the teach-in function

## Benefits

- Eminently suitable for use in harsh industrial environments thanks to degree of protection IP65
- Control of extremely high-speed processes possible thanks to the short inspection time of the sensor (approximately 30 inspections per second)
- Short changeover times thanks to simple model change
  - 16 inspection models can be taught
  - Inspection models are selected using digital inputs
- Flexible adaptation to the individual applications possible
  - Flexible adjustment of image window and operating distance
  - Flexible adjustment of parameters
- Fast commissioning
  - No image processing knowledge necessary
  - No programming necessary

## Application

The SIMATIC MV220 image processing sensor is a complete image processing system for automatic inspection of color objects. It completes the product portfolio in the low-end image processing segment and high-end segment of conventional sensors.

Due to its high performance and simplicity, simple color inspection tasks are accessible that are too complex for the other image processing systems and which exclude themselves on grounds of cost.

The module is used in:
- Manufacturing and assembly systems for automobile industry suppliers and electronics;
- Checking the presence of colored components
- Packaging machines for blister packs and combined packs

- Checking for presence, part recognition and checking the location of colored objects
- Cup and bottle filling in the food & beverages industry
- Print inspection and parts identification for labels and covers

## Design

The SIMATIC MV220 image processing sensor combines all the components required for the test in a compact housing:
- Rugged plastic/metal housing with degree of protection IP65
- Digital camera for evaluation of color pictures:
  - CMOS chip
  - Resolution of 640 x 480 pixels
- Continuously adjustable lens:
  - Variable image field from 40 x 30 mm to 200 x 150 mm
  - Variable object distance from 50 mm to 250 mm
- Integrated white lighting
- Laser-based alignment tool
- Operator controls and displays:
  - Input keys
  - Display
  - LEDs
- M12 plug and socket with connections for:
  - Power supply
  - Digital inputs and outputs
- M4 fastening holes for mechanical fixing system for industrial sensors

## Function

The following functions are available:
- Teaching in the models using one or more good parts
- Inspecting an object using the features extracted during teach-in
- Inspection can be performed on stationary and moving objects
- Inspection of the object supplies a good/bad statement in accordance with the set threshold values
- The results are output on two digital outputs:
  - OK: Compliance of the object with the saved model is better or equal to the set threshold value
  - N_OK: Compliance of the object with the saved model is worse than or equal to the set threshold value

### Mode of operation

Manual alignment of the sensor is supported by a laser-based alignment tool. Two laser beams project two light spots into the image window of the sensor.

The sensor is calibrated to the ambient conditions, menu-driven, based on the templates supplied.

The inspection tasks are taught by presenting one or more good objects. The result of teach-in can be saved in one of 16 data records. The learned inspection task can then be tested immediately in test mode.

To start the evaluation mode you have to select a trained object data record and switch to "RUN" mode. The sensor starts the evaluation after triggering.

Depending on the trained threshold values and the actual evaluated values, the result is output to the OK or N_OK digital outputs for a good or bad result respectively.

The inspection task can be changed by selecting a different data record (model) in "RUN" mode.

Any sensor faults or errors in operating the sensor are reported in the diagnostics. Evaluation mode continues or is terminated depending on the type of error.

## Technical specifications

| MV220 Vision Sensor | |
|---|---|
| **Image sensor** | |
| Image acquisition | CMOS sensor (color); 640 x 480 pixels |
| Size of the image field | Continuously variable; depending on the object distance |
| • For object distance of 50 mm | 40 x 30 mm |
| • For object distance of 250 mm | 200 x 150 mm |
| Number of distinguishable colors | Depending on inspection severity; 2048 colors / 64 colors / 16 colors |
| Inspection types | Matching, recognition |
| Inspection triggering | External; via digital input |
| Output of results | "OK" and "N_OK"; via LEDs and digital outputs |
| **Lighting** | |
| Light source | Integrated white LEDs |
| Light intensity | 800 LUX for object distance of 150 mm |
| External lighting | Controllable via digital output |
| **Functions** | |
| Operator control | 4-character text display and 4 operator buttons |
| Alignment tool | Using laser projection (laser class 2) |
| Number of models that can be stored | 16; using digital inputs |
| Teach-in of models | Using "Teach-in" |
| Diagnostics messages | Using LED, text display and digital output |
| Operating status display | Using LED and digital output |
| Disabling operation of keys | Possible using digital input |
| **Interfaces** | |
| Digital inputs | 6 inputs, 24 V DC of which one trigger input (100 μs delay time) and 5 inputs for model selection and key disabling |
| Digital outputs | 5 outputs; 24 V DC |
| | Outputs for results, 500 mA |
| | Outputs for diagnostics and external lighting, 100 mA |
| | Outputs for operating status, 20 mA |
| Connection of digital inputs and outputs | M12 socket and M12 plug, 8-pole |
| Mounting the sensor | Using M4 fixing holes |
| **General specifications** | |
| Supply voltage | |
| • Rated value | 24 V DC |
| • Voltage range | 20.4 … 28.8 V DC; with reverse polarity protection |
| Power consumption max. | 2 A |
| Material | |
| • Housing | Plastic, aluminum |
| • Lens cover | Plastic |
| Mechanical strength | |
| • Oscillations | acc. to IEC61131-2 |
| • Shock | acc. to IEC61131-2 |

| MV220 Vision Sensor | |
|---|---|
| Dimensions (H x W x D) in mm | 113 x 35 x 90 |
| Degree of protection | IP65 acc. to DIN EN 60529 |
| Ambient temperature | 0 … 45 °C |
| Weight | 430 g |

