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DS900 Series Models

<table>
<thead>
<tr>
<th>Model</th>
<th>Class 2M Laser</th>
</tr>
</thead>
<tbody>
<tr>
<td>DS925B</td>
<td>✔</td>
</tr>
<tr>
<td>821-0116-1R</td>
<td></td>
</tr>
</tbody>
</table>

Laser Safety Warnings

LASER LIGHT, DO NOT STARE INTO BEAM: CLASS 2M LASER PRODUCT
FAILURE TO FOLLOW THESE INSTRUCTIONS MAY CAUSE SERIOUS INJURY

---

DS900 Series Sensor Accessories

<table>
<thead>
<tr>
<th>Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power supply PS2020</td>
</tr>
<tr>
<td>power supply for DIN rail mounting</td>
</tr>
<tr>
<td>input 230 VAC</td>
</tr>
<tr>
<td>output 24 VDC/2.5 A</td>
</tr>
<tr>
<td>For maximum 2 sensors at the same time.</td>
</tr>
<tr>
<td>Ethernet connection cable (CCB-2901858-05)</td>
</tr>
<tr>
<td>length: 5 m, IP65-rated</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Optional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power cable (CCB-2901868-05)</td>
</tr>
<tr>
<td>+ I/O + Encoder cable, IP65-rated, 5 m</td>
</tr>
<tr>
<td>NOTE: This cable is required if PoE is not used to power the camera</td>
</tr>
</tbody>
</table>
Warnings and Notices

- Do not stare into the beam.
- Do not view directly with optical instruments (magnifiers).
- Do not place optical components (mirrors) into the beam.
- Design test fixtures in such a way that unintentional viewing of the beam is prevented.
- Switch off the laser when not in use.
- Avoid the use of highly reflective materials. If you cannot, try to angle the part so unintentional viewing of the reflection is prevented.
- Terminate (block) unused beams.
- Keep the laser plane horizontal or pointing downwards.
- Report any issues that may have an impact on laser safety to your supervisor or Laser Safety Officer.
- There is no scheduled maintenance necessary to keep the product in compliance (see "Sensor Maintenance" on page 11).
- Under no circumstance should you modify in any way the sensor or its housing.
- Caution – Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.
- When moving the unit from a very hot environment to a cold environment please allow the unit to equalize in a room temperature environment for 24 hours between temperature extremes.

- DS900 Series Sensors with a maximum laser power up to 8 mW are classified in Laser Class 2M (IIM).
- Hazard to the eye via laser radiation! Consciously close your eyes or turn away if the laser radiation impinges on the eye.
- Lasers of Class 2M are not subject to notification and a laser protection officer is not required. Mark the laser area recognizable and everlasting.
Sensor Maintenance

The DS900 Series Sensor windows should be kept clean, so avoid touching the windows and, if possible, keep your sensor in a clean area. If the windows are touched, scratched or have a large amount of dust, the accuracy of the sensor may be impacted.

If the windows collect significant dust or become dirty, clean them with great care as they have a coating that can be easily damaged. Use minimal pressure, rotate the swab during cleaning so dirt is not dragged across the surface, start at the center of the window and spiral out to the edges, and use several swabs.

1. Unplug the power to the unit so the laser is not fired by mistake. Cognex recommends doing a drag wipe with lens tissue and isopropyl alcohol.

2. Saturate a piece of lint-free tissue with reagent-grade isopropyl alcohol and drag it across the surface. If done properly, the alcohol will evaporate uniformly and without leaving streaks or spots. An alternative is to use an optical grade cotton swab ("Qtip") saturated with isopropyl alcohol.

The body of the sensor does not require a specific cleaning method.

Product Service

- The sensor cannot and should not be allowed to be serviced by the customer, so bring any performance issues to the attention of your local Cognex representative.

- In case of any necessary service or repairing processes, return the unit to the factory.

- Service is only to be handled by authorized factory trained technicians. The sensor does not contain parts that are user-serviceable.

- Under no circumstances should you operate the sensor if it is defective or the seal damaged. Cognex Corporation cannot be held responsible for any harm caused by operating a faulty unit.
This document provides basic information about how you can set up your DS900 Series Sensor, how it works, and how to connect it to your network.

You must use the VisionPro acquisition software together with the sensor to acquire images to determine the height profile of objects passing under the device. You can use the range image particularly to determine the 3D shape of objects. Vision applications can use this 3D shape information to determine whether a certain 3D feature appears in the expected manner on the surface of the object.

To set up your sensor for image acquisition using VisionPro quickly, see the DS900 Series – Getting Started acquisition topic in the CHM file mentioned hereinafter.

Additional information is available through the Windows Start menu:

You can also use the Help inside the VisionPro software by clicking **Help -> QuickBuild Help -> How to... -> Use QuickBuild.**
**DS925B Labels**

In accordance to the standards, the following labels are placed on their respective places on every sensor manufactured by Cognex Corporation:

![Laser radiation label]

FAILURE TO FOLLOW THESE INSTRUCTIONS MAY CAUSE SERIOUS INJURY

If you need more information on the collection, reuse, and recycling systems, please contact your local or regional waste administration.

You may also contact your supplier for more information on the environmental performance of this product.

