ifm Vision Sensors
Reliable inspection for industrial automation

Contour Sensor
Pixel Counter
**efector dualis Vision Sensors**

**Part verification for error-proofing and inspection**

efector dualis Vision Sensors can solve a variety of error-proofing and inspection applications throughout the manufacturing process. The compact CMOS vision sensors provide reliable performance in production control.

ifm’s Vision Sensor product line includes two sensor families: the efector dualis Contour sensors and the efector dualis Pixel Counter sensors.

- The Contour Sensor inspects an object by quickly analyzing and comparing its defined shape and comparing it to similar objects. It is the ideal solution in applications when the shape of the inspected objects is repeated.
- The Pixel Counter analyzes the area of an object by counting the pixels and is best used when the inspected objects vary in shape, size or shade.

ifm’s Vision Sensors are compact and powerful. Each sensor type applies a unique, high performance algorithm to solve most of today’s industrial error-proofing applications without the high-cost of traditional vision systems.

The sensor’s Ethernet process interface allows for quick adjustments to an application and process data communication for Ethernet TCP and Ethernet IP. The 128 mb RAM enables teaching up to 32 applications.

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**The power of a vision system with the simplicity of a sensor**

**efector dualis Vision Sensors bridge the gap between sensor clusters and vision systems**

**The best of both worlds**

ifm’s dualis CMOS vision sensors provide the simplicity of a standard sensor and the high performance of a vision system.

- Eliminates the added maintenance needed for sensor clusters.
- Provides a reliable alternative to high-end vision systems.
- Price-to-performance ratio allows the sensor to be used throughout a plant for error-proofing applications.

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**Challenge: Sensor clusters**

Sensor clusters are the least expensive option, but cause problems when multiple devices are used for error-proofing.

Additional challenges:
- Complex wiring
- Multiple mounting brackets
- Time-consuming installation

**Challenge: Vision systems**

Vision systems offer high performance but are complex and often require vision specialists.

Additional challenges:
- Additional computer processing power
- External lighting
- Integration that increases costs
Reliable functionality with a new benchmark for performance and value

efector dualis Vision Sensors include an image sensor, evaluation electronics and integrated lighting in a robust die-cast metal housing that withstands harsh industrial environments. Objects are reliably detected and precisely evaluated with the sensor’s fast image capture and powerful algorithms.

Vision Sensor camera types
The Contour Sensor analyzes the outline of an object. The Pixel Counter captures the area of an object.

Robust housing
Robust design and compact metal housing provide long life and reliability in industrial environments.

High performance
CMOS image sensor and Digital Signal Processor with no moving parts for durability.

Fast image capture
The efector dualis focus tool quickly defines images.

Integrated lighting
Integrated lighting provides the correct amount of image brightness at various ranges. For longer distances, a backlight can be used.

High speed
dualis can be applied in conveyor and dynamic applications with moving targets.

Easy setup
Easy application Setup Wizard guides you step-by-step with advanced functionality for demanding applications.

Flexible connection
Supports Allen-Bradley’s Ethernet IP and standard Ethernet TCP products.

Diecast metal housing rated IP67
Pushbutton setup and 4-digit numeric display
On-board lighting element illuminates object
Lens
Focus tool defines images
Microprocessor
Ethernet parameter setting interface
M12 8-pin connection

Robust industrial CMOS image sensor can withstand tough industrial applications

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Vision sensors for a broad range of applications

**efector dualis Contour Sensor**

ifm’s Contour Sensor has the ability to analyze shapes and capture the contour of an object. It is ideal in applications where the object's shape is repeatable and defined.

The Contour Sensor can easily differentiate between the two parts because it analyzes the shape and compares it to the reference part.

**efector dualis Pixel Counter**

ifm’s Pixel Counter analyzes the area of an object and counts the pixels. It is ideal for applications where the objects vary in shape, size or shade.

The Pixel Counter can easily differentiate between parts by analyzing an area in each object.

A dark brown spot is detected on the metal when the part is welded together properly. The absence of this mark could lead to part failure.

The weld spot does not have a consistent shape or contour to detect. This makes the Pixel tool ideal for this application.

**Assembly automation**

**Automotive**
Vision sensors with many functions

Which sensor is best for your application?

<table>
<thead>
<tr>
<th>Functionality</th>
<th>The efector dualis Contour Sensor analyzes the shape of an object</th>
<th>The efector dualis Pixel Counter Sensor analyzes the area of an object</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pattern matching</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Shape detection</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Orientation</td>
<td>√</td>
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<tr>
<td>Object position</td>
<td>√</td>
<td>√</td>
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<tr>
<td>Object counting</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Sorting</td>
<td>√</td>
<td>√</td>
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<tr>
<td>Object area</td>
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<td>√</td>
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<tr>
<td>Inner / Outer radius</td>
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<td>√</td>
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<tr>
<td>Object width / Height</td>
<td></td>
<td>√</td>
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<tr>
<td>Roundness / Rectangularity</td>
<td></td>
<td>√</td>
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<tr>
<td>Hole counting</td>
<td></td>
<td>√</td>
</tr>
<tr>
<td>Object contrast</td>
<td></td>
<td>√</td>
</tr>
</tbody>
</table>
Proven success in solving a broad range of applications

The following pages list a broad range of error-proofing and inspection applications that eflctor dualis Vision Sensors have had proven success in solving. These include verification, orientation, sortation, part / no part, object character verification and measurement.