## Selection and Ordering data      Order No.

| | | Order No. |
|---|---|---|
| **SIMATIC MV220** ► | | **6GF5 110-0AA00-0AA0** |
| Color mark sensor for inspecting colored objects; size of image field 40 x 30 mm … 200 x 150 mm; operating unit, display unit and LED lighting integrated; incl. operating instructions and templates | | |
| *Accessories* | | |
| **M12 cable plug** | | **3RX8 000-0CB81-1GF0** |
| With 5 m PUR cable, black, shielded, 8-pole (8 x 0.25 mm$^2$) | | |
| **M12 cable plugs** ► | | **3RX8 000-0CD81-1GF0** |
| With 5 m PUR cable, black, shielded, 8-pole (8 x 0.25 mm$^2$) | | |
| **Round-steel fixing bar** | | |
| Diameter = 12 mm, length = 200 mm, for fixing system for sensors | ► | **3RX7 315** |
| Diameter = 12 mm, length = 300 mm, for fixing system for sensors | ► | **3RX7 316** |
| **Holding plate** | ► | **3RX7 326** |
| For accommodating the SIMATIC MV 220, use in connection with fixing bar; for fixing system for sensors | | |
| **Mounting base** | ► | **3RX7 322** |
| With 12 mm receptacle for sensor fixing system | | |

► Preferred type, available from stock.

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# Vision Sensors
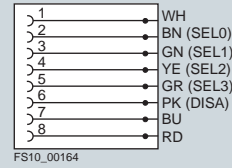## SIMATIC MV220

### Dimensions



FS10_00158

### Schematics



| 1 | WH (L+) |
| 2 | BN (N_OK) |
| 4 | YE (OK) |
| 5 | GR (TRG OUT) |
| 6 | PK (DIAG) |
| 7 | BU (TRG) |
| 8 | RD (RDY) |
| 3 | GN (M) |

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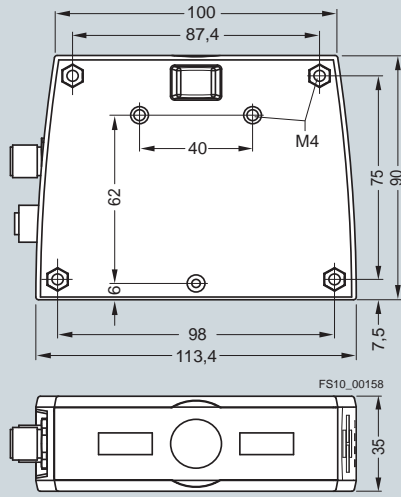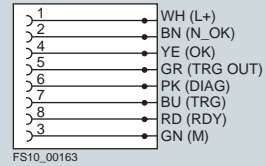
MV220 Vision Sensor, X1 interface

| 1 | WH |
| 2 | BN (SEL0) |
| 3 | GN (SEL1) |
| 4 | YE (SEL2) |
| 5 | GR (SEL3) |
| 6 | PK (DISA) |
| 7 | BU |
| 8 | RD |

FS10_00164

MV220 Vision Sensor, X2 interface

FS10_00165

MV220 Vision Sensor, socket pin assignment

FS10_00166
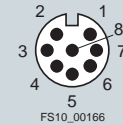
MV220 Vision Sensor, plug pin assignment

## Overview



- Compact image processing sensor for the automatic testing of objects based on the specific surface contour or profile.
- A synthesis of high-performance image processing technology with simple, compact sensors
- High stability against ambient light
- For applications in manufacturing, the packaging industry and in the construction of special machines and serial machines
- Process-oriented implementation thanks to degree of protection IP65
- Integration in plant automation using digital inputs and outputs
- Quick familiarization with task thanks to the teach-in function

## Benefits

- Degree of protection IP65 makes use in harsh industrial environments possible
- Costs for shielding against ambient light can normally be saved due to their high stability against ambient light
- Short changeover times thanks to simple model change
  - 16 inspection models can be taught
  - inspection models are selected using digital inputs
- Rapid startup thanks to Teach In
  - no image processing knowledge necessary
  - effective start-up and maintenance functions using diagnostics, checksums and statistical information
- Prevention of unauthorized operation through button disabling

## Application

The SIMATIC MV230 height profile sensor is a complete image processing system for the automatic inspection of objects based on the specific height contour or profile. The split-beam method and laser projection on which it is based supports extremely rugged and reliable inspection.
It completes the product portfolio in the low-end image processing segment and high-end segment of conventional sensors.

Its performance capability, simplicity and in particular the ruggedness of the test procedures can be used for inspection tasks that are too complex for other image processing systems and that must be disregarded for cost reasons.

The module is used in:

- Production and assembly systems for automotive suppliers and electrical engineering;
  checking, parts recognition and position inspection during assembly
- Packaging machines
  Checking for presence, parts recognition and checking the location of objects
- General machine construction
  Checking for presence, parts recognition and checking the location of objects

## Design

The SIMATIC MV230 height profile sensor combines all the components required for the test in a compact enclosure:

- Rugged plastic/metal enclosure with degree of protection IP65
- Digital camera:
  - CMOS chip
  - Resolution of 750 x 480 pixels
- Integrated laser line of up to 75 mm in length
- Operator controls and displays:
  - Input keys
  - Display
  - LED displays
- M12 plug and socket with connections for:
  - Power supply
  - Digital inputs and outputs
- M4 fastening holes for mechanical fixing system for industrial sensors

## Function

The following functions are available:
- Training of models based on a Good object
- Inspecting an object using the features extracted during teach-in
- Inspection of the object supplies a good/bad statement in accordance with the set threshold values (Q-LIMIT)
- Inspection results are output on two digital outputs:
  - OK: Compatibility of the object with the saved model is greater than or equal to the set threshold value
  - N_OK: Compatibility of the object with the saved model is less than the set threshold value

*Operating principle*

Manual alignment of the sensor is supported by the visible laser line.

The inspection task is trained by presenting a Good object. The object to be inspected or the object area to be inspected is positioned under the laser line.

For smaller objects, the length of the laser line range that can be evaluated can be reduced. The teach-in result is saved under one of 16 data records (model number).

The learned inspection task can then be tested immediately in test mode.

To start the evaluation mode you have to select a trained object data record and switch to "RUN" mode.

