1 • GENERAL INFORMATION

1.1 Installation, use and maintenance manual

In this installation, use and maintenance manual, SENSOE s.r.l., with registered office in Via Verdi 2 - 24121 - Bergamo - ITALY, hereinafter referred to as the manufacturer of the device, provides, as simply as possible, all the instructions to install, use and perform maintenance on the product ALBERT-01 under entirely safe conditions and by making the most of its features.

The recipients of this manual are all those people who – because of their training, experience and education, as well as those familiar with safety standards, requirements and provisions and service conditions – have been authorised to carry out any activity required and are able to detect and avoid any potential hazard. These people will be hereafter identified as qualified personnel able to perform transport, installation, use and maintenance work on the device covered in the manual itself.

This material can only be used by customers who have been given the manual along with the device and only for the purposes of installing, using and performing maintenance on the machine.

The manufacturer reserves the right to make changes or improvements without prior notice to this material and/or the same model of the marketed device that this manual refers to.

The following typographical conventions are used in this manual:

**NOTE:** The notes contain important information highlighted outside the text they refer to

**CAUTION:** These indications highlight procedures that, if not observed in their entirety or in part, can cause damage to the machine or to the appliances

**HAZARD:** These indications highlight procedures that, if not observed in their entirety or in part, can cause injuries or affect the health of the operator
This manual must be kept for the entire service life of the machine, within easy reach if needed. If the device is sold, the respective manual must be included.

### 1.2 Product identification data

The ALBERT-01 device features an identification plate at the back of the product featuring the necessary data to identify the system and make it easier for the manufacturer to provide assistance to the customer.

![Figure 1: Product identification data](image)

<table>
<thead>
<tr>
<th>Nome prodotto</th>
<th>ALBERT-01</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part number</td>
<td>2017</td>
</tr>
<tr>
<td>Anno</td>
<td>2017</td>
</tr>
<tr>
<td>Numero seriale</td>
<td>AL-XXXXX</td>
</tr>
<tr>
<td>Serial number</td>
<td>24 V DC</td>
</tr>
<tr>
<td>Tensione</td>
<td>24 V DC</td>
</tr>
<tr>
<td>Voltage</td>
<td>150 W</td>
</tr>
<tr>
<td>Potenza installata</td>
<td>150 W</td>
</tr>
</tbody>
</table>

*Figure 1: Product identification data*
1.3 Product operating principle

ALBERT-01 is a complete inspection system comprising optics, a camera, a lighting system, electronics for calculation and to control line and human interfaces. Specifically designed to inspect products on a line, even large-sized ones, it can check a wide set of features related to shape and colour.

Thanks to its technology based on neural networks, ALBERT-01 can self-learn new production features without any reprogramming intervention on the device. This means that product checks can be quickly and easily adjusted in different periods and situations.

The distinctive features of ALBERT-01 are:

- **Independent smart defect identification**: By simultaneously analysing the shape and colour of the products running on the line, ALBERT-01 detects, just like an operator would, which products do not match the quality standards of the current production and identifies them as defects. So by using ALBERT-01, one can identify as defective a wide variety of products, with different types of issues and which would not be highlighted simultaneously and as easily with a traditional vision system.

- **Fast inspection**: ALBERT-01 has a processing time of tenths of milliseconds, guaranteeing checks also on fast lines.

- **User-friendly**: once installed, ALBERT-01 can be easily controlled without having to connect the device to external peripheral devices, such as monitors and/or keyboards.
• **Easy PLC interface:** ALBERT-01 produces opto-isolated logic discard signals, with the option of setting the delay and pulse time. The discard signals can be assigned to different areas of the inspected field (up to 6 rows).

• **Remote control option:** ALBERT-01 can be controlled via an Ethernet or Wi-Fi connection.

• **Availability of aggregate data to control the production process:** ALBERT-01 provides aggregate data and statistics on production, as well as the option of viewing images of defective pieces.

### 1.4 Technical specifications

The technical specifications of ALBERT-01 are reported here below:

![Figure 2: Overall dimensions and visual field](image)
<table>
<thead>
<tr>
<th>Model</th>
<th>ALBERT-01</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>Self-learning vision system based on artificial intelligence</td>
</tr>
<tr>
<td><strong>Application</strong></td>
<td>Line inspection</td>
</tr>
<tr>
<td><strong>Visual field</strong> (mm x mm)</td>
<td>460 x 295 900 x 590 1350 x 890</td>
</tr>
<tr>
<td><strong>Minimum working distance</strong> (mm)</td>
<td>100</td>
</tr>
<tr>
<td><strong>Lens</strong></td>
<td>8 mm f1.4-1.6 with manual focus</td>
</tr>
<tr>
<td><strong>Lighting system</strong></td>
<td>Diffused light LED illuminator, white (5700 K), pulsed</td>
</tr>
<tr>
<td><strong>Line speed</strong> (m/s)</td>
<td>2 = 1 m/s</td>
</tr>
<tr>
<td><strong>No. of pieces per second</strong></td>
<td>3 = 20</td>
</tr>
<tr>
<td><strong>LED indicators</strong></td>
<td>Yes (STATUS and SEVERITY)</td>
</tr>
<tr>
<td><strong>No. of images that can be saved</strong></td>
<td>4 = 800K</td>
</tr>
</tbody>
</table>

### Ports

**Inputs**
- 1 opto-isolated (upper side)

**Outputs**
- for signal tower: 2 lights, 1 siren (upper side)
- for ejector(s): 6, opto-isolated (upper side)
- strobe synch: 1, opto-isolated (upper side)

### Communication
- Ethernet: 2 (upper side)
- Wireless: Wi-Fi (802.11n)
- USB 3.0: 4 (front)
- HDMI: 1 (front)
- DVI: 1 (front)

### Power supply
- Voltage: V, DC 24 ± 5%
- Maximum power absorbed: W 150
- Cable: CBPWLALB01, 5m long, IP65 (included)

### Mechanical specifications
- **Width** (mm): 330
- **Length** (mm): 311
- **Height** (mm): 171
- **Weight** (kg): 10
- **Material**: AISI316, AISI304 stainless steel and anodised aluminium
- **Assembly**: 4 x M6 holes (accessories available)

### Environment
- **Operating temperature** (°C): 10-40
- **Storage temperature** (°C): 0-50
- **Humidity**: 20-85% without condensation
- **IP rating**: 65
- **Installation**: indoor use only

---

1. Example values. Working distance must be set based on: size of the area to be imaged, size and number of pieces to be imaged and **type of control required**.
2. The value is meant as a guide, higher speeds are possible. Contact us to check compatibility with your production line.
3. Estimated value. The number of inspected pieces per second depends on their size and on the line speed.
4. Estimated value according to 250 KByte images on a 200 GB SSD storage device.
5. Wireless antenna included.
1.5 Features and description

1.5.1 Overview and package contents

The fundamental parts of the system are listed in the following table, with reference to the relative figure.