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Label Locations

DS925B (820-9164-1R)

AVOID EXPOSURE - LASER RADIATION IS Emitted FROM THIS APERTURE

LASER LIGHT, DO NOT STARE INTO BEAM: CLASS 2M LASER PRODUCT

Laser radiation
Do not stare into the beam or view directly with optical instruments
Class 2M Laser Product

ISO 8206:1-2006-05
P_{e} = 0.356W
P_{o} = 0.356W
H = 0.90cm²

λ = 660nm; T = 0.464m; L = 1; θ = 45°
System Layout

- Ethernet socket
- Multifunction socket (24V DC power + I/O connector)
- M5 threaded mounting holes
- This pin hole is provided for a position locking pin. The sensor can be mounted reproducible and replaceable together with an attachment point.
- Status LEDs
- Laser window
- Camera window
### LED Displays

<table>
<thead>
<tr>
<th>“laser on” LED</th>
<th>Green: Laser on</th>
<th>Note: The “state” LED flashes green:</th>
</tr>
</thead>
</table>
| “state” LED: Two-color LED (red / green) | • Green: Measurement  
• Green flashing: Data transmission  
• Red flashing: Error code | • **long** during active data transmission  
• **short** for controller accesses |

For the error codes, see [page 66](#).
Dimensions (DS925B)

Recommended attachment point

[ Diagram of DS925B sensor dimensions with specific measurements and notations provided. ]

- Dimensions (DS925B)
  - Recommended attachment point
  - Specific measurements and notes provided.
About The DS900 Series Sensors

The Cognex DS900 Series Sensors (from now on: sensors) have an integrated digital camera and laser stripe illuminator, mounted in a single mechanically robust package.

The sensor offers highly accurate physical object measurements by analyzing the shape of the laser stripe as it appears to the camera (which is positioned at an angle to the laser). The software running in the device can determine the 3D location of the points through which the laser stripe passes.

The sensor acquires several of these images while the scene in front of the sensor is moving, and by stitching them together, provides a 3D height image of the inspected object.

Safely Handling Your DS900 Series Sensor

- Whenever you transport or ship your sensor, use the packaging supplied by Cognex when you received your unit. Do not discard this packaging.

- For laser safety information, refer to section Warnings and Notices on page 8.

- Your sensor is a sensitive, precision instrument. Subjecting the unit to shock, vibration, or rough handling in excess of the specified limits may cause the unit to fail to operate correctly (see section “DS925 Sensor Specifications” on page 28).

- Do not store or install your sensor in excessively hot, cold, dusty, or damp environments. Observe the environmental limits specified in section “DS925 Sensor Specifications” on page 28.

- To clean your sensor, follow the instructions in section “Sensor Maintenance” on page 11.

- For electrical safety information, refer to section “Power Supply” on page 34.
### DS925B Sensor Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Weight</strong></td>
<td>380 g</td>
</tr>
<tr>
<td><strong>Dimensions</strong></td>
<td>96 mm (H) x 33 mm (W) x 85 mm (L)</td>
</tr>
<tr>
<td><strong>Operating Temperature</strong></td>
<td>0ºC to 45ºC (32ºF to 113ºF)</td>
</tr>
<tr>
<td><strong>Storage Temperature</strong></td>
<td>-20ºC to 70ºC (-4ºF to 158ºF)</td>
</tr>
<tr>
<td><strong>Maximum Humidity</strong></td>
<td>5% - 95% (non-condensing)</td>
</tr>
<tr>
<td><strong>Environmental</strong></td>
<td>IP65 (with Cognex recommended IP65 Ethernet and Power I/O cables)</td>
</tr>
<tr>
<td><strong>Laser Power</strong></td>
<td>8mW (class 2M) at 405nm wavelength</td>
</tr>
</tbody>
</table>
| **Power Supply Requirements** | Voltage: +24 VDC (11-30 VDC)  
Current: 500 mA max  
IEEE 802.3af Power over Ethernet |
| **Discrete I/O operating limits** | Trigger  
Input voltage limits: 0 VDC to +30 VDC  
Input ON: > 2.4 VDC (TTL); > 11 VDC (HTL)  
Input OFF: < 0.8 VDC (TTL); < 3 VDC (HTL) |
| **Encoder Input Specification** | Single-ended: A+/B+: 5-24V; A-/B-: +0VDC |
| **Scan Rate**         | Up to 2 kHz                                  |
| **Ethernet**          | • Gigabit Ethernet interface               
• Standard M12-8 female connector |

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### DS900 Series Technical Data

<table>
<thead>
<tr>
<th>Model</th>
<th>DS925B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring range Z-axis</td>
<td>25 mm</td>
</tr>
<tr>
<td>Start of measuring range</td>
<td>53.5 mm</td>
</tr>
<tr>
<td>End of measuring range</td>
<td>78.5 mm</td>
</tr>
<tr>
<td>Start of measuring range, extended, approx.</td>
<td>53 mm</td>
</tr>
<tr>
<td>End of measuring range, extended, approx.</td>
<td>79 mm</td>
</tr>
<tr>
<td>Line length midrange (X-axis)</td>
<td>25 mm</td>
</tr>
<tr>
<td>Linearity</td>
<td>± 0.16 % FSO (3 σ)</td>
</tr>
<tr>
<td>Resolution X-axis</td>
<td>1280 points/profile</td>
</tr>
<tr>
<td>Profile frequency (depending on sensor model)</td>
<td>200 - 2000 Hz</td>
</tr>
<tr>
<td>Light source laser</td>
<td>Semiconductor laser, approx. 405 nm, 20°...25° aperture angle, Laser class 2M: laser power 8 mW, reduced 2 mW</td>
</tr>
</tbody>
</table>