After triggering, the sensor starts evaluation.
On the basis of the learned threshold values and the actual values of the evaluation, a result is output on the OK digital outputs (Good) or N_OK (Bad).

The inspection task can be changed by selecting a different data record (model) in "RUN" mode.

Any sensor faults or errors in operating the sensor are reported in the diagnostics. Evaluation mode continues or is terminated depending on the type of error.

# Vision Sensors
## SIMATIC MV230

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## Technical specifications

| MV230 Vision Sensor | |
|---|---|
| **Image capture and evaluation** | |
| Image sensor | CMOS sensor; 750 x 480 pixels |
| Operating distance | 210 … 310 mm |
| Size of the image field | 75 x 100 mm (for 310 mm operating distance) |
| Measuring principle | Split-beam (laser-based triangulation) |
| Test type | Profile evaluation |
| Accuracy/physical resolution | Height accuracy: 0.5 mm; Width accuracy: 0.2 mm |
| Triggering for image capture | Internal, freewheeling trigger; external trigger through digital input TRG |
| Max. cycle time | 50 ms |
| Response time | 16 ms |
| Output of results | "OK" and "N_OK"; via LEDs and digital outputs |
| **Lighting** | |
| Light source | Laser diode, red light |
| Laser protection class | 2M (IEC 825-1, EN 60825-1) |
| Length of laser line | 50 … 75 mm |
| **Functions** | |
| Operation | 4-character text display and 4 operator buttons |
| Number of models that can be taught | 16 |
| Teach-in of models | "Teach-in" on the sensor |
| Diagnostic messages | available; using LED, text display and digital output |
| Operating status display | available; using LED and digital output |
| Disabling operation of keys | possible; using digital input |
| Checking the set values | possible using global and model-specific checksums |
| Statistics function | available |
| **Interfaces** | |
| Digital inputs | 6 inputs; for trigger (TRG), model selection (SEL0-3) and button disable (DISA) |
| Rated voltage | 24 V DC |
| Input current | typ. 7 mA |
| Voltage range | Signal 1: 15 ... 30 V Signal 0: -3 ...5 V |
| Input delay | 3 ms typical (input TRG 0.1 ms) |
| Input characteristics curve | IEC1131, Type 1 |
| Digital outputs | 4 outputs; for result output (OK, N_OK), diagnostics (DIAG) and ready status (RDY) |
| Output voltage for "1" signal | L+ (-0.8 V) |
| Output current for "1" signal | 500 mA (outputs OK, N_OK) 100 mA (DIAG) 20 mA (RDY) |
| Short-circuit protection at the outputs | Yes, electronic |

| MV230 Vision Sensor | |
|---|---|
| **General data** | |
| Supply voltage L+ | |
| • Nominal value | 24 V DC |
| • Voltage range | 20.4 … 28.8 V DC, with reverse polarity protection |
| Power consumption max. | 2 A |
| Mechanical strength | |
| • Vibration | acc. to IEC61131-2 |
| • Shock | acc. to IEC61131-2 |
| Material | |
| • Enclosure | Plastic, aluminum |
| • Lens cover | plastic |
| Dimensions (H x W x D) in mm | 161 x 35 x 112 |
| Degree of protection | IP65 to DIN EN 60529 |
| Ambient temperature | 0 … 45 °C, no moisture condensation |
| Weight | 450 g |

## Selection and Ordering data

| | | Order No. |
|---|---|---|
| **SIMATIC MV230** | ► | **6GF2 110-0BA00-0AA0** |
| Image processing sensor for the automatic inspection of objects and their position based on the specific surface contour and profile | | |
| *Accessories* | | |
| **M12 cable plug** | ► | **3RX8 000-0CB81-1GF0** |
| With 5 m PUR cable, black, shielded, 8-pole (8 x 0.25 mm$^2$) | | |
| **M12 cable plugs** | ► | **3RX8 000-0CD81-1GF0** |
| With 5 m PUR cable, black, shielded, 8-pole (8 x 0.25 mm$^2$) | | |
| **Round-steel fixing bar** | | |
| Diameter = 12 mm, length = 200 mm, for fixing system for sensors | ► | **3RX7 315** |
| Diameter = 12 mm, length = 300 mm, for fixing system for sensors | ► | **3RX7 316** |
| **Holding plate** | ► | **3RX7 326** |
| For accommodating the SIMATIC MV230, use in connection with fixing bar; for fixing system for sensors | | |
| **Mounting base** | ► | **3RX7 322** |
| With 12 mm receptacle for sensor fixing system | | |

► Preferred type, available from stock.

## Dimensions
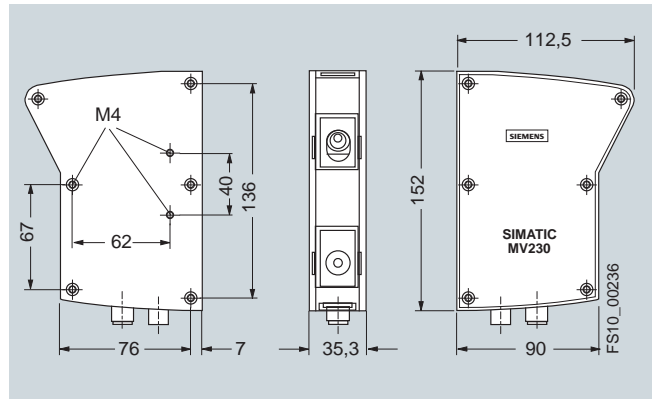


## Schematics
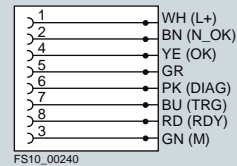


Plug connection for interface X1 and core color for M12 cable socket, 8-pin, length 5 m (Order No.: 3RX8 000-0CB81-1GF0)
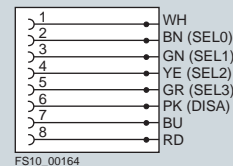


Plug connection for interface X2 and core color for M12 cable plug, 8-pin, length 5 m (Order No.: 3RX8 000-0CD81-1GF0)