The template below illustrates a typical application example that includes:

- Application type
- Pass / fail images
- Application description
- Primary industry
- Sensor type
- Degree of difficulty

Example of application template

**Identify welded washer on a part**

**Description:**
In this application, the contour of a circular washer is detected on a part. When the circular contour is not detected, the part is determined missing.

**Industry:** Automotive

The welded washer has a very repeatable contour when present, therefore the Contour Sensor is the appropriate choice.

**Applications defined by “Degree of Difficulty”**

**Setup Time**

- Simple applications are indicated with a green bar and are typical error-proofing applications that require simple parameter setup. Setup time is less than 5 minutes.
  - Less than 5 minutes

- Moderate applications are indicated with a yellow bar and may require some advanced parameter settings and mounting techniques. Setup time is less than 10 minutes.
  - Less than 10 minutes

- Advanced applications are indicated with a red bar and will require advanced parameter settings. Setup time may take up to 30 minutes.
  - Up to 30 minutes
1. Verify the correct position of a punch-out on a steel rod

**Description:** Verifying the correct punch-out position is imperative to the process. If left undetected, an improper crimp or punch-out position on a steel rod would lead to scrap metal.

**Industry:** Stamping

The Contour Sensor detects the outer edges of the rod and uses it as a reference point for the circular punch-out providing reliable results.

2. Verify the presence of threads

**Description:** Missing threads in metal parts can cause oil leaks and ultimately engine failure.

**Industry:** Metal casting

The Pixel Counter detects the inconsistencies on the threaded surface so that faulty parts can be eliminated prior to assembly.

3. Verify the correct nut assembly

**Description:** Detecting that the correct weld nut is installed on the proper assembly is essential to the automotive assembly process. The weld nuts have either a green or a white thread sealer.

**Industry:** Automotive

A diffuse sensor was used to detect the color sealant but movement would lead to inaccurate results. The Pixel Counter can easily detect the green and white sealant because of the different contrasts.

4. Detect registration marks used to identify parts

**Description:** A registration mark is used to identify parts that have been through a completed process. Without the mark, the parts go into quarantine, where every unit must be manually sorted. ifm’s Pixel Counter is able to identify that the mark is present regardless of the shape or size of the part, eliminating the quarantine process.

**Industry:** Assembly automation

Regardless of shape or size, the Pixel Counter is able to identify that the mark is present.
5. Verify the correct amount of glue for bonding on a joint

**Description:** In wood assembly, the right amount of glue must be applied to a joint. Too much glue causes bleeding out of the joint and too little causes improper bonding.

**Industry:** Wood

**The Pixel Counter is able to count the amount of white pixels (produced by the glue) to determine the amount of glue on the joint.**

6. Verify correct position of scoop

**Description:** A powder scoop must be placed correctly in the container of powder or it will cause a puncture in the foil seal. By ensuring the correct placement of the scoop, the container can be packaged correctly.

**Industry:** Food

**The Contour Sensor compares the scoop contour to the taught contour to determine the correct placement. If the scoop isn’t set completely flat onto the lid, the contour is changed and the sensor gives a signal of incorrect placement.**

7. Detect contrast in assembly processes requiring increased sensing ranges

**Description:** The goal is to separate a black seat frame from a silver seat frame. A standard contrast sensor would solve this application, but typically lacks the sensing range required to detect the seat frame. The Pixel Counter can be used for simple contrast applications when extra distance is needed and can easily detect the silver seat frame in this application.

**Industry:** Automotive

**The Pixel Counter can be used when a long range contrast sensor is required.**

8. Verify that the shape is accurately produced in the injection molding process

**Description:** In the plastic injection process, it is imperative that the plastic being injected into the mold reaches all portions of the mold to produce a complete product before shipping. In this example, the mold has produced a ‘short shot’ on the tip of the handle. The Pixel Counter is able to count the number of pixels at the tip and determine if enough material is present.

**Industry:** Assembly automation

**Due to the non-repeatable shapes and contours that are produced by a bad mold, the Pixel Counter is the appropriate solution.**
9. Verify alignment of a car panel and windshield

**Description:** To verify that a car panel and windshield header are aligned correctly before welding, the placement contour is detected. If misaligned, the whole car must be scrapped.

**Industry:** Automotive

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**Correct placement**

**Incorrect placement**

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**Degree of difficulty**

<table>
<thead>
<tr>
<th>Simple</th>
<th>Moderate</th>
<th>Advanced</th>
</tr>
</thead>
</table>

When the panel is aligned correctly, the distances between the contours are correct. Any misalignment will result in a different distance or orientation of the contours. The Contour Sensor is the appropriate choice for this application.