**Supplied with:**
- IEEE 802.3af Power over Ethernet, class 2
- 1x state / 1x laser on
- according to: EN 61326-1: 2006-10
- DIN EN 55011: 2007-11 (group 1, class B)
- EN 61000-6-2: 2006-03

**EMC:**
- EN 61326-1: 2006-10
- DIN EN 55011: 2007-11 (group 1, class B)
- EN 61000-6-2: 2006-03

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1) Based on a Cognex Optronic standard target with metallic finished surfaces

FSO = Full Scale Output | MMR = Midrange
Mounting The DS900 Series Sensor

For accurate operation, the sensor must be mounted firmly – acquired range images will be unrepeatable (and, consequently, inaccurate) if the device moves during acquisition. Furthermore, the device must be mounted perpendicular to the motion of travel; the more accurately you mount your device, the more accurate your acquired range images will be.

The sensor must be precisely aligned with the direction of movement taking into consideration the following guidelines:

The origin of the X axis is the optical centerline of the sensor projected onto the Working Section.

Movement should be perpendicular to the laser plane.

The device has three (3) threaded M5 holes and can be mounted using 2 or 3 of these holes either as direct attachment points using M5 screws, or as through-holes accommodating M4 screws. A separate 3mm diameter reference pin hole is provided to ensure accurate location of the unit during initial mounting or replacement. Refer to the drawings on page 22 and page 24 for mounting dimensions and hole locations.

Depending on the installation position, it is recommended to determine the position of the sensor for example by adjusting screws on the specially marked attachment points.

NOTE:
- Please refer to page 27 for handling precautions that should be observed during mounting.
- The unit should be mounted such that the laser beam strikes the target surface at right angles. Misalignment of the unit can result in inaccurate measurements.
Power Supply

The unit can be powered by either connecting to a PoE port, or using an external power supply via the multifunction socket. The following information pertains to connecting power via the multifunction socket.

**IMPORTANT:** Connect the multifunction socket only when the power supply is switched off.

- For description and pin assignment, see page 40.
- Range: 11 V – 30 V (rated value 24 V) DC; Max 500 mA
- The operating voltage is protected against reverse polarity.
- The cable shield is connected with the connector housing and should be connected to the protective conductor PE of the power supply.
- The shielded multifunction cable CCB-2901868-05 is recommended.
- The operating voltage for the DS900 Series measuring device should come from a 24 V power supply that is only used for measuring equipment and not simultaneously for drives, contactors or similar pulse interference sources. Use a power supply with galvanic isolation.
Installation Instructions

- Only Cognex-approved shielded cables should be used. See page 7 for cable part numbers.
- Cable shields should be connected to the machinery’s potential equalization terminals in order to avoid electrical current ground loops.
- Cables should be routed in accordance with standard electrical wiring procedures in order to minimize electrical noise.
- The minimum bend radius of the cables is 80mm.
- Cognex recommends the use of a separate power supply, either
  - ACC-24I (DIN rail mountable, input 230VAC, output 24VDC/2A); or
  - ACC-QUINT-PS (DIN rail mountable, input 230VAC, output 24VDC/5A)

1. Mount the sensor according to the mounting instructions, see page 32.
2. Install the Ethernet interface hardware, if not already installed.
3. Install VisionPro software according to the instructions of the VisionPro documentation.
4. Make sure that your license is installed and valid.
5. Connect the DS900 Series Sensor to the PC via Ethernet.
6. Switch on the power supply (only applicable if not using PoE for power).
7. Open the Cognex GigE Vision Configurator PC application.
8. Check that the device is recognized by the PC. This may take a few seconds.

The “state” LED indicates different error conditions by flashing. For the error codes, see page 66. If several errors occur at the same time, it indicates two of them alternately. Therefore the LED can continue to flash for some time after the rectification of an error. If no flashing occurs for several seconds, no error has occurred.

**NOTE:** A DS900 Series sensor achieves highest precision measurements after it has been turned on for at least 20 minutes.
Ethernet Connector

The ethernet connection uses an M12-8 female connector.

<table>
<thead>
<tr>
<th>RJ45 Connector</th>
<th>8-pin screw connector (sensor side)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin No.</td>
<td>Color stranded hook-up wire SC2600/2900-x</td>
</tr>
<tr>
<td>1</td>
<td>white (orange)</td>
</tr>
<tr>
<td>2</td>
<td>orange</td>
</tr>
<tr>
<td>3</td>
<td>white (green)</td>
</tr>
<tr>
<td>6</td>
<td>blue</td>
</tr>
<tr>
<td>4</td>
<td>white (blue)</td>
</tr>
<tr>
<td>5</td>
<td>green</td>
</tr>
<tr>
<td>7</td>
<td>white (brown)</td>
</tr>
<tr>
<td>8</td>
<td>brown</td>
</tr>
</tbody>
</table>

We recommend the Gigabit-Ethernet connection cable CCB-2901858-05 for the Ethernet connection (5 m). Characteristics: 4 x 2 x 0.4 mm²; shielded.

The sensors are to be preferably connected directly to the network connection or to a high-quality switch. As a hub would result in a massive data collision it cannot be used. The PC should have one or more network cards dedicated only for the sensors.