Pin assignment X1, M8 connection for cable sockets



Pin assignment X2, M8 connection for cable plug

# Vision Sensors
## SIMATIC VS120

## ■ Overview
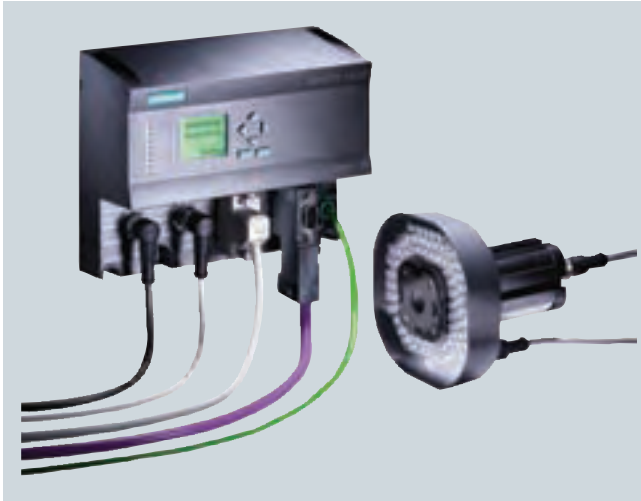


- Vision sensor for object finding and object size testing in reflected light
- VS120 finds and checks different objects and / or patterns, e.g.:
  - printed symbols (product markings on labels, packaging, etc. )
  - injection-molded parts,
  - ceramic elements,
  - ...
- Can be used in principle for the following applications:
  - position detection for Pick&Place applications,
  - checking the presence and position of objects in production,
  - checking the orientation of objects in infeed systems
- Easy configuration through presentation of the good object to be recognized. "Training" is done automatically by activating the training function of the unit.
- Parameter definition is done using the web-based operating interface and can be run on various platforms with the following requirements:
  - Browser (IE5.5 or higher),
  - JAVA-VM (MS, SUN).
- The web-based operator interface is also used for controlling the device from an HMI device. The same prerequisites apply here concerning the Browser and JAVA VM.
- Remote maintenance concept using web-based operator interface.
- Remote controlled with integrated digital inputs, PROFIBUS or PROFINET IO.
- Can be supplied as a complete package in several variations for different object sizes

## ■ Application

The intelligent vision sensor can be used for the following applications:

- Determining the position for Pick & Place applications
- Checking the presence and position of objects in production
- Checking the orientation of objects in infeed systems

Examples of possible inspection tasks and inspection objects:

- Checking the presence and position of symbols (warnings) and logos (corporate logos) on print media and packaging
- Checking the presence and position of objects in production for the quality assurance of assembly steps
- Checking the orientation of assembly items in infeed systems

## ■ Design

The SIMATIC VS 120 vision sensor offers the following image field sizes:

- 70 x 50 mm fixed-focus sensor head
- 40 x 30 mm fixed-focus sensor head
- Variable field of view with C/CS-Mount sensor head

The following components are required for use of the fixed-focus version of the SIMATIC VS120 vision sensor and are included in the scope of delivery:

- Sensor head
- Front lighting in the form of a ring light matched to the application and sensor head
- Evaluation unit
- Connecting cables
- CD with configuration software and assembly/operating instructions

To start up the fixed focus version you also need the following items (not included in the scope of delivery):

- Ethernet cable (see "Accessories") for connecting the evaluator to any web client. The web client, e.g. a PC with web browser installed, is used to adjust the sensor head and the lighting.

The following components are required for use of the C/CS mount version of the SIMATIC VS120 vision sensor and are included in the scope of delivery:

- Sensor head (without lens!)
- Evaluation unit
- Connecting cables (no connecting cable for lighting!)
- CD with configuration software and assembly/operating instructions

To start up the C/CS-Mount version you also need the following items (not included in the scope of delivery):

- C/CS-Mount lens with the required imaging properties
- Suitable light source and suitable connecting cable (see accessories)
- Ethernet cable (see "Accessories") for connecting the evaluator to any web client. The web client, e.g. a PC with web browser installed, is used to adjust the sensor head and the lighting.

### Sensor head

The sensor head is equipped with:

- Extruded aluminium housing to degree of protection IP65 (fixed-focus version)
- CCD chip (640 x 480 quadratic pixels)
- Lens, permanently installed and non-adjustable (fixed focus version)
- Interface for digital transmission of image data to the evaluation unit

A sensor head for C/CS-Mount lenses is additionally available.

### Evaluation unit

The evaluation unit has:

- Plastic housing, designed for cabinetless construction (IP40)
- Connections for
  - Supply voltage 24 V DC
  - Lighting
  - Sensor head
  - Digital inputs and outputs
  - Ethernet interface (DHCP-Client, DHCP-Server, fixed IP address)
  - PROFIBUS DP
- 4-line text display for operator prompting

- 6 keys for operating the unit
- User guidance with web-based operator interface (HTML, JAVA VM)
- Access protection by means of password.

The following communication services are included:

- PROFINET IO (slave)
- PROFIBUS DP V0 (slave),
- TCP/IP native

The analysis is carried out by a powerful digital signal processor.