<table>
<thead>
<tr>
<th>N</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>LED mood bar</td>
</tr>
<tr>
<td>2</td>
<td>Heatsink</td>
</tr>
<tr>
<td>3</td>
<td>Removable front door</td>
</tr>
<tr>
<td>4</td>
<td>M6 hole for installation</td>
</tr>
<tr>
<td>5</td>
<td>Upper panel</td>
</tr>
<tr>
<td>6</td>
<td>Wi-fi antenna</td>
</tr>
<tr>
<td>7</td>
<td>PWR Power input</td>
</tr>
<tr>
<td>8</td>
<td>TRG Synch input</td>
</tr>
<tr>
<td>9</td>
<td>SNG TWR Signal tower output</td>
</tr>
<tr>
<td>10</td>
<td>OUT Synch outputs</td>
</tr>
<tr>
<td>11</td>
<td>ETH1 Ethernet 1</td>
</tr>
<tr>
<td>12</td>
<td>EHT2 Ethernet 2</td>
</tr>
<tr>
<td>13</td>
<td>Scratchproof polycarbonate window</td>
</tr>
<tr>
<td>14</td>
<td>Optics window</td>
</tr>
<tr>
<td>15</td>
<td>Key to reduce sorting sensitivity</td>
</tr>
<tr>
<td>16</td>
<td>Key to increase sorting sensitivity</td>
</tr>
<tr>
<td>17</td>
<td>ON/OFF key</td>
</tr>
<tr>
<td>18</td>
<td>STOP sorting key</td>
</tr>
<tr>
<td>19</td>
<td>START sorting key</td>
</tr>
</tbody>
</table>

The ALBERT-01 pack contains:

- Inspection unit comprising:
  PC to process images and control discard signals;
  camera optical unit and lighting with relative protection;
- Power cable;
- Connector plugs;
- Wi-fi antenna;
- Use and maintenance manual.
1.5.2 LED mood bar

The LED bar on the perimeter of the device indicates the system status.

The statuses are identified by 4 colours: white, green, red and yellow.

The statuses identified by the 4 colours are:
1. **Stand-by, WHITE**: the system is on, but is NOT sorting the pieces;
2. **Sorting of good products, GREEN**: the system is in the inspection phase, the checked pieces are good;
3. **Discard, RED**: the system is in the inspection phase, but has detected a defective product (discard);
4. **Learn, YELLOW**: in this case the LEDs on the bar turn on incrementally (from the 1st to the 10th LED) and this indicates the learning progress status of ALBERT-01. The sorting stage starts automatically after the learning stage is completed and therefore the bar turns RED or GREEN depending on the result of the check.

The LED mood bar turns either colour even when the sensitivity (severity) of the check is changed: in this case, the colour is BLUE and 1 (minimum severity) to 10 LEDs (maximum severity) can light up on the front of the device.
1.5.3 Control panel and commands

The physical interface of ALBERT allows for a direct check of the product, without having to use display and input devices (such as monitors, keyboards or tablets). The features that can be activated directly on the control panel are:

1. **Start machine**: press key (1)
2. **Shut down machine**: press and hold key (1)
3. **Start inspection and sorting**: press key (2)
4. **Stop inspection and sorting**: press key (3)
5. **Start learning phase**: press and hold keys (2) and (3) at the same time
6. **Increase severity**: press key (4)
7. **Decrease severity**: press key (5)
8. **Switch from “continuous inspection” mode to “trigger” mode (or vice versa)**: press and hold keys (4) and (5) at the same time

![Figure 4: Control panel](image-url)
Remove the panel cover to access a compartment with connections to all the external peripheral devices (monitor, mouse, keyboard and USB flash drives) that can be used at the initialisation stage. **When the cover is removed, the device does not have the IP65 rating any more.**

![Figure 5: Connectors to external peripheral devices](image)

### 1.5.4 Inputs, outputs and external peripheral devices

The connections for inputs, outputs and external peripheral devices are located on the upper panel of the device.

![Figure 6: Upper panel](image)
Here below is the identification table of the connectors for the upper panel.

<table>
<thead>
<tr>
<th>Numero</th>
<th>Porta</th>
<th>Descrizione</th>
<th>Connettore</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Power supply</td>
<td>24V DC power supply + protective earthing</td>
<td>ODU G81K0C-P03RP00</td>
</tr>
<tr>
<td>2</td>
<td>Synch input</td>
<td>1 X 24V DC output line to power the proximity switch + 1 opto-isolated synch input</td>
<td>ODU G81K0C-P04QJ00</td>
</tr>
<tr>
<td>3</td>
<td>Signal tower output</td>
<td>3 X 24V DC power supply output lines 24V DC (2 for traffic lights + 1 for siren)</td>
<td>ODU G81KAC-P04QJ00</td>
</tr>
<tr>
<td>4</td>
<td>Output for ejector(s)</td>
<td>6 opto-isolated output lines with ejection lines + 1 pulsed lighting synch line</td>
<td>ODU G81K0C-P14QC00</td>
</tr>
<tr>
<td>5, 6</td>
<td>Ethernet communication ports</td>
<td>Ethernet 10/100/1000 connection network Cat. 5e</td>
<td>ODU G81KFC-PD8QC0</td>
</tr>
</tbody>
</table>

*Table 1: Upper panel inputs and outputs*

All the ports of the upper panel come with an IP65 rating, regardless of whether they are coupled with the relative connector or plug.