Operating the sensor via Ethernet does not require any driver installation. However, the network settings have to be correct:

- If more than one network card is used, they must be placed on different subnets.
- Certain network settings will affect (and in some cases inhibit) the performance of the sensor (for example firewall and packet filter settings).
- A packet (payload) size of 1024 bytes/packet is recommended. The sensor is capable of supporting jumbo frames up to 4096 bytes/packet, provided all network components also support jumbo frames.
- The sensor supports DHCP (this setting is activated by default). If the sensor is unable to obtain a network address via DHCP, the sensor will use link-local addressing (169.254.x.x). Note that IP address conflict detection is not implemented.
- The sensor supports Power over Ethernet (PoE).
- The sensor can be configured with a fixed (static) IP address using the Cognex GigE Vision Configurator PC application.

![View on pin side male cable connector](image1)

![View on solder pin side screw connector](image2)
### Multifunction Port

The multifunction cable provides access to trigger and inputs and Power Over Ethernet. The drawing on the left shows the plug on the device.

<table>
<thead>
<tr>
<th>Pin #</th>
<th>Signal Name</th>
<th>Notes</th>
<th>Wire Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>+Ub</td>
<td>+ 11 V - 30 V DC rated value 24 V; max. 500 mA</td>
<td>Red</td>
</tr>
<tr>
<td>12</td>
<td>RS422</td>
<td>RS422, input respectively output</td>
<td>Red/Blue</td>
</tr>
<tr>
<td>11</td>
<td>/RS422</td>
<td>Optional</td>
<td>Gray/Pink</td>
</tr>
<tr>
<td>6</td>
<td>In1</td>
<td>Digital Input 1</td>
<td>Yellow</td>
</tr>
<tr>
<td>4</td>
<td>GND-In1</td>
<td>Ground In1</td>
<td>Green</td>
</tr>
<tr>
<td>5</td>
<td>In2</td>
<td>Digital Input 2</td>
<td>Pink</td>
</tr>
<tr>
<td>8</td>
<td>GND-In2</td>
<td>Ground In2</td>
<td>Gray</td>
</tr>
<tr>
<td>10</td>
<td>In3</td>
<td>Digital Input 3</td>
<td>Purple</td>
</tr>
<tr>
<td>7</td>
<td>GND-In3</td>
<td>Ground In3</td>
<td>Black</td>
</tr>
</tbody>
</table>

#### RS422

The RS422 connection (Pin 11 and 12 of the multifunction port) can be used in either of the following configurations:

- Load user modes and sensor control (half-duplex RS422)
- Supplying line trigger signals
- Synchronization of line trigger signals (section “RS422, Synchronization”)

#### Trigger, Encoder, Mode Switching

The switching inputs of the multifunction port can either be used for encoder input, for trigger input or for loading previously stored user modes.

The signal levels are switchable for all switching inputs between LLL (low-voltage-, TTL logic) and HLL (high-voltage-, HTL logic):

- LLL level: Low 0 V ... 0.8 V, high 2.4 V ... 5 V, internal pull-up 10 kΩ to 5 V
- HLL level: Low 0 V ... 3 V, high 11 V ... 24 V (permitted to 30 V), internal pull-up 10 kΩ to 24 V
- Pulse duration: ≥ 5 μs
Switching Inputs

The switching inputs In1 up to In3 can be used for triggering or for connecting an encoder. All switching inputs are identical. The used circuits have an internal electrical isolation. The inputs are galvanically isolated from the GND and Laser on/off.

Each switching input has its own ground connection (Gnd-In1 to 3), which has to be connected with the external ground (synchronization/trigger source or another device).
Switching Inputs

The multifunction socket can be used with any of the following configurations:

<table>
<thead>
<tr>
<th>Configuration</th>
<th>In1</th>
<th>In2</th>
<th>In3</th>
</tr>
</thead>
<tbody>
<tr>
<td>0   Encoder with index, positive edge works with the index 1</td>
<td>N</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>1   Encoder without index, additionally line trigger possible 1</td>
<td>Trigger</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>2   Line trigger</td>
<td>Trigger</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3   Line trigger, load up to 4 usermodes</td>
<td>Trigger</td>
<td>Mode Bit 0</td>
<td>Mode Bit 1</td>
</tr>
<tr>
<td>4   Load up to 8 usermodes</td>
<td>Mode Bit 0</td>
<td>Mode Bit 1</td>
<td>Mode Bit 2</td>
</tr>
<tr>
<td>5   Transmit in time stamp, (only 2910/2960)</td>
<td>Bit 0</td>
<td>Bit 1</td>
<td>Bit 2</td>
</tr>
</tbody>
</table>

1) The encoder input counts each edge. Quadrature encoders typically output 4 edges per encoder step.

Signal level (switching level):
The signal levels are switchable for all switching inputs together via software between LLL (low-voltage-, TTL logic) and HLL (high-voltage-, HTL logic):

- **LLL level:** Low 0 V… 0.8 V, High 2.4 V… 5 V, internal pull-up 10 kOhm to 5 V
- **HLL level:** Low 0 V… 3 V, High 11 V… 24 V (permitted up to 30 V), internal pull-up 10 kOhm to 24 V
- **Pulse duration:** ≥ 5 μs

**NOTE:** Use a shielded cable with twisted wires, especially the recommended CCB-2901868-05 from the accessories.

Connect the cable shield with the potential equalization PE or the connector housing.