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10. Count number of holes in a rotor

**Description:** A rotor can be machined incorrectly with irregular holes or holes with incorrect diameters.

**Industry:** Automotive

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**Correct holes**

**Irregular holes**

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**Degree of difficulty**

<table>
<thead>
<tr>
<th>Simple</th>
<th>Moderate</th>
<th>Advanced</th>
</tr>
</thead>
</table>

The Pixel Counter reliably detects irregularities in the shape and diameter of the holes and can accurately count the existing holes.

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11. Verify that a metal insert was over-molded correctly

**Description:** A piece of metal is inserted in a rubber mold, and it is imperative that the area is covered smoothly. In this case, while in the molding process, an inconsistent shape formed around the insert.

**Industry:** Rubber products

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**Correct molding**

**Incorrect molding**

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**Degree of difficulty**

<table>
<thead>
<tr>
<th>Simple</th>
<th>Moderate</th>
<th>Advanced</th>
</tr>
</thead>
</table>

The molding process can leave an inconsistent shape around the insert. The Pixel Counter inspects for a low level of bright pixels, detecting an incorrect molding.

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12. Confirm grippers have not caused damage to "honey comb"

**Description:** When robots grab the "honey comb" and place it into the canister, the robot’s grippers can cause damage to the outside diameter. The damage to the outside diameter of the "honeycomb" can result in insufficient emissions testing. The Pixel Counter is able to reliably detect the irregularities marked by the dark pixels and alert to "honeycomb" damage.

**Industry:** General machinery

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**Correct outside diameter**

**Damaged outside diameter**

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**Degree of difficulty**

<table>
<thead>
<tr>
<th>Simple</th>
<th>Moderate</th>
<th>Advanced</th>
</tr>
</thead>
</table>

When the outside diameter is damaged, open irregular spaces create additional dark pixels. The Pixel Counter detects the irregular shape and is the solution for this application.
13. Ensure that correct media has been placed inside of a filter

**Description:** In this application, media with two different colors must flow through a filter. The correct media must be verified.

**Industry:** Automotive

*The contrast between the two objects differs greatly; the Pixel Counter is able to differentiate between the shades.*

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14. Verify the correct depth of an air sensor

**Description:** An air sensor assembly used on an automotive AC unit must be inserted to a specific depth or risk failure of the component. The correct depth of the air sensor is detected within the Contour Sensor’s field of view.

**Industry:** Automotive

*By teaching the contour of the base and upper part of the object, the correct insertion depth can be maintained.*

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15. Short shot can result in loose electrical assemblies in automotive parts

**Description:** A short shot part can result in loose electrical assemblies in automotive parts causing shorts and electrical failures.

**Industry:** Plastic injection molding

*The short shots are unpredictable due to a wide range of acceptable parts. The Pixel Counter is the appropriate choice in this example because it inspects the area of the prong for improper molding.*

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16. Ensure that grease has been applied

**Description:** Grease is applied by a “Dobber” that never drops the same shaped glob. The absence of grease results in loose and rattling brakes.

**Industry:** Automotive

*The Pixel Counter can detect the grease spot and smearing, regardless of the inconsistent shapes.*
17. Detect position of a key in a valve engine

**Description:** A laser was used to detect a key that was inserted into an engine valve spring. When the laser detected the key seams, it provided a false negative. As a more reliable alternative, the Contour Sensor can identify the key and ignore the seams that can cause false signals.

**Industry:** Automotive

**VERIFICATION**

If one of the keys is missing, the contour circle in the middle does not appear, resulting in a repeatable application.

18. Double sheet detection

**Description:** A stamping press could be catastrophically damaged if two sheets of metal were selected instead of one in a stamping process.

**Industry:** Automotive

The reflectivity of the sheets causes inconsistent contours which can be easily detected using the Pixel Counter.

19. Determine that mastic is present and correct amount has been applied

**Description:** In this application, it must be verified that mastic is present and that the correct amount has been applied.

**Industry:** Automotive

The Pixel Counter analyzes each mastic portion and verifies that the correct amount has been applied. By analyzing the area, the Pixel Counter can detect the missing mastic.

20. Verify correct installation of dental scrubber

**Description:** In this application, dental scrubbers are monitored for correct installation. If the scrubber is installed incorrectly, the non-matching contour indicates incorrect placement.

**Industry:** Assembly automation

A correctly installed scrubber results in a very defined shape and contour. If the scrubber is incorrectly installed, the shape of the object is different.
Error Proofing Application Examples

21. Verify correct order of washers on a gear shaft

**Description:** To verify that the correct order of washers is placed on a gear shaft, the unique features of the washer sequence are compared.

**Industry:** Automotive

The width of the upper washer is always thicker than the bottom washer. By teaching the edges of the washers, the Contour Sensor can verify the correct order.