Here below are the electrical specifications and instructions to connect each connector.

### 1.5.4.1 Power supply (PWR)

The **power supply** network must be able to provide 24V DC ± 5% and 6.5A. The device absorbs up to 150W in terms of power, a value that can vary according to the accessories connected to it.

Always check that the power supply line matches the voltage, frequency and electrical absorption of the system.

The power cable must be in pristine condition. Do not bend it or pull it, which can interrupt the conductors.

Any connectors for the connection to the power supply must be able to withstand the electrical absorption of the system with a suitable margin.

The power supply line must have an earthing system in good working order. This is required to guarantee product safety and compliance with EMC regulations.

Ensure the polarity of +V and 0V is correct before turning the device on.
Here below is a diagram and description of the synch connector.

![Diagram of Synch Connector](image)

**CAUTION:** Before cutting off the power, follow the shut-down steps reported in this manual

<table>
<thead>
<tr>
<th>Pin</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+V</td>
<td>Power supply, positive pole</td>
</tr>
<tr>
<td>2</td>
<td>0V</td>
<td>Power supply, negative pole</td>
</tr>
<tr>
<td>3</td>
<td>Earth</td>
<td>Earthing</td>
</tr>
</tbody>
</table>

**1.5.4.2 Synch input (TRG)**

The synch input is opto-isolated. This input can be connected directly to a signal generator (photocell, proximity switch, etc.) to synchronise the acquisition of images as the products move forwards on the production line.

Moreover, the port has a 24V DC output to power the direction devices directly (photocell, proximity switch, etc.).

Here below is a diagram and description of the synch connector.

![Diagram of Synch Input](image)

<table>
<thead>
<tr>
<th>Pin</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+V</td>
<td>Proximity switch power supply, positive pole</td>
</tr>
<tr>
<td>2</td>
<td>0V</td>
<td>Proximity switch power supply, negative pole</td>
</tr>
<tr>
<td>3</td>
<td>TRIGGER+</td>
<td>Synch input, positive pole</td>
</tr>
<tr>
<td>4</td>
<td>TRIGGER-</td>
<td>Synch input, negative pole</td>
</tr>
</tbody>
</table>
The following graph shows the internal diagram of the synch circuit.

![Internal Diagram of the Synch Circuit](image)

The parameters of the power supply circuit and the synch parameters are listed in the table below.

<table>
<thead>
<tr>
<th>Pin Name</th>
<th>Value</th>
<th>Unit</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proximity switch supply voltage</td>
<td>24</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Output current (max)</td>
<td>300</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>Synch signal voltage</td>
<td>0-24</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Absorbed current (limited on the inside)</td>
<td>6-10</td>
<td>mA</td>
<td></td>
</tr>
</tbody>
</table>

### 1.5.4.3 Signal tower output (SGN TWR)

The **signal tower** output allows you to connect ALBERT-01 to a tower light with two lights and a siren. It consists of 3 X 24V DC signals that refer to a shared mass (0V) and activated directly by the electronics of the system.

Here below is a diagram and description of the signal tower connector.

![Signal Tower Connector Pin Configuration](image)

**Figure 9: Signal tower connector pin configuration**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SIREN+</td>
<td>Siren power supply, positive pole</td>
</tr>
<tr>
<td>2</td>
<td>LED_R+</td>
<td>Red light power supply, positive pole</td>
</tr>
<tr>
<td>3</td>
<td>LED_G+</td>
<td>Green light power supply, positive pole</td>
</tr>
<tr>
<td>4</td>
<td>GND</td>
<td>Shared power supply, negative pole</td>
</tr>
</tbody>
</table>
The following graph shows the internal diagram of the tower’s power supply circuit.

![Power Supply Circuit Diagram]

The parameters of the power supply circuit and the synch parameters are listed in the table below.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Unit</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output voltage</td>
<td>24</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Output current (max)</td>
<td>300</td>
<td>mA</td>
<td>For each power supply channel</td>
</tr>
</tbody>
</table>

The signals for the tower are activated to reflect the system status as part of a production line. Namely, refer to the following table:

<table>
<thead>
<tr>
<th>Name</th>
<th>Activation condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIREN+</td>
<td>Serious system error. The system is rebooted and the siren goes off for about 5 seconds.</td>
</tr>
<tr>
<td>LED_R+</td>
<td>The red light output is active if the system is off. It tells the system operator that the inspection system needs to be activated.</td>
</tr>
<tr>
<td>LED_G+</td>
<td>The green light output is active when the system is on and running.</td>
</tr>
</tbody>
</table>
1.5.4.4 Output for ejectors (OUT)

The **OUT connector** includes 1 output to synch the light pulse signal and 6 outputs to control the ejectors of the discard system downstream of the control system. All the outputs are opto-isolated.

Here below is a diagram and description of the OUT connector.

<table>
<thead>
<tr>
<th>Pin</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>STROBE+</td>
<td>Lighting synch output, positive pole</td>
</tr>
<tr>
<td>2</td>
<td>STROBE-</td>
<td>Lighting sync output, negative pole</td>
</tr>
<tr>
<td>3</td>
<td>GPO1+</td>
<td>Discard signal output 1, positive pole</td>
</tr>
<tr>
<td>4</td>
<td>GPO1-</td>
<td>Discard signal output 1, negative pole</td>
</tr>
<tr>
<td>5</td>
<td>GPO2+</td>
<td>Discard signal output 2, positive pole</td>
</tr>
<tr>
<td>6</td>
<td>GPO2-</td>
<td>Discard signal output 2, negative pole</td>
</tr>
<tr>
<td>7</td>
<td>GPO3+</td>
<td>Discard signal output 3, positive pole</td>
</tr>
<tr>
<td>8</td>
<td>GPO3-</td>
<td>Discard signal output 3, negative pole</td>
</tr>
<tr>
<td>9</td>
<td>GPO4+</td>
<td>Discard signal output 4, positive pole</td>
</tr>
<tr>
<td>10</td>
<td>GPO4-</td>
<td>Discard signal output 4, negative pole</td>
</tr>
<tr>
<td>11</td>
<td>GPO5+</td>
<td>Discard signal output 5, positive pole</td>
</tr>
<tr>
<td>12</td>
<td>GPO5-</td>
<td>Discard signal output 5, negative pole</td>
</tr>
<tr>
<td>13</td>
<td>GPO6+</td>
<td>Discard signal output 6, positive pole</td>
</tr>
<tr>
<td>14</td>
<td>GPO6-</td>
<td>Discard signal output 6, negative pole</td>
</tr>
</tbody>
</table>

*Figure 10: Ejector output connector pin configuration*
The following graphs show the diagrams of the lighting and discard synch circuit.