**NOTE:** If the sensor is connected to a network adapter/switch that is capable of POE and if you also use the power supply of the multifunction port, these two power supplies have to be galvanically isolated.
RS422, Synchronization

**NOTE:** The DS900 Series Sensors support Power over Ethernet. If the sensor is connected to a network adapter/switch that is capable of POE and if you also use the power supply of the multifunction port, these two power supplies have to be galvanically isolated.

- For the multifunction socket, see page 40.
- For pin assignment, see page 40.

The DS900 Series sensor has an RS422 port according to EIA standards, which can be parameterized as input or output via software.

The RS422 port can be used to synchronize line-triggering of multiple sensors with each other.

The internal terminating resistor (termination $R_T = 120$ Ohm, see diagram on page 49) can be activated or switched off via software. The signals must be operated symmetrically according to the RS422 standard.

The RS422 port is galvanically isolated from GND and Laser on/off, but not from GND-In1 ... 3. When used, one of the GND-In1 ... 3 should be connected to the GND of the remote station in order to avoid potential differences.

The multifunction socket can be used with either of the following configurations:

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Direction</th>
<th>Standard setting for terminating resistor $R_T$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Half-duplex, serial communication with 115200 Baud</td>
<td>input/output</td>
</tr>
<tr>
<td>1</td>
<td>Half-duplex, serial communication with 57600 Baud</td>
<td>input/output</td>
</tr>
<tr>
<td>2</td>
<td>Half-duplex, serial communication with 38400 Baud</td>
<td>input/output</td>
</tr>
<tr>
<td>3</td>
<td>Half-duplex, serial communication with 19200 Baud</td>
<td>input/output</td>
</tr>
<tr>
<td>4</td>
<td>Half-duplex, serial communication with 9600 Baud</td>
<td>input/output</td>
</tr>
<tr>
<td>5</td>
<td>Line trigger input</td>
<td>input</td>
</tr>
<tr>
<td>6</td>
<td>Line trigger output</td>
<td>output</td>
</tr>
<tr>
<td>7</td>
<td>CMM trigger output</td>
<td>output</td>
</tr>
</tbody>
</table>
Synchronizing several sensors with each other:

- Connect the output RS422+ (Pin 12) of sensor 1 with the input RS422+ (Pin 12) of sensor 2.
- Connect the output RS422- (Pin 11) of sensor 1 with the input RS422- (Pin 11) of sensor 2.
- Also connect both the GND-In1 - pins (Pin 4) of the sensors to each other.

Software settings:

<table>
<thead>
<tr>
<th>Setting</th>
<th>Sensor 1</th>
<th>Sensor 2</th>
<th>Sensor 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>RS422 mode</td>
<td>Line trigger output</td>
<td>Line trigger input</td>
<td>Line trigger input</td>
</tr>
<tr>
<td>No RS422 termination</td>
<td>No (terminating resistor not active)</td>
<td>Yes (terminating resistor not active)</td>
<td>No (terminating resistor active)</td>
</tr>
</tbody>
</table>

Sensor 1 then synchronizes the sensor 2 and further sensors as master.
Encoder

You must use an encoder to generate pulses as the parts move under the sensor.

The way in which you set up your encoder affects the results from the sensor. Observe the following guidelines when installing your encoder:

- The rate at which encoder pulses are generated, relative to the speed of movement of the surface, will determine how many slices of height data are acquired per millimeter.

If too many slices are acquired, the image will be stretched in the Y-direction.

If too few slices are acquired, the image will be squashed in the Y-direction.

(Y-direction: The axis on which the conveyor belt and the object itself is moving.)

- For each set of encoder steps per line, the sensor acquires an intensity image, locates the laser line, and generates a row of peak data, which is the basis of a row in the range image. The time that it takes for the sensor to do this is the time that it takes for the encoder to count the number of steps specified in software as EncoderTriggerCounts. The duration of this encoder time must always be longer than the time it takes for the sensor to expose and process one row of data from an intensity image. The time needed to acquire an intensity image and process it is referred to as the DS900 Series Line Time.

NOTE: The sensor has its own software encoder. This is a good troubleshooting encoder that can be used to verify operation of the sensor and diagnose any encoder wiring issues.
Measuring Field Selection

The optical design of the sensor satisfies the so-called “Scheimpflug condition” which ensures optimum mapping over the complete measuring range. In doing so, the measuring range is mapped on a rectangular matrix. The distortions resulting from this are shown, see the next page. The usable measuring range is always trapezoidal.

The assigned maximum x-values for the z-coordinates can be found, on page 22 and page 24.

The top edge corresponds to the start of the measuring range and the bottom edge to the end of the measuring range. The corners of the predefined measuring fields are on a grid with grid spacing of 1/8 of the matrix.

The sensor matrix used in the DS900 Series Sensor supports the reading of a restricted measuring field.