### Front lighting

- Designed as ring light pushed onto sensor head
- Can be dismounted, and secured with different orientation on the machine
- Housing with degree of protection IP65
- Equipped with red LEDs
- Operation in flash mode
- Power control for the flash integrated in the light

### ■ Function

- Training the object test parameters using one or more good objects
- Testing an object and/or pattern with the features taken from the training
- Testing can be performed on stationary and moving objects
- Checking for a match with the reference provides a good/poor indication after comparison with set-value criteria
- Test results output to three control outputs:
  - OK:
    trained object and/or pattern found based on features; degree of match greater than set value
  - N_OK:
    trained object and/or pattern NOT found based on features; degree of match NOT greater than set value
- Position information output via PROFIBUS DP, PROFINET IO, Ethernet or with converter to RS 232 interface
- Integrated DI/O enables "stand-alone" operation without additional controller.
- Remote control via PROFIBUS DP, PROFINET IO, DI/O or Ethernet
- Remote maintenance via web-based operator interface Intranet or Internet:
  - monitoring (live image in read mode)
  - diagnostics (fault image, log information, ...)
  - system administration (software update, ...)
  - error analysis for troubleshooting for faulty readings
- Actuation of ring lighting

### Mode of operation

The following steps are required for using the SIMATIC VS120:

- Mount the vision sensor and lighting.
- Manual alignment of the camera, lighting check:
  This is handled with the web-server integrated in the unit and the web-based operator interface contained within. The operator interface displays the camera image. In the setup phase, the sensor head can be aligned with reference to the live image in the user interface. The user interface executes on any PC with Microsoft Internet Explorer and JAVA VM installation. If the sensor head adjustment is complete, the vision sensor automatically takes over the following procedures:
  - optimization of lighting control.
  - "Training" the image processing parameters by applying a reference object
  - the result of the training is stored under one of the 64 data records

- Starting the evaluation operation requires loading a trained object record and changing into the "RUN" operating mode. The VS120 starts the evaluation after triggering.
- Depending on the trained set values and the actual values of the evaluation, one of the digital control outputs OK (good result) or N_OK (poor result) is set.

The position information is output via the PROFIBUS DP, PROFINET IO or Ethernet interface.

### Programming

SIMATIC VS120 is not programmed and parameters are not defined as on standard image processing systems. It is trained for its special task, finding and testing a special object. The SIMATIC VS120 is shown a good object and the device is "trained" to this object.

The training procedure can be performed while a conveyor system is running.

Up to 64 different data records can be stored in the device and can be called up at any time by the operator or can also be called up through an external controller.

### ■ Technical specifications

| SIMATIC VS120 Vision Sensor | |
| --- | --- |
| **Sensor head** | |
| Image capture | CCD chip ¼", 640 x 480 square pixels; full frame shutter with automatic exposure time |
| Image data transfer | Triggered frame transfer |
| Available versions | • Fixed lens system for two different field of view sizes and mounting positions<br>• One C/CS-mount version without lens. |
| • Large field of view | Size of field of view:<br>70 x 50 mm<br>for object sizes up to approx.:<br>60 x 40 mm<br>Operating distance: 120 mm |
| • Small field of view | Size of field of view:<br>40 x 30 mm<br>for object sizes up to approx.:<br>34 x 24 mm<br>Operating distance: 85 mm |
| • Variable field of view | Lens can be selected by the user; hence freely selectable field of view size and object size<br>Operating distance: dependent on the lens |
| Enclosure | Aluminum profile casing, anodized black |
| Dimensions (W x H x D) in mm | 42 x 42 x 100 |
| Degree of protection | IP65 according to DIN EN 60529 / VDE 0470-1 |
| Ambient temperature | 0 … 50 °C |
| Mechanical strength | |
| • Vibrations | 1 $g$ (60 … 500 Hz) |
| • Shock | 70 $g$ (6 ms, 3 shocks) |

**3**

# Vision Sensors
## SIMATIC VS120

**3**

| SIMATIC VS120 Vision Sensor | |
|---|---|
| **Lighting** | |
| Illuminant | LED, wavelength 630 nm (red), designed as a flash of 20 µs … 10 ms, diffuse |
| Enclosure | Ring lamp with multiple fixing possibilities; plastic with plastic diffusing panel |
| Dimensions (W x H x D) in mm | 102 x 102 x 26.5 |
| Degree of protection | IP65 according to DIN EN 60529 / VDE 0470-1 |
| Ambient temperature | 0 … 50 °C |
| **Evaluation unit** | |
| Operator controls | 4-line text display and 6 operator buttons |
| Training | Fully-automatic training procedure |
| Number of types saved | 64 different data records, can be selected via control button or digital inputs or PROFIBUS DP or PROFINET IO, network-fail-safe storage |
| Triggering inspection | External (via digital input, PROFIBUS DP or PROFINET IO) |
| Permitted object rate, max. | 20 objects/s |
| Infeed direction of the objects | |
| • For external triggering | As required |
| • Setup software | Software for displaying the sensor image when mounting and adjusting the sensor head and lighting. The software is provided directly by the integrated web server and can be executed on every JAVA-capable browser (preferably IE6.0). |
| Enclosure | Plastic, all cables can be plugged in, suitable for installation without cabinet |
| Dimensions (W x H x D) in mm | 170 x 140 x 76 |
| Degree of protection | IP40 according to DIN EN 60529 / VDE 0470-1 |
| Ambient temperature | 0 … 50 °C |
| Mechanical strength | |
| • Vibrations | 1 $g$ (60 … 500 Hz) |
| • Shock | 70 $g$ (6 ms, 3 shocks) |
| Interfaces on evaluation unit | |
| • Digital inputs for 24 V DC | 8; of which one interrupt-capable trigger input for standard binary sensors, 7 further PLC-capable control inputs |
| • Digital outputs for 24 V DC | 6; of which 3 quality outputs 0.5 A are for the direct activation of pneumatic valves (15-pin Sub-D socket for inputs/outputs) |
| • Integrated PROFIBUS DP interface | DP (9 pin D-sub socket) to control the testing and real-time transmission of test results |
| • Integrated PROFINET IO interface | RJ45 (socket) for operating software, controlling the testing and real-time transmission of test results |
| • Integrated Ethernet interface | RJ45 (socket) for operating software, controlling the testing and real-time transmission of test results |

| SIMATIC VS120 Vision Sensor | |
|---|---|
| • Lighting control | 4-pin circular connector (female) for power supply and for triggering the flash |
| • Sensor head interface | Digital interface (26 pin Sub-D socket) for connecting the VS120 sensor head |
| Power supply | |
| • Rated value | 24 V DC |
| • Permitted range | 20 … 30 V DC |
| Current consumption, max. | 4 A, of which up to 1.5 A for supplying the pneumatic valves that can be connected |