**CAUTION:** As the TRIGGER- (#4) pins of the synchronisation input and the STROBE- (#2) pin of the illuminator synch output are internally connected, the voltage applied to the ends of the respective terminals must have the same reference level.
1.5.4.5 Ethernet communication ports (ETH1 and ETH2)

On the device there are 2 X 10/100/1000 Ethernet communication ports Cat. 5e. The ETH1 port is configured with a dynamic IP, which must be assigned by an external DHCP service, while the ETH2 port has the following static IP: **192.168.1.101**. The configuration of the ports can be modified from the control panel of the operating system according to the needs of the local network.

Here below is a diagram and description of the Ethernet connector.

<table>
<thead>
<tr>
<th>Pin</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>TX_D1+</td>
<td>Transmit or Bidirectional Data1+</td>
</tr>
<tr>
<td>2</td>
<td>TX_D1-</td>
<td>Transmit or Bidirectional Data1-</td>
</tr>
<tr>
<td>3</td>
<td>RX_D2+</td>
<td>Receive or Bidirectional Data2+</td>
</tr>
<tr>
<td>4</td>
<td>BI_D3+</td>
<td>Bidirectional Data3+</td>
</tr>
<tr>
<td>5</td>
<td>BI_D3-</td>
<td>Bidirectional Data3-</td>
</tr>
<tr>
<td>6</td>
<td>RX_D2-</td>
<td>Receive or Bidirectional Data2-</td>
</tr>
<tr>
<td>7</td>
<td>BI_D4+</td>
<td>Bidirectional Data4+</td>
</tr>
<tr>
<td>8</td>
<td>BI_D4-</td>
<td>Bidirectional Data4-</td>
</tr>
</tbody>
</table>

*Figure 11: Ethernet connectors pin configuration*
1.6 Signal acquisition and timing sequence

The steps to acquire, process and generate the output signals are illustrated here below, along with a diagram showing the timeline.

1.6.1 Synchronous acquisition or “trigger”

If the system is running in trigger mode (with synch input from a photocell or other proximity switch), the sequence of steps carried out by the system is the following:

1. Image acquisition starts when a trigger signal is received (the instant referring to the red “TRIGGER” line in the image). This means that the illuminator is turned on and the camera starts exposure.
   The synch signal for any external illuminators (STROBE) is activated as well.
2. At the end of the exposure, the illuminator is turned off (and the STROBE disabled) and the image is transferred to the processing unit.
3. The image is processed and identified products are examined based on the neural model acquired during the last learning process.
4. If any defective products are identified, the corresponding GPOx outputs are activated after a time specified by the user (Discard offset). In the example below, lines 1 and 3 are activated because defective products have been identified in the corresponding areas of the field framed by the camera.
   The outputs remain active for the time specified by the user, so that the discard system can acquire the signals.
5. The sequence starts again when a new trigger signal is received.

NOTES:

- The pulse time on the synch output (STROBE signal) is equal to the switch-on time of the built-in illuminator and the camera exposure. This way, an external illuminator can remain on in synch with the acquisition of the system.
- The processing time may vary based on the number of objects framed and the computational load.
• The trigger signal for a subsequent acquisition can be received only after completing the previous processing. Therefore, there is no need to wait for the generation of the discard signals.

1.6.2 Continuous acquisition or “free-run”

If the system is running in “free-run” mode (continuous acquisition without external inputs), the sequence of steps carried out by the system is the following:

1. At the end of the previous processing, the acquisition of a new image starts immediately. This means that the illuminator is turned on and the camera starts exposure. The synch signal for any external illuminators (STROBE) is activated as well.
2. At the end of the exposure, the illuminator is turned off (and the STROBE disabled) and the image is transferred to the processing unit.
3. The image is processed and identified products are examined based on the neural model acquired during the last learning process.
4 If any defective products are identified, the corresponding GPOx outputs are activated after a time specified by the user (Discard offset). In the example below, lines 1 and 3 are activated because defective products have been identified in the corresponding areas of the field framed by the camera. The outputs remain active for the time specified by the user, so that the discard system can acquire the signals.
5 The sequence restarts.

NOTES:
• The pulse time on the synch output (STROBE signal) is equal to the switch-on time of the built-in illuminator and the camera exposure. This way, an external illuminator can remain on in synch with the acquisition of the system.
• The processing time may vary based on the number of objects framed and the computational load.
• The acquisition of a new image starts right after the processing of the previous one (point 3 of the above list of steps) and does not require the generation of the discard signal in the meantime.
1.7 Environmental conditions

The supplied system can operate under the following environmental conditions:

• temperature range: +10 ÷ +40°C;
• environmental humidity degree: < 85% without condensation;
• non-explosive atmosphere;
• closed environment with no chips or dust.