The following picture shows the predefined view areas and the associated measuring fields.
### Maximum Scan Rates for Measuring Fields

<table>
<thead>
<tr>
<th>Maximum Acquiring Rate Depending on the Measuring Field Number</th>
<th>+0</th>
<th>+1</th>
<th>+2</th>
<th>+3</th>
<th>+4</th>
<th>+5</th>
<th>+6</th>
<th>+7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>144Hz</td>
<td>192Hz</td>
<td>192Hz</td>
<td>192Hz</td>
<td>284Hz</td>
<td>284Hz</td>
<td>284Hz</td>
<td>552Hz</td>
</tr>
<tr>
<td>8</td>
<td>181Hz</td>
<td>239Hz</td>
<td>239Hz</td>
<td>239Hz</td>
<td>354Hz</td>
<td>354Hz</td>
<td>354Hz</td>
<td>680Hz</td>
</tr>
<tr>
<td>16</td>
<td>181Hz</td>
<td>239Hz</td>
<td>239Hz</td>
<td>239Hz</td>
<td>354Hz</td>
<td>354Hz</td>
<td>354Hz</td>
<td>680Hz</td>
</tr>
<tr>
<td>24</td>
<td>181Hz</td>
<td>239Hz</td>
<td>239Hz</td>
<td>239Hz</td>
<td>354Hz</td>
<td>354Hz</td>
<td>354Hz</td>
<td>680Hz</td>
</tr>
<tr>
<td>32</td>
<td>241Hz</td>
<td>318Hz</td>
<td>318Hz</td>
<td>318Hz</td>
<td>469Hz</td>
<td>469Hz</td>
<td>469Hz</td>
<td>892Hz</td>
</tr>
<tr>
<td>40</td>
<td>241Hz</td>
<td>318Hz</td>
<td>318Hz</td>
<td>318Hz</td>
<td>469Hz</td>
<td>469Hz</td>
<td>469Hz</td>
<td>892Hz</td>
</tr>
<tr>
<td>48</td>
<td>241Hz</td>
<td>318Hz</td>
<td>318Hz</td>
<td>318Hz</td>
<td>469Hz</td>
<td>469Hz</td>
<td>469Hz</td>
<td>892Hz</td>
</tr>
<tr>
<td>56</td>
<td>241Hz</td>
<td>318Hz</td>
<td>318Hz</td>
<td>318Hz</td>
<td>469Hz</td>
<td>469Hz</td>
<td>469Hz</td>
<td>892Hz</td>
</tr>
<tr>
<td>64</td>
<td>362Hz</td>
<td>476Hz</td>
<td>476Hz</td>
<td>476Hz</td>
<td>694Hz</td>
<td>694Hz</td>
<td>694Hz</td>
<td>1282Hz</td>
</tr>
<tr>
<td>72</td>
<td>362Hz</td>
<td>476Hz</td>
<td>476Hz</td>
<td>476Hz</td>
<td>694Hz</td>
<td>694Hz</td>
<td>694Hz</td>
<td>1282Hz</td>
</tr>
<tr>
<td>80</td>
<td>362Hz</td>
<td>476Hz</td>
<td>476Hz</td>
<td>476Hz</td>
<td>694Hz</td>
<td>694Hz</td>
<td>694Hz</td>
<td>1282Hz</td>
</tr>
<tr>
<td>88</td>
<td>362Hz</td>
<td>476Hz</td>
<td>476Hz</td>
<td>476Hz</td>
<td>694Hz</td>
<td>694Hz</td>
<td>694Hz</td>
<td>1282Hz</td>
</tr>
<tr>
<td>96</td>
<td>552Hz</td>
<td>552Hz</td>
<td>1030Hz</td>
<td>1030Hz</td>
<td>1030Hz</td>
<td>1030Hz</td>
<td>1030Hz</td>
<td>1030Hz</td>
</tr>
<tr>
<td>104</td>
<td>680Hz</td>
<td>680Hz</td>
<td>1265Hz</td>
<td>1265Hz</td>
<td>1265Hz</td>
<td>1265Hz</td>
<td>1265Hz</td>
<td>1265Hz</td>
</tr>
<tr>
<td>112</td>
<td>892Hz</td>
<td>892Hz</td>
<td>1612Hz</td>
<td>1612Hz</td>
<td>1612Hz</td>
<td>1612Hz</td>
<td>1612Hz</td>
<td>1612Hz</td>
</tr>
<tr>
<td>120</td>
<td>1282Hz</td>
<td>1282Hz</td>
<td>2000Hz</td>
<td>2000Hz</td>
<td>2000Hz</td>
<td>2000Hz</td>
<td>2000Hz</td>
<td>2000Hz</td>
</tr>
</tbody>
</table>

### Recommended shutter times

<table>
<thead>
<tr>
<th>Target material</th>
<th>DS925B</th>
</tr>
</thead>
<tbody>
<tr>
<td>White paper/plastic</td>
<td>10 - 50μs</td>
</tr>
<tr>
<td>Colored plastic</td>
<td>50 - 100μs</td>
</tr>
<tr>
<td>Metallic surfaces</td>
<td>0.1 - 1ms</td>
</tr>
<tr>
<td>Black plastic/rubber</td>
<td>0.5 - 1ms</td>
</tr>
</tbody>
</table>
Calibration
The calibration of the sensor is performed using the complete matrix and is independent from the selected measuring field.
The trapeze form of the measuring field is produced from the projection onto the sensor matrix. The standard measuring range is framed in the center.
The DS900 Series sensors provide fully calibrated measurements within their measuring range. Highest accuracy measurements are achieved within the standard measuring range. Less accurate measurements are achievable outside of the standard measuring range within the extended measuring range. All measuring fields within the extended measuring range and are covered by the sensor’s single calibration.

Measuring Field Selection
The measuring field can be restricted by omitting complete matrix areas in order to suppress interfering image ranges.

**Measuring field** and **measuring range** must be clearly differentiated in practical use. The measuring field is related to the matrix and the measuring range is related to the measuring object (the object space).

Both do not have to match on account of the optical mapping and the definitions.

The measuring field “standard” is larger than the measuring range “standard”. The minimum dimensions can be found in the dimensional drawings, on page 23 and page 25.