## ■ Selection and Ordering data      Order No.

**SIMATIC VS120 Vision Sensor**

Complete package for object testing; consisting of sensor head, LED front lighting, evaluation unit and the following cables:

- Cable between evaluation unit and sensor head, for lengths see below
- Cable between lighting and evaluation unit (except for vision sensor with variable field of view), for length see below
- Cable for power supply, length 10 m
- Cable for connecting digital I/O devices, length 10 m

Incl. documentation package for SIMATIC VS120

| | | | |
|---|---|---|---|
| • Field of view 70 x 50 mm | | | |
| - With cable length 2.5 m | ► | B | **6GF1 120-1AA** |
| - With cable length 10 m | ► | B | **6GF1 120-1AA01** |
| • Field of view 40 x 30 mm | | | |
| - With cable length 2.5 m | ► | B | **6GF1 120-2AA** |
| - With cable length 10 m | ► | B | **6GF1 120-2AA01** |
| • Variable field of view, prepared for IP65 protective housing /note: supplied without light and light cable) | | | |
| - With cable length 2.5 m | ► | B | **6GF1 120-3AB** |
| - With cable length 10 m | ► | B | **6GF1 120-3AB01** |

► Preferred type, available from stock.
B: Subject to export regulations AL = N and ECCN = EAR99S

## ■ Accessories

Accessories for SIMATIC VS120 can be found starting with page 6/14.

## Overview

Using a lens appropriate to the respective image evaluation task, the size of the image field at a desired working distance is determined for the camera image. In order to achieve reproducible statements from the image evaluation concerning the position, measurement or quality, the geometry and light intensity for the image must be kept constant within the permissible tolerances. For this reason, only lenses with a fixed focal length, aperture and focus are usually used. Motorized zoom, automatic aperture or autofocus are more detrimental than helpful.

## Application

- Measuring tasks and form recognition
  For high-precision, reproducible measurement of geometric variables, a full-format image is necessary to satisfy resolution requirements. Lenses must therefore be selected that have low distortion, high modulation depth and a small angle of view. Telecentric lenses are recommended for objects that have protrusions in the direction of the lens.

- Quality control and parts recognition
  For recognition or inspection of the features of an object on the surface, the quality of the results depends on contrast and lack of distortion of the image. Macro lenses are often used at close range.

- Code and text reading
  The recognition algorithms are tolerant to variations in form and size of the patterns. The requirements on quality of the optics are not very high. Low-cost lenses contribute towards the cost-effectiveness of image evaluation systems especially when they are used in more than one reading station.

- Check for completeness and handling
  For localization and pattern recognition, the same criteria apply as for measurement tasks or parts recognition.

## Function

### Image types

The optical path of the lens is defined by its construction.

For **spherical lenses** the solid angle depends on the focal length, focus adjustment and aperture; all rays run through the focal point of the lens (central projection). Objects that are further away from the lens are depicted smaller; objects that are closer to the lens are depicted larger:
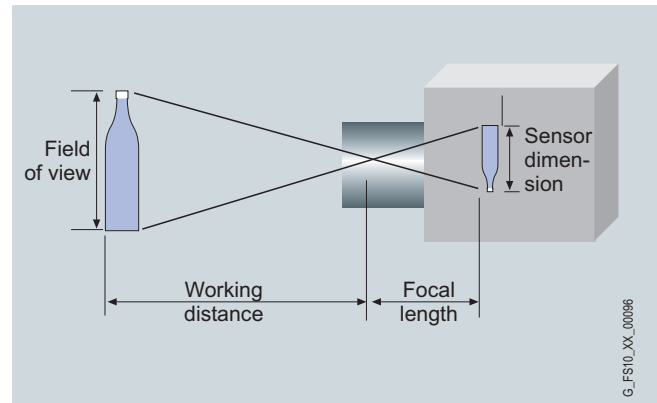
The required image field size (height and width of the image), the size of the sensor chip and the focal length of the lens determine the operating distance:

**d = (f x IS) / b**

d = Operating distance (distance from lens to test object) in mm

f = Focal length of the lens in mm

IS = Size of image in the plane of the test object in mm

b = effective dimensions of the sensor in mm

In the case of lenses used in image processing systems, the focal length is fixed, the aperture and focus settings can be fixed. The focal length, the maximum focal aperture and the focusing range are normally specified on the lenses.

### Focal distance

The focal length makes a statement about the angle of the image field or magnification of the lens.

The focal length of the lens is determined by the size of the required image field and the size of the camera chip when a specific distance has to be maintained. The most common chip sizes in cameras today are $\frac{1}{2}$", $\frac{1}{3}$" and $\frac{1}{4}$". If the distance to the object lies below the adjustable focusing range of the lens, i.e. at close range, the focus can be adjusted using intermediate rings.

If the seating dimensions are designed for CS-Mount lenses in this camera, as for VS 100, a 5 mm intermediate ring can be used to adjust a C-Mount lens.

### Aperture

Reduction of the light intensity by interrupting the optical path.

### Focus

Setting the focus of the lens to a specific distance.

### Depth of field

Depth of field is the area within which (in front of and behind the object) that is displayed with sufficient sharpness of focus. The larger the aperture (the smaller the aperture number), the smaller the depth of field.

Lenses with a larger focal length have a smaller depth of field, the effect is considerable for images at close range.

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# Vision Sensors
## Lenses

### Lens types

Lenses with smaller focal length are called wide-angle lenses, they can also be used at short operating distances, but produce intense distortion of the image. At a suitable distance, they have a large image field.

Lenses with a long focal length are called telephoto lenses; they have a large magnification but cannot be focused at close range, so macro lenses are used that can be focused by means of large telescopic extensions or intermediate rings. At a suitable distance, they have a small image field.

In the case of telecentric lenses, at least the optical path at the object end is almost parallel (parallel projection). This means that objects at different distances are depicted in the same size. Objects can, however, only be displayed that are smaller than the diameter of the lens. It is not possible to adjust the range of focus with these lenses.