1.8 Dichiarazione CE

SENSOE srl, with registered office in via Verdi 2, Bergamo (BG) 24121, Italy, declares that ALBERT-01 complies with the requirements set forth in the following EU Directives, including all applicable amendments:

• 2014/30/EU (Electromagnetic Compatibility Directive, EMC) for which all the standards and/or technical specifications below have been applied:

<table>
<thead>
<tr>
<th>Directive</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN 61326-1:2013</td>
<td>Electrical equipment for measurement, control and laboratory use – EMC requirements Part 1: General requirements</td>
</tr>
</tbody>
</table>
| EN 55011:2009/A1:2010 | Industrial, scientific and medical (ISM) radio-frequency equipment
Radio disturbance characteristics – Limits and methods of measurement |
| EN 61000-3-3:2008 | Electromagnetic compatibility (EMC) – Part 3-3: Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection |
| EN 61000-4-2:2009 | Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques
Section 2: Electrostatic discharge immunity test – Basic EMC publication |
| EN 61000-4-3:2006/A1:2008/A2:2010 | Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test |

Tests carried out by INTEK SPA with issue of Test Report RP 2016-0461-00
1.9 Warranty

The machine comes with a 12-month warranty from the date it is actually delivered, with reference to the serial number of the machine. The warranty covers the replacement or repair of the defective part (component, machine or part thereof), with the exclusion of disassembly, reassembly and shipping costs. Replacing this part does not renew the warranty period of the whole machine. The manufacturer shall be relieved from any obligation to provide compensation, for any reason, and the buyer shall renounce any claim for costs or damages, even from third parties, due to any machine downtime. The warranty shall not cover electrical parts and parts subjected to normal wear or deterioration due to external atmospheric and environmental agents. It does not cover any failures deriving from insufficient, incorrect or no maintenance, from misuse, incorrect use, unintended or unforeseen use, from unauthorised modifications or repairs and tampering.
The validity of the warranty is subject to:

- Correct execution of maintenance as described in the instruction manual that comes with the machine;
- Unintended uses of the machine and machine use not compliant with the specifications of this manual (see paragraph 1.7 Product disclaimer).

## 2 • PRODUCT DISCLAIMER

### 1.1
SENSEO S.r.l. declines any liability for incorrect use of the product and cannot be held liable for any error or omission.

### 1.2
The instructions provided at the time of delivery cannot cover every possibility that may occur during installation, operation or maintenance. Please contact your SENSEO S.r.l. representative if you need further information about specific product installation, use and maintenance procedures.

### 1.3
Furthermore, SENSEO S.r.l. declines any liability for any damage, of any kind, that may, either directly or indirectly, be caused to persons or property as a result of the incorrect choice carried out by the customer/user or failure to comply with all the requirements specified in the Documentation and user and assembly manuals.

### 1.4
The buyers/users of the SENSEO S.r.l. Product are required to carry out, under their own responsibility, care and by bearing the relative costs, the necessary and suitable checks, tests, verifications and, if required, technical operating tests in order to ascertain whether the SENSEO S.r.l. Product meets their needs or requirements.

### 1.5
The pros or cons of employing the SENSEO S.r.l. Product for any use or application can be examined in a critical manner and in their entirety only through the verifications, analyses and tests carried out by the buyers/users themselves, as the latter are in a position to know their needs, especially in terms of operation, safety, reliability, duration, conditions of use, performance and standards. They are also in a position to meet the requirements set forth by regulations, technical specifications, standards, local customs or imposed or suggested by special or unusual conditions of use due to particular climatic and/or atmospheric conditions, as well as particular conditions related to the unhealthiness of the premises.
1.6 SENSOE S.r.l. highlights that the Product is a unit that carries out a check on a statistical basis and not deterministic. This is why, just like a human operator, the Product is not exempt from errors either. This is why the Product cannot, in any way, be used as a replacement for deterministic control instruments and to exclude with absolute certainty the presence of components, foreign bodies and any other anomaly that can affect the quality of production, damage property or cause injury to persons.

1.7 If SENSOE S.r.l. carries out tests on equipment or products supplied by customers for the purpose of finding the most suitable solution, SENSOE S.r.l. may never be held liable by its customers for defects or malfunctions or design and manufacturing errors of these devices and/or finished products.

1.8 Any invalidity or ineffectiveness of one or several clauses of this Disclaimer shall not affect the validity and effectiveness of the other provisions. In this case, the invalid or ineffective provision or clause will be replaced with another valid and effective one that pursues, as much as possible, the same results and intent of SENSOE S.r.l.
3 • SAFETY RULES AND DEVICES

3.1 General Warnings

The safety rules contained in this instruction manual must be meticulously observed, along with the national accident-prevention regulations and any internal work and safety rules.

The user must ensure that all installation, maintenance and inspection works are carried out by qualified and authorised personnel who has read this manual in its entirety. The employer is responsible for making sure the content of this instruction manual is understood correctly by operators.

Failure to comply with the above safety rules may cause dangerous situations, as well as damage to property and people: the employer is required to train and inform operators working on the system about the risks involved and the rules to follow to avoid them.

3.2 Unintended uses

Do not tamper with or alter the system.
Do not use the system for purposes other than the ones for which it has been designed.
Do not perform maintenance and cleaning on the system when it is running.

3.3 Workstations and personnel training

The ALBERT-01 system can perform the sorting of the product in a completely autonomous manner.

The side heatsinks of ALBERT-01 can reach high temperatures during operation, so avoid touching these parts during operation and for all the time required to cool down the device after switching it off. If it is necessary to touch the device before it has cooled down, the operator needs to wear protective gloves against burns and cuts.
ALBERT-01 features elements with sharp metal edges. It is always a good idea to wear cut-resistant gloves when handling the product.

ALBERT-01 has a built-in pulsed illuminator under the RISK EXEMPT class in accordance with IEC/EN regulation 62471:2010 (Photobiological safety of lamps and LED systems).

However, exposure to intermittent light, always active during every operating stage of the device, may cause serious consequences to subjects at risk, such as people who suffer from epilepsy.

Personnel appointed to carry out inspections and maintenance must be specialised personnel suitably informed about use-related risks. Personnel is therefore required to know and follow all applicable procedures to safely carry out their duties.

The area around the system must be kept clean and clear.

3.4 Residual risks

The residual risks that can occur during maintenance and checks on the system are mostly related to the presence of live electrical components.

During maintenance work and checks requiring the intervention of an operator, it is still necessary to disconnect the system from the power supply mains.
4 • STORAGE AND INSTALLATION

4.1 Storage

If necessary, the system must be stored away from direct sunlight and atmospheric agents. We recommend protecting the system from humidity and avoiding shocks, stress and considerable temperature variations.

Storage must take place in environmental conditions where the temperature is between +0°C and +50°C, with a maximum relative humidity of 85% without condensation.

4.2 Positioning of the device and connection to energy supplies

After defining, according to the field to be framed and the required resolution for the application and the working distance of the device (see 1.4.1), the latter can be secured by the 4 X M6 holes located on the upper panel.