The DS900 Series Sensors are distinguished by:

- a laser line with 20° opening angle (measuring range 25 mm) respectively 25° opening angle (measuring ranges 50 mm and 100 mm).
- The receiver has a smaller opening angle (view angle) than the laser line.
- Centered measuring field (symmetrical to the center axis).
- The high resolution sensor image matrix has 1280 x 1024 pixels. The measuring field geometry is fixed.
- Reference for the distance (Z-axis) is the lowest body edge of the sensor, see on page 23 and page 25.
- Use of the GigE-Vision standard.
- Standard GigE Vision implementation from different manufacturers can be used.
### DS925B – Measurement Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Near Field of View</td>
<td>23.4 mm</td>
</tr>
<tr>
<td>Far Field of View</td>
<td>29.1 mm</td>
</tr>
<tr>
<td>Clearance Distance (CD)</td>
<td>53.5 mm</td>
</tr>
<tr>
<td>Measurement Range (MR)</td>
<td>25 mm</td>
</tr>
<tr>
<td>Resolution X</td>
<td>0.0183 mm – 0.0227 mm</td>
</tr>
<tr>
<td>Resolution Z</td>
<td>0.002 mm</td>
</tr>
</tbody>
</table>

![Diagram of DS925B sensor]  

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3. Temperature Influences
A running-in time of at least 20 minutes during start-up is required in order to achieve a uniform temperature spread in the sensor.

If measurements with accuracy in the μm range are made, the effect of temperature fluctuations on the mounting must also be observed by the user.

Due to the damping effect of the thermal capacity of the sensor, fast temperature changes are only measured after a delay.

2. Color Differences
Color differences of measurement objects have effects. However, these color differences are often also combined with different penetration depths of the laser light into the material. Different penetration depths in turn result in apparent changes of the line thickness. Therefore, color changes, combined with penetration depth changes, can result in inaccurate measurements.

As the exposure parameters can only be changed as a whole for one profile, careful matching of the exposure to the target surface is recommended.

4. External Light
An interference filter in the sensor is present for suppression of external light.

In general, the shielding of external light directly emitted on the target or reflected in the sensor must be ensured using protective covers or similar.

Pay particular attention to unwanted reflections of the laser line outside the measuring object range (background, object holder or similar) which can be reflected back again into the view area of the receiver.

Matte black surface coatings are recommended for all objects outside the measuring range (object holders, transport apparatus, grippers or similar).
5. Mechanical Vibrations
If you want to achieve high resolutions in the μm range with the sensor, pay particular attention to stable or vibration-damped sensor and measuring object mounting.

6. Surface Roughness
Surface roughness of 5 μm and more results in “surface noises” due to interference of the laser light.

Direct reflections of the laser light into the receiver can also occur due to fine surface grooves (e.g. abrasion marks), particularly if these run parallel to the laser line. This can result in inaccurate measurements.

Prevention of this effect might be possible by adjusting several sensor settings e.g. exposure time, filter.

7. Shadowing Effects
- **Receiver**: The laser line can disappear completely or partially behind steep edges. The receiver then can not “see” these areas.
- **Laser line**: The fan-shaped form of the laser line inevitably results in partial shadowing at vertical edges. In order to make these areas visible, only changing the sensor or object position helps.

As a general rule, measuring objects with steep edges cannot be one hundred percent measured using laser triangulation. The missing areas can only be supplemented or interpolated using suitable software.
DS900 Series Sensor Accuracy

- Measurement accuracy varies depending on how accurately the unit is mounted and on the surface characteristics of the object being measured; it is not possible to specify a guaranteed accuracy value.

- In general, sensor accuracy is improved when:
  - Relative measurements are made within a single scene (what is the difference between surface A and surface B) are more accurate than absolute measurements (how far is surface B from the sensor).
  - The unit is rigidly mounted using the high-accuracy mounting hole.
  - The unit is precisely perpendicular to the surface being measured.

- In general, sensor accuracy is the best at the optical axis.

- In general, sensor range measurements are extremely repeatable, however the accuracy is dependent on how well the exposure is set.

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## Error Codes

<table>
<thead>
<tr>
<th>Flashing sequence</th>
<th>Cause</th>
<th>Remedy</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>.</code> 2x short</td>
<td>Mode not found.</td>
<td>Select different one.</td>
<td>Only previously stored modes can be called up.</td>
</tr>
<tr>
<td><code>..</code> 2x short, 1x long</td>
<td>White error flash</td>
<td>Contact manufacturer, return sensor.</td>
<td>Should not occur in normal operation.</td>
</tr>
<tr>
<td><code>...</code> 3x short</td>
<td>Flash full</td>
<td>None, contact manufacturer.</td>
<td>Should not occur in normal operation.</td>
</tr>
<tr>
<td><code>....</code> 4x short</td>
<td>Loading suppressed due to active data transmission.</td>
<td>Stop active data transmission.</td>
<td>Prevents PC software crashes.</td>
</tr>
</tbody>
</table>

**Group: Loading / saving configuration**

- `.` 2x short, 1x long, Mode not found. Select different one. Only previously stored modes can be called up.
- `...` 3x short, Flash full. None, contact manufacturer. Should not occur in normal operation.
- `....` 4x short, Loading suppressed due to active data transmission. Stop active data transmission. Prevents PC software crashes.