The optical characteristics can be restricted by means of optical filter glasses to counteract distortion in the image. Colored filters limit the spectral range, gray filters limit the light intensity and polarization filters restrict the transmission plane. Filters of this type can be attached either by using the internal thread or the flange on the front of the lens. The holder for the filter glass is designed to fit the lens.

---

**Selection and Ordering data**       Order No.                                                                 Order No.

| **Lenses for reading code and plain text and parts recognition** | | **CS-Mount for C-Mount adapter ring 5 mm** | ► K | **6GF9001-1AP02** |
|---|---|---|---|---|



with fixed focal length, adjustable aperture and focus, with locking screw

- Mini lens 8.5 mm, 1:1.5 D = 42 mm, L = 47 mm; successor type for 6GF9001-1BE ► K **6GF9001-1BE01**

- Mini lens 12 mm, 1:1.4 D = 29.5 mm, L = 35.7 mm ► K **6GF9001-1BL01**

- Mini lens 16 mm, 1:1.4 D = 29.5 mm, L = 37.2 mm; successor type for 6GF9001-1BF ► K **6GF9001-1BF01**

- Mini lens 25 mm, 1:1.4 D = 29.5 mm, L = 38.9 mm; Successor type for 6GF9001-1BG ► K **6GF9001-1BG01**

- Mini lens 35 mm, 1:1.6 D = 29.5 mm, L = 41.4 mm ► K **6GF9001-1BH01**

- Mini lens 50 mm, 1:2.8 D = 29.5 mm, L = 38.0 mm; successor type for 6GF9001-1AH ► K **6GF9001-1BJ01**

- Mini lens 75 mm, 1:2.8 D = 34.0 mm, L = 63.6 mm ► K **6GF9001-1BK01**

**Accessories for utilizing the mini lenses at close range:**

- Set of intermediate rings with 0.5 mm, 1.0 mm, 5.0 mm, 10.0 mm, 20.0 mm, 40 mm rings with 31 mm diameter C thread, attached between the lens and the camera body for shots in the macro range ► K **6GF9001-1BU**

**Accessories for utilizing the mini lenses in telephoto range:**

- Focal length extender, D = 30.5 mm, L = 17.9 mm with C thread, attached between the lens and the camera body for extending the focal length by a factor of 2 ► K **6GF9001-1BV**

- Lens intermediate ring 15 mm  M **6GF9001-1AP01**

**Filter for utilization of the mini lenses in the limited field of view:**

- Infrared filter for lenses 6GF9001-1BF01, -1BG01, -1BH01, -1BJ01, -1BL01 ► M **6GF9001-2AD**

- Blue filter for lenses 6GF9001-1BF01, -1BG01, -1BH01, -1BJ01, -1BL01 ► M **6GF9001-2AE**

- Polarization filter for lenses 6GF9001-1BF01, -1BG01, -1BH01, -1BJ01, -1BL01 ► M **6GF9001-2AF**

► Preferred type, available from stock.
K: Subject to export regulations AL = 9I999 and ECCN = EAR99H
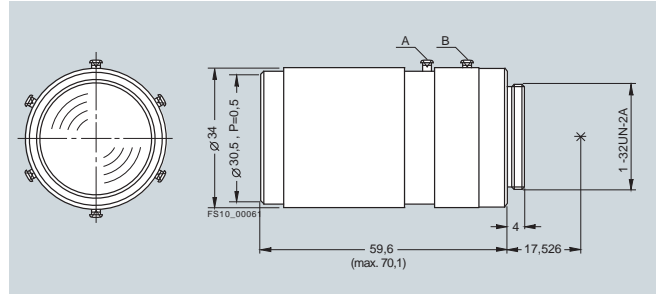M: Subject to export regulations AL = 9I999 and ECCN = N

## Dimensions

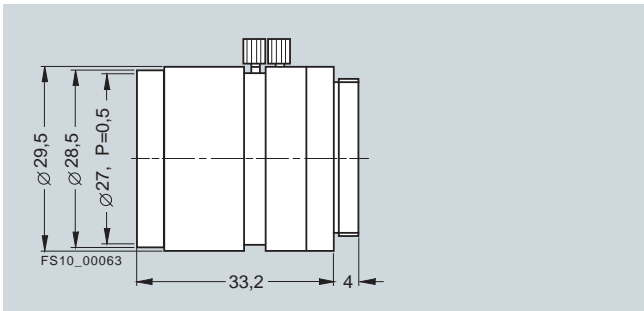### Lenses for reading code and plain text and parts recognition
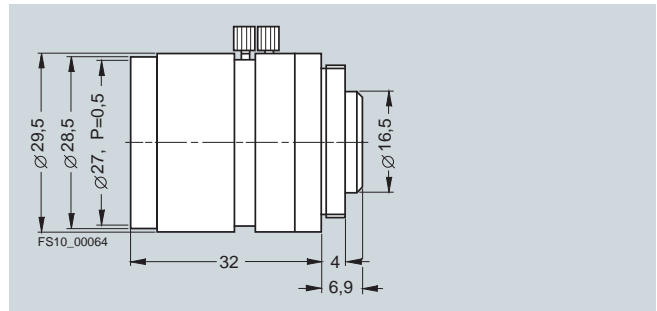
Lens 6GF9 001-1BE01
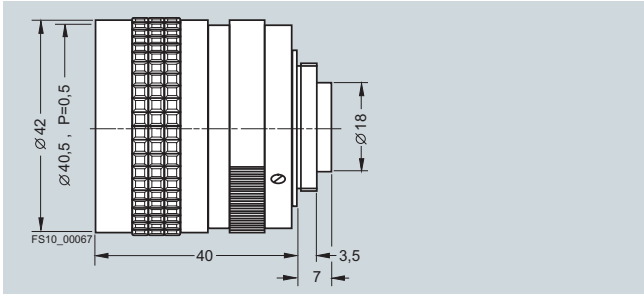