This might be easier to perform by using the CMHOALB01 plate in the Accessories chapter.

After firmly securing the system, it can be connected to the mains power supply via the power cable (CBPWALB01).

The mains power supply must be free from interference with a voltage oscillation within a 5% range, either higher or lower.

CAUTION: Check that the power supply line matches the voltage, frequency and electrical absorption of the system (also indicated on the identification plate of the system's electrical cabinet)

Check that the power cable is always in pristine condition. Avoid bending it or stretching it, as this can interrupt the conductors.
Any connectors for the connection to the power supply must be able to withstand the electrical absorption of the system with a suitable margin.

The mains power supply must have an earthing in good working order.

Refer to the wiring diagrams enclosed in paragraph 1.4.3.

4.3 Focus

Proceed as follows for focus adjustment:

1. Connect ALBERT-01 to a monitor through the designated ports on the front panel after removing the protective cover (see 1.4.2);
2. Connect ALBERT-01 to a mouse and keyboard through the designated ports on the front panel after removing the protective cover (see 1.4.2);
3. Press START to turn on the system (see 1.4.2);
4. Wait for the software to load;

**NOTE**: the LEDs of the buttons flash during the whole loading phase of the software. They stop flashing when the above is completed and the home page of the software appears on the screen

5. Remove the scratchproof polycarbonate window by undoing the designated screws with a round, domed slotted head;
6. Position the sample to be viewed by acquiring the image via the camera (see 4.1.2);
7. Adjust the focus by using the software as reported in paragraph 4.1.3;
8. Put the scratchproof window back in and make sure you tighten the screws supporting it correctly.

**WARNING**: carefully check the tightening of the screws any time they have been undone by the operator to carry out any work
5 • SOFTWARE AND INSTRUCTIONS FOR USE

5.1 Software

The following paragraphs explain how the ALBERT-01 software must be used for ‘extraordinary’ initialisation operations and routine ones for product checks on the line.

5.1.1 Software home page

The home page is divided in two sections:

• On the left-hand side there are the various tools to set and manage the software.
• On the right-hand side there is:
  - the summary of the number of good and defective pieces, the discard percentage, the average colour index of the last 100 products and the keys to minimise the page (rectangular icon) and to close the software (square key);
  - the window showing the video flow of the camera;
• the buttons used to control the system (start check, stop check, learn, minimum number of products for the learning process and severity bar).
5.1.2 Source

The first operation section on the left-hand side is SOURCE.

It is used to select the acquisition method of the frame to be processed.

By selecting CAMERA, the frame is acquired by the ALBERT-01 camera. The camera frame rate can be slowed down by setting a delay in milliseconds (ms) in the space under the CAMERA key (the frame rate is set to the maximum value by default and the delay is therefore set to the minimum value). Slowing down acquisition allows you to optimise the learning stage with production lines that are not too fast, allowing for a larger acquired population, whilst maintaining the current learning phase fast and simple.

By choosing FOLDER instead, the images to be processed are read by the specified folder. The time between two processing actions, in milliseconds (ms), is set in the box under the FOLDER key.
5.1.3 System calibration

This section contains the tools to calibrate the focus of the optical unit, the colour and the region of interest (ROI) for the check.

FOCUS CALIBRATION allows for an optimal focus at any working distance. During the manual adjustment of the focus on the optical unit, the instrument shows the current focus value (ACTUAL FOCUS VAL) on the right.

Here below are the steps to follow for the focus calibration:

1. Press button 1;
2. Move the adjustment ring on the optical unit from 0 to infinite to allow the software to identify the optimal focus;
3. Press button 2 to view the optimal focus value on the left (MAX FOCUS VALUE).
4. Adjust the camera focus to bring the actual focus value to the max focus value. The software informs you when this has been done by highlighting the field of the actual focus, which turns green/orange.
The ROI SELECTION is used to select the region of interest for the check, which will be identified with a green rectangle.
To create or edit a ROI, just use the mouse to left-click one of the ends of the field (on the left of the frame) you want to frame (a green spot will appear) and then right-click (on the right of the frame) on the opposite side. The system will create a green rectangle, which will be a new ROI.

The COLOR CALIBRATION is used to adjust and unify the colours of the system. By placing the calibration cardboard (18% grey) RT-10060911, you need to select a ROI that only frames the grey cardboard and set a target value (the default value is 90). Press the “start calibration” button and the system will operate according to average RGB values, setting them to a uniform value against each other. Calibration is automatically interrupted when it reaches the target value.

The LIGHT RADIAL CORRECTION is used to create uniform light distribution along the radial direction where the lighting (either a built-in or separate system) produces a strong lack of homogeneity in the radial distribution between the centre and the edge. Select the ACTIVE key to activate the correction.
With the correction activated, set the MULTIPLIER, which is the degree of multiplication of the light intensity. The entered value multiplies the intensity factor of the pixels on the edge. The optimal value to be entered is the ratio between the intensity value of the central pixel and the intensity value of the corner pixel.
With the MULTIPLIER set to 1, there is no radial correction.

**CAUTION:** do not use the LIGHT RADIAL CORRECTION feature if the lighting geometry is not radial (for instance when using lighting bars)
5.1.4 Color-Trigger-Strobe

CAMERA SETTINGS is used to adjust the camera exposure time, the pulsed light intensity and, via the “color U” and “color V” bars you can change the shades of colour.

TRIGGER SETTINGS is used to enable or disable trigger:

- **By selecting trigger** → the system works in trigger mode and captures the image only if there is an external signal from a photocell.
- **By deselecting trigger** → the system works in free-run mode by constantly capturing the images.

In strobe mode, if there is no external synch signal, the **trigger sw** mode must be enabled and the images must be acquired by pressing the SNAP button.

STROBE SETTINGS is used to select the type of lighting mode:

- **Internal light**: activates the built-in strobed lighting;
- **External light**: disables the built-in lighting so that an external one can be used.
5.1.5 GPIO Management

This feature is used to manage the digital outputs of the system (discard).

The following can be set in this area:
- the direction;
- the region to be divided into lines;
- the number of discard lines (from 1 to 6); the duration of the discard pulse in ms and a delay offset on the latter, also in ms.
5.1.6 Test

By enabling this section, you can have a report used to verify the quality of the inspection setup by carrying out check tests with ALBERT-01.