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22. Verify that a cap is fully seated

**Description:** In the assembly process, proper seating of a part is essential to the process. If a cap is not properly seated, the rest of the assembly process will be adversely affected. The Contour Sensor can verify that a cap is fully seated by detecting the unique features of its position.

**Industry:** Assembly automation

When the cap is fully seated, the gap is small. By teaching the correct seated position, the Contour Sensor determines incorrect seating by detecting gap tolerance.

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23. Detect difference between polished and non-polished flute

**Description:** In a metal stamping application, it is necessary to detect the difference between a polished and non-polished flute. The Pixel Counter analyzes the entire area of the flute.

**Industry:** Metal stamping and forming

Since the reflections do not create a repeatable shape or contour, the Pixel Counter is an ideal solution.

---

24. Verify correct alignment of part

**Description:** Prior to the welding process, components must be aligned properly. The Contour Sensor can detect the correct orientation of a part by comparing contours.

**Industry:** Automotive

By teaching the edges of the outer and inner part, the sensor can verify the correct alignment.
25. Verify placement of label

**Description:** In this packaging application, correct label position is essential. Verifying that a wine label is applied to a bottle is easily achieved by matching the contour of the label.

**Industry:** Packaging

![Correct placement](image1)
![Incorrect placement](image2)

**Degree of difficulty**
- Simple
- Moderate
- Advanced

By teaching the contour of the label, the Contour Sensor is the ideal solution for verifying correct placement.

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26. Verify that the correct profile has been loaded

**Description:** In this example, 15 different vinyl window profiles can be loaded into the machine. The Contour Sensor is used to verify that the correct recipe has been loaded in the machine.

**Industry:** Window manufacturing

![Correct profile](image3)
![Incorrect profile](image4)

**Degree of difficulty**
- Simple
- Moderate
- Advanced

Each vinyl window profile has a unique shape and contour which can be taught using the Contour Sensor.

---

27. Verify registration mark

**Description:** A registration mark is used to identify parts that have been through the manufacturing process. Without the mark, the parts go into quarantine, where every unit must be manually sorted.

**Industry:** Assembly automation

![Mark present](image5)
![Mark missing](image6)

**Degree of difficulty**
- Simple
- Moderate
- Advanced

Ifm’s Pixel Counter is able to identify that the mark is present regardless of the shape or size, eliminating the quarantine process.

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28. Detect that a nut has been inserted and is seated correctly

**Description:** In the assembly process, small components must be seated correctly. If a nut is not seated correctly, a higher number of white pixels is indicated. Using the rectangularity tool, it is determined that the shape is more rectangular when not seated correctly.

**Industry:** Assembly automation

![Nut inserted correctly](image7)
![Nut missing](image8)

**Degree of difficulty**
- Simple
- Moderate
- Advanced

The Pixel Counter has tools to verify the rectangularity of the part as well as the number of pixels.
29. Correct orientation on engine head

Description: If an engine head is not oriented correctly, it will cause a tool crash in a down-the-line process. To verify the correct orientation, the unique features of an engine head are matched.

Industry: Automotive

In the correct orientation, the part will have a unique feature that can be taught with a Contour Sensor.

30. Verify that a date code is printed on an object

Description: A legible date code is required on all shipped products. If one unit is found to have a missing date code, the whole container must be shipped back. The Contour Sensor can detect and match the contours of characters.

Industry: Food

The Contour Sensor is a good choice since a specific number sequence exists in the date code.

31. Detect broken speaker tab after molding process

Description: In this application, laser sensors were used to detect broken speaker tabs after the molding processes. Any slight movement in the speaker fixtures would cause false negatives. As an alternative, the Contour Sensor is applied, providing improved reliability.

Industry: Automotive

The Contour Sensor can be configured to look for several similar contours.

32. Verify the alignment or missing contact lens bottle

Description: In this pharmaceutical application, the alignment of contact lens bottles or missing bottles must be verified to within 1/8" tolerance.

Industry: Pharmaceuticals

Anchors can be configured with the Contour Sensor, and close tolerances can be maintained.
33. Verify that part is fully threaded

**Description:** Quality control for thread detection on the part is essential to the process. The number of threads can be verified by matching the contour threads.

**Industry:** Automotive

- **Correct part**
- **Incorrect part**

When the part is fully threaded, the threads create more contours that can be detected. The Contour Sensor learns the unique shape and verifies that the part is fully threaded.

34. Confirm bottle cap is sealed correctly

**Description:** Using the contour of a bottle cap, the correct placement of a bottle cap is verified.

**Industry:** Food

- **Correct placement**
- **Incorrect placement**

When the cap is incorrectly sealed, the contour of the cap changes which results in a failed inspection. The Contour Sensor reliably detects the change in the cap’s contour.

35. Count number of seeds on a hamburger bun

**Description:** Counting the number of sesame seeds on a fast food bun can be achieved by creating three zones. Below a certain tolerance, the bun will be rejected.