FS10_00067

Lens 6GF9 001-1BK01



FS10_0006

Lens 6GF9 001-1BF01



FS10_00063

Lens 6GF9 001-1BG01



FS10_00064

Lens 6GF9 001-1BH01



FS10_00065
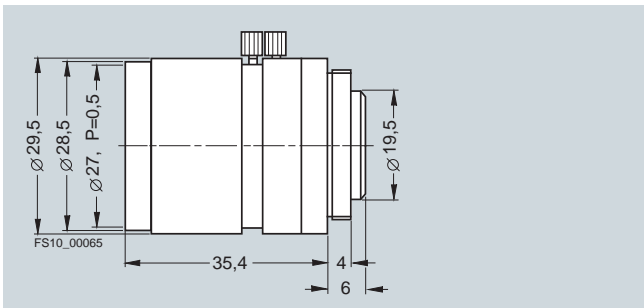
Lens 6GF9 001-1BJ01



FS10_00066
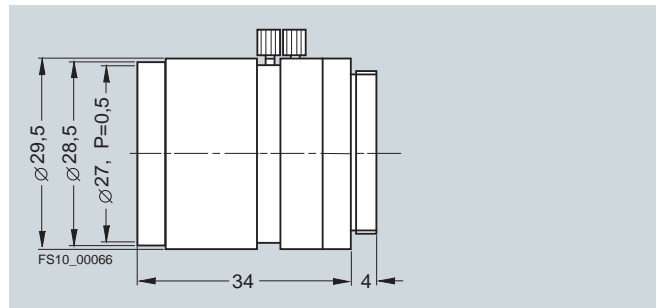
Lens 6GF9 001-1BL01



FS10_00062
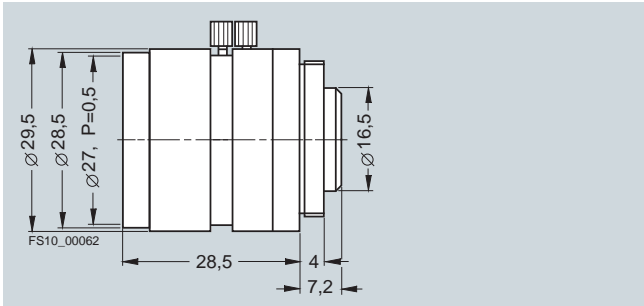
### Accessories for lenses

Pentax intermediate ring set 6GF9 001-1BU:



| 0,5 mm | 1 mm | 5 mm | 10 mm | 20 mm | 40 mm |

FS10_00060

**3**
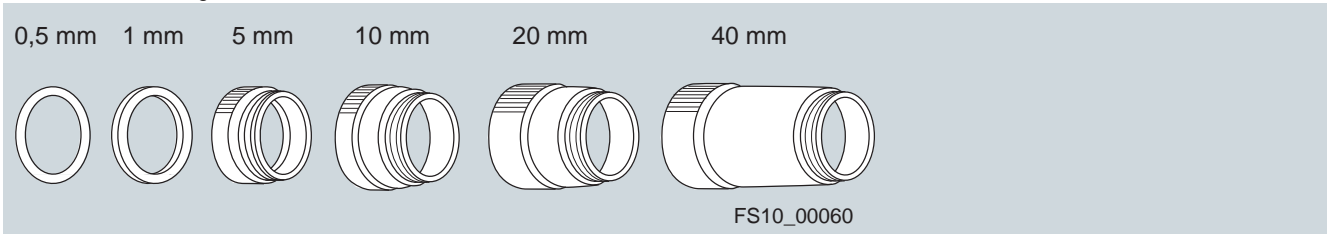
# Vision Sensors

## Lenses

■ **Notes**

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# Appendix
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| **6GK1905-0EB00** | 5/120 | N |
| **6GK1905-0EC00** | 4/58, 4/114 | N |
| **6GK1905-0EC00** | 5/120 | N |
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| 6GR1802-7BD05 | 2/124 | N |
| 6GR1804-7AD00 | 2/124 | N |
| 6GR1804-7BD05 | 2/124 | N |
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| 6GR1806-7BD05 | 2/124 | N |
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| **6GT2300-0AA00** | 5/9 | EAR99H |
| **6GT2300-0BB00** | 5/10 | N |
| **6GT2300-0CD00** | 5/11 | N |
| **6GT2300-0CE00** | 5/12 | N |
| **6GT2301-0CA00** | 5/20 | N |
| **6GT2301-2BB00** | 5/25 | N |
| **6GT2302-2CE00** | 5/130 | EAR99H |
| **6GT2302-2EE00** | 5/130 | N |
| **6GT2303-0AA10** | 5/27 | 4A994X |
| **6GT2303-1AA00** | 5/27 | EAR99H |
| **6GT2303-1CA00** | 5/63 | EAR99H |
| **6GT2305-0AA00** | 5/15 | N |
| **6GT2305-0AB00** | 5/17 | N |
| **6GT2305-0CA00** | 5/20 | N |
| **6GT2390-0AA00** | 5/9 | EAR99H |
| **6GT2390-0BA00** | 5/130 | N |
| **6GT2390-1AA00** | 5/15, 5/17, 5/20 | N |
| **6GT2390-1AB00** | 5/62, 5/82, 5/85, 5/90, 5/92, 5/130 | EAR99H |
| **6GT2391-0BH50** | 5/130 | N |
| **6GT2391-0BN20** | 5/130 | N |
| **6GT2391-1AH50** | 5/130 | N |
| **6GT2391-1BN10** | 5/25, 5/130 | N |
| **6GT2391-1BN25** | 5/25, 5/130 | N |
| **6GT2391-1DH50** | 5/15, 5/17, 5/20 | EAR99H |
| **6GT2398-1AF00** | 5/22 | N |
| **6GT2398-1CA00** | 5/22, 5/45 | N |
| **6GT2398-1CB00** | 5/22, 5/45 | N |

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