**NOTE:** the activation of the TEST MODE is only envisaged for the feasibility stages of the inspection. We do not recommend using it during normal operation, as it can cause the system to slow down.
5.1.7 Segmentation

This section is designed to set the criterion used to clearly distinguish the inspected object from the background where the object is placed.

The “CURRENT SEGMENTATION RECIPE” shows the name of the segmentation solution currently used.

“CHANGE SEG. RECIPE” is a drop-down menu, with two keys, used to change the solution by selecting one from the saved solutions (if there are any).

If the default solutions do not meet your requirements, you can manually edit some parameters. Open “PARAMETERS SETTING” (with the arrow pointing downwards) to go to the advanced segmentation, where you can set the desired parameters.
On the left there are the controls to be used to define the correct segmentation:

**CH.1:** shows a drop-down menu where you can select a colour channel (RED, BLUE, GREEN, GRAY, ALL, etc.) associated with the part that needs to stand out against the background (generally the product to be inspected);

**CH.2:** shows another drop-down menu where you can select a channel (RED, BLUE, GREEN) associated with the background (usually the belt that the piece is moving on).

On the rights, by setting colour channels CH.1 and CH.2, the object to be highlighted will appear white, while the background will appear black.
For a correct definition of the edge of the white part, it is necessary to set the TH BIN value. TH BIN provides the binarisation threshold value (white/black) for the value calculated as:

\[ \text{CH.1} - \text{CH.2}. \]

The system turns the image into black and white, using white for anything with a difference higher than the value set on the bar.

The graph shows the binarisation curve: this represents the trend of the difference between CH.1 and CH.2, in greyscale shades (from 0 to 255), calculated for all the ROI images.

Typically, this trend shows a trough (the minimum level of grey in the image) and a peak (the maximum level of grey in the image). The best segmentation condition occurs when the value set for TH BIN is equal to the value on the x axis mid-trough.

Moreover, on top of this graph there are the indexes of all the colour codes.

On the left of the section there are the following tools:

**INVERT SEGMENTATION**: inverts the binarisation by turning everything from white into black and vice versa.

It is normally used when, via the difference of the channels, there is an attempt to highlight the bottom belt (which is easier to identify, as it is in plain colour (e.g. blue). By then reversing the segmentation, the resulting effect is the identification of the product on the belt. This is very useful for products with different colours moving on a fixed monochrome background.
OPEN/CLOSE: morphology algorithm of contours and edges which makes the product profile smoother.

ADD OBJ ON BORDERS: this is used to also analyse objects touching the border and that are not entirely inside the ROI. By default, this is disabled.

FILL HOLES: this fills the holes inside the product. This way, the system can consider or not consider the variations that occur inside the holes. FILL HOLES is usually active for objects with no holes and disabled for products with holes.

DIVIDE DOUBLE OBJ: this allows you to see two separate products even if they are too close.

![CAUTION: by activating DIVIDE DOUBLE OBJ, the system slows down](image)

The SAVE button is used to save a segmentation recipe, DELETE to eliminate it, LOAD to load a previously saved one.
5.1.8 Recipe & feature management

This area of the software is used to enable or disable the classes controlling the shape (simple, complex or custom) and colour (simple, complex and custom). Each control class has a series of features that are measured. There is also a histogram showing the discard percentage of each control class. The saving stage also includes the enabling or disabling of the control class.

Again in this recipe, it is possible or save or load the “recipes”, i.e. the compliance thresholds of each feature that the system previously identified through a learning stage via keys SAVE and LOAD, respectively.
5.1.9 Snap images

This area is used to save the images of what you are analysing in a specific folder. The number of images to be saved is set by the user.
5.1.10 Average data

This section shows, in real time, the average trend of the last 100 products with 3 graphs:

- **Avg color**: shows the trend of the product colour average value over time.
- **Avg min axis**: shows the trend of the minor axis dimension.
- **Avg max axis**: shows the trend of the major axis dimension.

There is the option of setting a sampling time (expressed in ms).
5.1.11 Last 6 defects

This shows the last defects identified.
5.1.12 Operational controls management

The LEARN feature, which can be activated with the red button under the image acquired by the camera, launches the self-learning stage, during which the system:

1. Extrapolates and saves the most important features of the product to be inspected;
2. Sets the maximum threshold values for the identified features.

There is the option of defining how many frames you want to analyse for the LEARN stage: to successfully run LEARN, the system needs to identify the object via segmentation. Once the LEARN feature has been activated, the system will learn by storing information from the total frames acquired (set previously). The completion time varies based on the number of frames to learn and the progress is displayed on the incremental LED mood bar (see 1.4.4).

For effective learning, the number of pieces analysed at this stage must be significant: this number grows according to production variability. The higher said variability, the more the system will need to analyse a higher number of products to guarantee stable checks.

**NOTE: In free-run mode, the number of frames captured will not match the number of pieces examined, as obviously several acquisitions will be carried out for each single product.**

The minimum number of images to acquire is 20.

Once the LEARN stage is completed, the system will automatically go to the next stage, CHECK, which is identified by the green status of the LEDs.

The CHECK feature starts automatically at the end of the learn stage and is the actual sorting step.

It can also be activated manually. In this case, the system will start analysing the products by using the last analysis recipe acquired or loaded.
The CHECK or LEARN phase can be stopped with the designated STOP button on the right of the severity bar.

![Screen capture showing start, learn, and stop buttons.]  

Via the software, there is the option of changing the check sensitivity threshold (a value from 1 to 10) with the bar under the LEARN button: the higher the value, the more the system will identify pieces with less relevant unevenness as defective.
5.2 Instructions for use

To use ALBERT-01, it is necessary to carry out two preliminary steps to guarantee system operation.

In short, the steps that must be carried out are those in the sections highlighted in grey on the left screen of the graphical interface:

The steps to carry out are:

- **SOURCE**;
- **TEST**;
- **SYSTEM CALIBRATION**;
- **COLOR-TRIGGER-STROBE**;
- **GPIO MANAGEMENT**.