**Industry:** Food

- **Correct number**
- **Incorrect number**

The sesame seeds produce unique contours that can be used to count the relative amounts of seeds on a bun. By setting the minimum number of models that need to be found, the Contour Sensor reliably verifies the correct number of seeds.

36. Proper orientation of washer fluid cap

**Description:** Proper orientation (± 60 degrees) of the windshield washer fluid cap is required. If mistakes are found, all existing stock must be rechecked.

**Industry:** Automotive

- **Correct orientation**
- **Incorrect orientation**

By setting the outline of the letters and symbol, the Contour Sensor will detect the slightest change in orientation.
37. Verify correct orientation of inner bearing

Description: The correct orientation of the inner bearing is critical to the process. If the bearing is oriented incorrectly, this will lead to engine failure. The Contour Sensor can easily identify the orientation by detecting the bearing pattern.

Industry: Automotive

The ball bearing will have different but consistent contours when in opposite orientations.

38. Detect correct orientation of steering gear

Description: The correct orientation of the steering gear is critical to the assembly process. If the part is assembled incorrectly, the gear will be scrapped and existing stock will be rechecked. By identifying the side contour of the gear, the proper position is confirmed.

Industry: Automotive

By teaching the Contour Sensor the outer edge of the knuckle, the sensor can determine that the object is in the correct orientation.

39. Identify the correct orientation of a symbol

Description: Small components can easily rotate in the wrong position during the assembly process. The Contour Sensor can quickly verify the correct orientation of locking symbols on a car door.

Industry: Automotive

By setting the outline of the symbol, the Contour Sensor will detect the slightest orientation change.

40. Verify correct orientation of cap

Description: To determine the correct orientation of housing cap, its circular contour is matched. If the cap is installed upside down, it will damage the next installed component.

Industry: Assembly automation

When the cap is installed in the wrong orientation, the tabs are missing. The Contour Sensor detects the correct orientation of the tabs. The correct orientation of the part is repeatable, an ideal application for the Contour Sensor.
41. Correct orientation of a part

**Description:** If a part is positioned only millimeters in the wrong direction, the assembly process will be affected. By detecting that the part is within the sensor’s field of view, the correct orientation is confirmed.

**Industry:** Assembly automation

*The correct orientation of the part produces a repeatable contour.*

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42. Sort connectors by knurled nuts and hex nuts

**Description:** In this application, connectors are sorted by knurled nut or hex nut. Using the hex nut contour, the Contour Sensor can differentiate between connector types.

**Industry:** Assembly automation

*The reflection from the hex nut is repeatable in shape and allows the Contour Sensor to be very effective.*

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43. Sort the correct clamp and screw type

**Description:** In this application, different types of clamps and screws must be sorted. A high-end camera system was originally used for this application, but required vision specialists and additional computer processing power.

**Industry:** Automotive

*Different types of clamps will produce unique contours. The Contour Sensor easily sorts the parts by identifying the unique contour of each screw.*

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44. Identify correct piston rods

**Description:** Verifying the difference between two types of piston connecting rods can be achieved by programming two contour styles in the sensor’s field of view.

**Industry:** Automotive

*Each connecting rod has a specific shape that is unique and can be solved with the Contour Sensor.*
45. Sort gears by pitch and teeth

**Description:** The Contour Sensor can sort the difference between a 24-pitch gear with 16 teeth compared to a 32-pitch gear with 20 teeth.

**Industry:** Assembly automation

**Degree of difficulty:** Simple

- Correct pitch and teeth
- Incorrect pitch and teeth

46. Sort golf balls by brand names

**Description:** Multiple golf ball brands are required to be sorted on the machine. Within the field of view, the characters of a logo can be verified and then sorted.

**Industry:** Assembly automation

**Degree of difficulty:** Simple

- Correct brand
- Incorrect brand

47. Identify the presence of contacts in the battery housing

**Description:** A negative terminal must be assembled on the seam side of the battery housing. The angle of the camera picks up the light reflection from a metal tab that is always present in the seam, creating a concentration of white pixels.

**Industry:** Assembly automation

**Degree of difficulty:** Simple

- Part
- No part

48. Identify cap on top of spray can

**Description:** In this application, identifying missing components is performed manually at the plant. By automating this process with the Contour Sensor, spray caps are verified leading to efficiency and cost savings.

**Industry:** Food

**Degree of difficulty:** Simple

- Part found
- Part missing
49. Identify missing piece in O-ring assembly

**Description:** In this application, identifying that a piece is missing in an O-ring is imperative. The Pixel Counter is programmed to verify that the O-ring is complete and that no piece is missing regardless of the size and location of the missing piece.

**Industry:** Assembly automation

The Pixel Counter is the appropriate choice for this application because the missing piece can vary in location and size.

50. Identify missing clips in the automotive assembly process

**Description:** Highly reflective clips can take on different contours and shades, making it difficult for recognition. The Pixel Counter is able to adjust to the different shapes of two clips in this application and identify the clips that are missing.