**Group: Data processing and transmission**

<table>
<thead>
<tr>
<th>Flashing sequence</th>
<th>Cause</th>
<th>Remedy</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>--</code> 2x long</td>
<td>Data overflow in the sensor</td>
<td>Select smaller measuring field, reduce profile frequency, select less complex measuring program.</td>
<td>Data can be impaired; exposure time can be longer than expected.</td>
</tr>
<tr>
<td><code>--</code> 2x long, 1x short</td>
<td>Data overflow during receipt of the data from the sensor.</td>
<td>Select smaller measuring field, reduce profile frequency, select less complex measuring program.</td>
<td>Data can be impaired.</td>
</tr>
<tr>
<td><code>--</code> 2x long, 2x short</td>
<td>Data overflow for serial port RS422</td>
<td>Reduce profile frequency, select less complex measuring program.</td>
<td>Data can be impaired.</td>
</tr>
</tbody>
</table>

- "state" LED lights for a longer time
- "state" LED lights briefly
The “state” LED flashes green and long during active data transmission.
The “state” LED flashes green and short for controller accesses. A controller access can cause various data overflows particularly if the measuring frequency is near its maximum.

<table>
<thead>
<tr>
<th>Flashing sequence</th>
<th>Cause</th>
<th>Remedy</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;.... 2x long, 3x short</td>
<td>Data overflow during transmission of the data via Ethernet</td>
<td>Reduce profile frequency, increase packet size.</td>
<td>Data can be impaired.</td>
</tr>
<tr>
<td>&quot;..... 2x long, 5x short</td>
<td>Error during calculation</td>
<td>Reduce profile frequency, select faster calculation mode.</td>
<td>Data can be impaired.</td>
</tr>
<tr>
<td>&quot;..... 2x long, 6x short</td>
<td>Error during Ethernet transmission</td>
<td>Reduce profile frequency.</td>
<td>Data can be impaired.</td>
</tr>
</tbody>
</table>

**Group: Ethernet Interface**

| ..... 4x long | IP Address conflict | Check the Ethernet configuration of device and the host PC. Choose another IP address for the device. | If the problem persists, please contact the manufacturer. |

**Error Codes**

- “state” LED lights for a longer time
- “state” LED lights briefly
Compliance Statements

DS900 series sensors meet or exceed the requirements of all applicable standards organizations for safe operation. However, as with any electrical equipment, the best way to ensure safe operation is to operate them according to the agency guidelines that follow. Please read these guidelines carefully before using your device.

Laser Safety Statement - DS925B

Compliance with FDA performance standards for laser products except for deviations pursuant to Laser Notice No. 50, dated June 24, 2007.

This device has been tested in accordance with IEC60825-1 2nd ed., and has been certified to be under the limits of a Class 2M Laser device.

Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

European Compliance

The CE mark on the product indicates that the system has been tested to and conforms to the provisions noted within the 2004/108/EEC Electromagnetic Compatibility Directive and the 2006/95/EEC Low Voltage Directive.

For further information please contact:
Cognex Corporation
One Vision Drive
Natick, MA 01760
USA

Cognex Corporation shall not be liable for use of our product with equipment (i.e., power supplies, personal computers, etc.) that is not CE marked and does not comply with the Low Voltage Directive.

FCC Class A Compliance Statement

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communication.

Regulator Specification

<table>
<thead>
<tr>
<th>Regulator</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>CFR 47 FCC Part 15 (b) Class A</td>
</tr>
<tr>
<td></td>
<td>FDA/CORDH Laser Notice No. 50</td>
</tr>
<tr>
<td>Canada</td>
<td>ICES-003 Issue 4 Class A</td>
</tr>
<tr>
<td>European</td>
<td>EN 55022:2006/A1:2007 Class A</td>
</tr>
<tr>
<td>Community</td>
<td>EN 61000-6-2:2005</td>
</tr>
<tr>
<td>Australia</td>
<td>C-TICK, AS/NZS CISPR 22 / EN 55022 for Class A Equipment</td>
</tr>
<tr>
<td>Japan</td>
<td>JS5022, Class A</td>
</tr>
</tbody>
</table>

This device has been tested in accordance with IEC60825-1 2nd ed., and has been certified to be under the limits of a Class 2M Laser device.

Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

FCC Class A Compliance Statement

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communication.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communication. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at personal expense.

European Compliance

The CE mark on the product indicates that the system has been tested to and conforms to the provisions noted within the 2004/108/EEC Electromagnetic Compatibility Directive and the 2006/95/EEC Low Voltage Directive.

For further information please contact:
Cognex Corporation
One Vision Drive
Natick, MA 01760
USA

Cognex Corporation shall not be liable for use of our product with equipment (i.e., power supplies, personal computers, etc.) that is not CE marked and does not comply with the Low Voltage Directive.

FCC Class A Compliance Statement

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communication.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communication.
Compliance Statements (continued)

For European Community Users

This product has required the extraction and use of natural resources for its production. It may contain hazardous substances that could impact health and the environment, if not properly disposed.

In order to avoid the dissemination of those substances in our environment and to diminish the pressure on the natural resources, we encourage you to use the appropriate take-back systems for product disposal. Those systems will reuse or recycle most of the materials of the product you are disposing in a sound way.

The crossed out wheeled bin symbol informs you that the product should not be disposed of along with municipal waste and invites you to use the appropriate separate take-back systems for product disposal.

If you need more information on the collection, reuse, and recycling systems, please contact your local or regional waste administration.

You may also contact your supplier for more information on the environmental performance of this product.