For these steps, there is the option of using a PC, keyboard and mouse (in this case, you should use the output ports on the control panel by removing the small front cover) or the remote desktop connection, bearing in mind the information reported in the **Remote desktop connection** section.

After completing all of the operations above for the first time, you can carry out a LEARN procedure and start the check.
At this point the system works perfectly on its own.
The operator has the option of checking how many and which items are discarded (blue sections of the software, AVERAGE DATA and LAST 6 DEFECTS) and decide, without interrupting the sorting process, whether to increase or reduce the severity of the check. The operator can stop sorting by pressing STOP.

You can always quickly launch a new LEARN (in case, for instance, of the launch of a new production) allowing you to adjust the check in line with production itself. **During the new LEARN stage, the system keeps on checking the products based on the previous learning process.**

The LEARN, START, STOP, SEVERITY ADJUSTMENT steps can be carried out via PC, remote desktop or tablet.

The entire system is switched off by pressing the physical START/STOP button for 5 seconds.

**CAUTION: In the event of a power cut, the system automatically restarts and maintains the control parameters active at the time**
5.2.1 Remote desktop connection

To access Albert via a remote desktop, connect the remote device to the ETH2 network socket (static IP).
Access Albert by using the following computer name:
• “ALBERT-xxxxx”
where “xxxxx” must be replaced with the albert serial number
(e.g.: serial number “AL-00001”, the computer name is “ALBERT-00001”).

Here are the log-in details:
• username: “User”
• password: “albert01”

The first time a remote device is connected, you need to accept the security certificate.

To connect more than one Albert to a remote device, connect the units to an Ethernet router/switch via the ETH1 socket (dynamic IP).
On the network there must be a DHCP service to assign an IP address to the various devices (provided for instance by a router).
To access the individual Albert units from a remote desktop, repeat the same steps of the direct connection.

CAUTION: Using the remote desktop allows you to employ the same interface displayed during configuration (full functionality). The image display may be slowed down due to the band of the Ethernet connection.
5.2.2 How to use the tablet

Here below are the instructions to use the RT-UT10 TABLET, provided as an accessory of ALBERT-01.

When the TABLET is switched on, the desktop shows the “albert” folder (2), where you can find the file connect.html. Open it to launch the application.
Once open, you will see the connection screen, which prompts you to enter the IP address of ALBERT-01.

The IP address is shown on the software interface of ALBERT-01, on the status bar shown at the top.
After entering the IP address on the screen of the tablet, press CONNECT.

After the first time it is entered, the IP address is saved for the next start-ups.

Once the connection is completed successfully, the screen will show the remote control interface of the system, which consists of two pages, each of which can be accessed by clicking the icon at the top right.
The interface is used to carry out, on the first screen, basic steps, like how to perform a new **LEARN**, **START** or **STOP** on the system and change the **severity threshold**.

The same screen also provides data such as:

- current status of the system;
- current recipe;
- current segmentation;
- date and time of the last learn performed (the format is yyyymmdd_hhmmss);
- no. of compliant products;
- no. of non-compliant products;
- discard percentage.
Press the icon at the top left (yellow ring), to go to the second screen with the statistics.

The interface reports the following data:
  - number of non-compliant products in a settable time interval;
  - discard percentage;
  - histogram representing the progress of the current inspection classes;
  - histogram with the measurements of the major and minor axis of the product
  - progress of the product colour index.

To exit the software, just close the browser window.
6 • MAINTENANCE AND CLEANING

6.1 Cleaning and routine maintenance

Clean the system and the area around it at least once a week. At each shift, clean the scratchproof polycarbonate window with a clean damp cloth. Use a dry, clean cloth also for the other parts of the device.

CAUTION: before going ahead with any maintenance or cleaning, disconnect the machine from all the energy supplies

CAUTION: maintenance and any other work on the machine must only be carried out by specialised and authorised personnel

CAUTION: do not use compressed air to clean the system to avoid pushing dust into the areas protected by gaskets, thereby damaging electronic and optical parts

CAUTION: never use aggressive chemical solutions to clean any part of the produc

Check, at least once a month, the tightening of the parts forming the system. Accidental shocks and cleaning performed incorrectly may indeed modify the tightness and alignment of the parts.
6.2 Unplanned maintenance

Should there be the need to replace components, request any spare parts from SENSOE s.r.l., along with the instructions required to carry out the work. Should there be a problem with the optical system and/or software, do not try and replace it or tamper with it. Inform SENSOE s.r.l. and request support.

6.3 Deactivation

To put the equipment out of service in the event of prolonged machine inactivity, cut it off from all energy supplies.

At the end of the service life of the machine, it will need to be dismantled with the necessary equipment.

Carefully sort the components forming the machine based on the type of material. Namely, stainless steel, aluminium, iron and copper.

Contact companies specialising in the collection of special waste and materials resulting from demolition.
7 • ACCESSORIES

7.1 Fixing plate

\[NOTE:\ The\ accessories\ reported\ in\ the\ chapter\ must\ be\ purchased\ separately\ from\ ALBERT-01,\ if\ you\ believe\ you\ need\ to\ use\ them\]

The fixing plate comes with **4 X M6 fixing holes** to couple the plate to ALBERT and **4 X M10 holes** in a cross pattern to couple ALBERT with a bar along one of the two system axes.

*Figure 12: CMHOALB01*

The figure below shows how to couple the plate to ALBERT.
### 7.2 Cables

Here below are the cables compatible with the connectors on the upper panel of ALBERT-01.

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Measurements</th>
<th>Protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBETH002</td>
<td>Ethernet cable, generic use, 5 m, IP65</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CBGPO001</td>
<td>Output cable, 5 m, IP65</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CBPH001</td>
<td>Cable for photoelectric proximity switch with M12 connector, 5 m, IP65</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CBPH002</td>
<td>Cable for photoelectric proximity switch with M12 connector, 5 m, IP65</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CBTL001</td>
<td>Cable for photoelectric proximity switch with flying conductors, 5 m, IP65</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CBTL002</td>
<td>Cable for lighting column with flying conductors, 5 m, IP68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CBPWL0B1</td>
<td>Cable for lighting column with flying conductors, 5 m, IP68</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>