**Industry:** Automotive

The Pixel Counter is able to adjust to the different shapes produced by the clips.

51. Identify weld nuts and studs on a truck panel

**Description:** Detecting the presence of weld nuts and studs on a truck panel is important to the assembly process. The Contour Sensor is programmed to identify six indentations on the panel to confirm that the part is correct.

**Industry:** Automotive

Reflections within the holes enable the Contour Sensor to confirm that the weld nuts and studs are not present. The consistency of lighting on the truck panel produces a repeatable contour for detection.

52. Identify welded washer on a part

**Description:** In this application, the contour of a circular washer is detected on a part. When the circular contour is not detected, the part is determined missing.

**Industry:** Automotive

The welded washer has a repeatable contour when present, therefore, the Contour Sensor is the appropriate choice.
53. Identify presence of two O-rings

Description: Two O-rings are required on a brake line. By identifying the side contour of the O-rings, the Contour Sensor can determine whether both parts are present.

Industry: Automotive

The O-ring provides a repeatable edge for reliable detection.

54. Detect missing gum pack in a packaging line

Description: In a gum manufacturing packaging line, there is a possibility that a pack of gum in a layer could be missing. In this application, three layers of gum packets are packed in a white box.

Industry: Food packaging

When a pack of gum is missing, the Pixel Counter detects the exposed area inside the box. Since the gum layers do not have a consistent shape or contour, the Pixel tool is ideal for this application.

55. Identify presence of a washer on a gear shaft

Description: The Contour Sensor identifies the presence of a washer on a gear shaft. The circular contour is detected in the sensor’s field of view.

Industry: Automotive

The reflection from the washer provides reliable and consistent contours.

56. Detect if the poly bag is present before packaging of product

Description: A poly bag must be present before packaging a product. When the bag is present, it generates a reflection that can vary depending on the placement of the bag.

Industry: Food packaging

The shape and size of this image changes which makes the Pixel Counter a good solution for this application.
57. Verify presence of rivets

Description: Rivets are good as long as there is plastic present to indicate proof of weld. The entire area is analyzed to determine that all rivets are present.

Industry: Automotive

An ultrasonic welder can produce rivets in various shapes. The Pixel Counter is ideal where the objects vary in shape and therefore reliably verifies the presence of rivets in this application.

58. Identify presence of washers and pins

Description: To determine if washers and pins are correctly installed, the washer contour and pin contour are matched to confirm that the correct part is in place.

Industry: Assembly automation

By teaching the sensor the contours of the washer and pin, the Contour Sensor confirms the presence of the parts.

59. Identify clips on a panel

Description: In this application, three body clips are positioned on a panel. By monitoring the contours of multiple clips, the missing parts are identified.

Industry: Assembly automation

The Contour Sensor is used to solve this application because the body clips, when installed, produce repeatable contours for part presence.

60. Identify presence of an E-clip on a pin

Description: The goal of this application is to determine the correct placement of an E-clip on the shaft of a metal pin. The E-clip's unique features are verified and the correct placement is confirmed.

Industry: Assembly automation

The Contour Sensor learns the unique shape of the E-clip when in the correct position on the metal pin.
61. Detect the correct number of needle bearings

**Description**: The correct amount of needle bearings is critical to the steering operation. If one bearing is missing, it will lead to a malfunction of the system. A high-end camera was used and required extensive programming. As an alternative, the Contour Sensor can find the correct amount of bearings with minimal configuration.

**Industry**: Automotive

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62. Identify seal in a shock absorber

**Description**: Detecting a seal within a shock absorber is essential to the assembly process. By matching the contour, the correct part is confirmed.

**Industry**: Automotive

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63. Detect copper studs on truck panel

**Description**: The original system used prox sensors to detect copper studs on a truck firewall panel. This proved to be unreliable and difficult to change out when a sensor failed. The Contour Sensor is a better alternative by detecting the shape of the studs.

**Industry**: Automotive

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64. Verify presence of O-ring

**Description**: In the assembly process, detecting the presence of a brown O-ring is achieved by comparing its double-edged contour.

**Industry**: Assembly automation

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65. Measure needle length

**Description:** In this application, the needle length is measured to maintain quality control. The correct needle length is identified in the sensor's field of view.

**Industry:** Pharmaceuticals

*By teaching the contours of the base and the tip, the x coordinate can be subtracted to determine the length of the needle.*

66. Measure width of test tubes

**Description:** To differentiate between 13 mm and 16 mm wide test tubes, the Contour Sensor compares two unique features.

**Industry:** Robotics

*The Contour Sensor learns each edge of the test tube. By subtracting the x coordinates, the width of the test tube can be determined.*
Getting started with efector dualis

Required components:
A standard M12 8-pin cable is used for digital I/O and power. Please see wiring diagram below.
Ethernet cable (M12 / RJ45) and PC are required to configure the sensor
- Contour Sensor (O2Dxxx): The default IP address is set to 192.168.0.49 or
- Pixel Counter (O2Vxxx): The default IP address is set to 192.168.0.59

Please make sure that your PC is set to the same domain, for example, 192.168.0.100 as long as the last three numbers are different from the Vision Sensor's IP address.
The sensor is configured using software that can be downloaded from our website.
http://www.ifm.com/ifmus/web/dualis_download.htm

The sensor can be setup as a standard digital device and/or transmit information via Ethernet port.

Process interface (1)
M12 connector, A-coded, 8-pin

1. U+
2. Trigger input
3. 0 V
4. Switching output / trigger output
5. Switching output (ready)
6. Switching output (OUT)
7. Switching output / input 1
8. Switching output / input 2

If external sensor trigger is required, the sensor can be wired as shown.

PC or PLC interface

Integrated Ethernet port for transferring information to plant network.
E11898 (2m), E18422 (5m), E18423 (10m)
Ethernet TCP and Ethernet IP supported

M12 8 pin cable:
E11231 (2m), E11232 (5m)
E11950 (2m), E11807 (5m)

Configurable digital I/O to PLC
Select the optimum solution for your application

**Selection Chart**

**Step 1**
Define the necessary resolution for your application (the smallest change to the contour). Check whether the field of view size is sufficient (all search zones must be within this field of view size).

**Step 2**
The maximum distance to the object can be read from the intersection point with the horizontal black line. This allows you to determine the optimum solution for your application.

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**Example:**
A 0.05 mm resolution and field of view of 33 x 24 mm can be accomplished at 50 mm with the wide angle lens version.
Selection Guide

efector dualis Vision Sensor selection guide

<table>
<thead>
<tr>
<th>Minimum Field of View</th>
<th>Maximum Field of View</th>
<th>Internal Lighting</th>
<th>Output</th>
<th>Type</th>
<th>Part No.</th>
<th>List Price (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wide angle</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>33 x 24 mm</td>
<td>1320 x 945 mm</td>
<td>Infrared</td>
<td>PNP</td>
<td>Contour Sensor</td>
<td>O2D 222</td>
<td>$895.00</td>
</tr>
<tr>
<td>Resolution: 0.05 mm</td>
<td>Resolution: 2 mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Infrared</td>
<td>NPN</td>
<td>Contour Sensor</td>
<td>O2D 229</td>
<td>$895.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>White</td>
<td>PNP</td>
<td>Pixel Counter</td>
<td>O2V 102</td>
<td>$895.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>White</td>
<td>NPN</td>
<td>Pixel Counter</td>
<td>O2V 103</td>
<td>$895.00</td>
</tr>
</tbody>
</table>

| Standard              |                       |                   |        |                    |          |                  |
| 16 x 12 mm            | 640 x 480 mm          | Infrared          | PNP    | Contour Sensor     | O2D 220  | $895.00          |
| Resolution: 0.03 mm   | Resolution: 1 mm      |                   |        |                    |          |                  |
|                       |                       | Infrared          | NPN    | Contour Sensor     | O2D 227  | $895.00          |
|                       |                       | White              | PNP    | Pixel Counter      | O2V 100  | $895.00          |
|                       |                       | White              | NPN    | Pixel Counter      | O2V 101  | $895.00          |

| Zoom                  |                       |                   |        |                    |          |                  |
| 15 x 11 [mm]          | 400 x 300 mm          | Infrared          | PNP    | Contour Sensor     | O2D 224  | $895.00          |
| Resolution: 0.02 mm   | Resolution: 0.63 mm   |                   |        |                    |          |                  |
|                       |                       | Infrared          | NPN    | Contour Sensor     | O2D 225  | $895.00          |
|                       |                       | White              | PNP    | Pixel Counter      | O2V 104  | $895.00          |
|                       |                       | White              | NPN    | Pixel Counter      | O2V 105  | $895.00          |

* Refer to selection chart on page 25.

efector dualis technical specs

<table>
<thead>
<tr>
<th>Maximum load current:</th>
<th>100 mA (per switching output)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current consumption:</td>
<td>&lt; 300 mA</td>
</tr>
<tr>
<td>Detection rate:</td>
<td>20 Hz</td>
</tr>
<tr>
<td>Operating voltage:</td>
<td>24 VDC ± 10 %</td>
</tr>
<tr>
<td>Short-circuit protection, pulsed:</td>
<td>Yes</td>
</tr>
<tr>
<td>Reversed polarity, overload protection:</td>
<td>Yes</td>
</tr>
<tr>
<td>Operating temperature:</td>
<td>14...122 °F (-10...50 °C)</td>
</tr>
<tr>
<td>Protection:</td>
<td>IP 67, III</td>
</tr>
</tbody>
</table>

| Material:             | Housing: die-cast zinc,        |
|                       | Front pane: glass, LED window:|
|                       | polycarbonate                  |
| Trigger mode:        | External 24 V PNP, continuous, TCP/IP, Ethernet IP |
| Switching outputs:   | 100 mA per output              |
| Connection external lighting: | 24 V DC PNP                |
| Parameter setting:   | Ethernet 10 Base-T             |
| Process data interface: | Ethernet TCP, Ethernet IP     |
Optional Lighting for effector dualis vision sensors

<table>
<thead>
<tr>
<th>Function</th>
<th>Dimensions [mm]</th>
<th>Illuminated Area [mm]</th>
<th>Connection</th>
<th>Current Consumption (mA)</th>
<th>Part No.</th>
<th>List Price (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Backlight · infrared 880 nm</td>
<td>34.4 x 66.5 x 9.2</td>
<td>25 x 25</td>
<td>Cable w/ M12 connector</td>
<td>50* / 25**</td>
<td>O2D 906</td>
<td>$310.00</td>
</tr>
<tr>
<td></td>
<td>81 x 103 x 9.8</td>
<td>50 x 50</td>
<td>Cable w/ M12 connector</td>
<td>200* / 100**</td>
<td>O2D 907</td>
<td>$342.00</td>
</tr>
<tr>
<td></td>
<td>133 x 156 x 9.8</td>
<td>100 x 100</td>
<td>Cable w/ M12 connector</td>
<td>450* / 250**</td>
<td>O2D 908</td>
<td>$379.00</td>
</tr>
<tr>
<td>Spot light · transmitter red light 630 nm</td>
<td>42 x 54 x 31</td>
<td>–</td>
<td>M12 connector</td>
<td>180* / 90**</td>
<td>O2D 909</td>
<td>$320.00</td>
</tr>
</tbody>
</table>

*Continuous operating mode **High intensity operating mode

Lighting technical specs
Supply voltage: 24 VDC ±10%
Reverse polarity protection: Yes
Overload protection: Yes
Temperature protection: Yes
Housing material: Aluminum
Lens material: PMMA
Ambient temperature: 0…50 °C
Protection: IP 65
LED display: Status: yellow, Power: green, Excess temp: red

Dimensions (mm)
O2D220, O2D222, O2D227, O2D229, O2V100, O2V102

O2D224, O2D225, O2V104

Cordsets and accessories for effector dualis vision sensors

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Part No.</th>
<th>List Price (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M12 Micro DC (8-pin) 2 m, PUR</td>
<td>E 11231</td>
<td>$27.00</td>
<td></td>
</tr>
<tr>
<td>M12 Micro DC (8-pin) 5 m, PUR</td>
<td>E 11232</td>
<td>$33.00</td>
<td></td>
</tr>
<tr>
<td>M12 Micro DC (8-pin) 10 m, PUR</td>
<td>E 11806</td>
<td>$67.00</td>
<td></td>
</tr>
<tr>
<td>M12 Micro DC (8-pin) 2 m, PUR</td>
<td>E 11950</td>
<td>$27.00</td>
<td></td>
</tr>
<tr>
<td>M12 Micro DC (8-pin) 5 m, PUR</td>
<td>E 11807</td>
<td>$33.00</td>
<td></td>
</tr>
<tr>
<td>M12 Micro DC (8-pin) 10 m, PUR</td>
<td>E 11311</td>
<td>$67.00</td>
<td></td>
</tr>
<tr>
<td>Ethernet cable, 2 m, M12 D-coded / RJ45, cross-link</td>
<td>E 11898</td>
<td>$43.00</td>
<td></td>
</tr>
<tr>
<td>Ethernet cable, 5 m, M12 D-coded / RJ45, cross-link</td>
<td>E 18422</td>
<td>$52.00</td>
<td></td>
</tr>
<tr>
<td>Ethernet cable, 10 m, M12 D-coded / RJ45, cross-link</td>
<td>E 18423</td>
<td>$67.00</td>
<td></td>
</tr>
<tr>
<td>Mounting Set, 100 mm rod</td>
<td>U 60042</td>
<td>$43.00</td>
<td></td>
</tr>
<tr>
<td>Mounting Set, 100 mm rod with rail mount cube</td>
<td>U 60043</td>
<td>$49.00</td>
<td></td>
</tr>
<tr>
<td>Glass protective lens</td>
<td>E21168</td>
<td>$93.00</td>
<td></td>
</tr>
<tr>
<td>Plastic protective lens for food and beverage applications</td>
<td>E21166</td>
<td>$93.00</td>
<td></td>
</tr>
<tr>
<td>Plastic lens for diffusing light</td>
<td>E21165</td>
<td>$106.00</td>
<td></td>
</tr>
</tbody>
</table>

Cordsets for lighting
M12 Micro DC (4-pin) 2 m, PUR EVC 001 $9.95
M12 Micro DC (4-pin) 5 m, PUR EVC 002 $13.50

Wiring for lighting

1 = Display
2 = Focus setting
4: Trigger
2: Operating mode “High Light Intensity”
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