Color sensor for color recognition from a great distance for matt surfaces
colorSENSOR OT Series

colorSENSOR OT-3-MA-30

- Measuring range typ. 10 mm ... 100 mm
- Big dynamic range due to focused white-light operation
- Up to 31 colors can be stored
- RS232 interface (USB adapter is available)
- 8x super-bright white-light LED, focused (AC-/DC-/PULSE-operation or OFF for luminous objects can be switched)
- Color detection, contrast detection, and gray scale detection
- Insensitive to outside light
- Brightness correction can be activated
- Switching frequency up to 35 kHz
- Several TEACH functions (via PC, PLC, or push button)
- Various evaluation algorithms can be activated
- “BEST HIT” mode (“human color assessment”)
- Switching state display by means of 5 yellow LEDs
- Temperature compensated in climatic cabinet
- Averaging can be activated (from 1 up to over 32000 values)
- Color control of luminous objects (LEDs, halogen lamps, displays, ...)
- 3-color filter detector (true color detector: “human color perception”)

Design

Product name:
colorSENSOR OT-3-MA-30-16
colorSENSOR OT-3-MA-30-8
(incl. software colorCONTROL-S)

d5 - By use of an aperture Ø 5 mm the detection range at the working distance of 30 mm will be reduced to 5 mm.

Mounting accessories: (p. 7)

Optics holding device
(aluminum, anodized)

Receiver optics and transmitter optics with 8x white light LED incl. 3-color filter detector (True Color)
(scratch-resistant optics cover made of glass)

4-pole fem. connector
Binder Series 707
RS232-interface

Connecting cable:
CAB-M5-4P-St-ge; xm-PUR; RS232 or
CAB-M5-4P-St-ge; xm-PVC; USB

TEACH button
(external teaching via input IN0)

8-pole fem. connector
Binder Series 712
(connection to PLC)

Connecting cable:
CAB-M9-8P-St-ge; xm-PUR; open

Sturdy aluminum housing, anodized in blue

Mounting screws
(M34)

LED display:
Switching state indication by means of 5 yellow LED
# Technical Data

<table>
<thead>
<tr>
<th>Type</th>
<th>OT-3-MA-30-8</th>
<th>OT-3-MA-30-16</th>
</tr>
</thead>
<tbody>
<tr>
<td>Article number</td>
<td>10234067</td>
<td>10234068</td>
</tr>
<tr>
<td>Object distance</td>
<td>typ. 10 mm-100 mm</td>
<td>ideal distance 30 mm</td>
</tr>
<tr>
<td>Light spot</td>
<td>Ø 5 - 16 mm</td>
<td>Ø 10 - 31 mm</td>
</tr>
<tr>
<td>Light spot diameter</td>
<td>Ø 8 mm at 30 mm</td>
<td>Ø 16 mm at 30 mm</td>
</tr>
<tr>
<td>Color difference</td>
<td>( \Delta E \geq 0.5 )</td>
<td></td>
</tr>
<tr>
<td>Color spaces</td>
<td>X/Y INT; s/i M (Lab)</td>
<td></td>
</tr>
<tr>
<td>Averaging</td>
<td>more than max. 32768 values</td>
<td></td>
</tr>
<tr>
<td>Size of the color memory</td>
<td>max. 31 colors in non-volatile EEPROM with parameter sets</td>
<td></td>
</tr>
<tr>
<td>Switching frequency</td>
<td>max. 30 kHz (depending on number of colors being taught and the setting for the averaging)</td>
<td></td>
</tr>
<tr>
<td>Reproducibility</td>
<td>In the x,y color range, 1 digit each with 12-Bit-A/D conversion</td>
<td></td>
</tr>
<tr>
<td>Temperature drift X,Y</td>
<td>(&lt; 0.01 % /K)</td>
<td></td>
</tr>
<tr>
<td>Light source</td>
<td>8x white light LED, AC-, DC mode (^1) (adjustable or OFF for self-luminous objects, software-switchable)</td>
<td></td>
</tr>
<tr>
<td>Type of illumination</td>
<td>focused</td>
<td></td>
</tr>
<tr>
<td>Effect through illumination</td>
<td>Large dynamic range for matt/dark surfaces</td>
<td></td>
</tr>
<tr>
<td>Ambient light</td>
<td>to 5000 Lux (AC mode)</td>
<td></td>
</tr>
<tr>
<td>Intermittent light operation</td>
<td>AC: typ. 10 kHz to 40 kHz (depending on amplification level AMP1 to AMP8) DC: switchable by PC software</td>
<td></td>
</tr>
<tr>
<td>Power supply</td>
<td>+24 VDC (± 10 %), inverse polarity protected, overload-proof</td>
<td></td>
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<tr>
<td>Current consumption</td>
<td>typ. 320 mA</td>
<td></td>
</tr>
<tr>
<td>Max. switching current</td>
<td>100 mA, short-circuit protected</td>
<td></td>
</tr>
<tr>
<td>TEACH button/inputs</td>
<td>1 button and IN0 for external teaching of the color references</td>
<td></td>
</tr>
<tr>
<td>Outputs</td>
<td>OUT 0 - OUT 4, digital (0 V/+Ub), short-circuit protected, 100 mA Max. switching current nnp-, pnp-capable (bright or dark switching, switchable)</td>
<td></td>
</tr>
<tr>
<td>Switching state display</td>
<td>Visualisation by means of 5 yellow LEDs</td>
<td></td>
</tr>
<tr>
<td>Interface</td>
<td>RS232 (optional USB)</td>
<td></td>
</tr>
<tr>
<td>Type of connector</td>
<td>to PLC: 8-pole flange socket (Binder series 712) to PC: 4-pole flange socket (Binder series 707)</td>
<td></td>
</tr>
<tr>
<td>Connection cable</td>
<td>to power/PLC: art. no. 11234091 / to PC: art. no 11234095 (RS232); 11234096 (USB).</td>
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<tr>
<td>Receiver</td>
<td>3-color filter detector (TRUE COLOR detector, color filter curve as per CIE 1931)</td>
<td></td>
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<tr>
<td>Software</td>
<td>colorCONTROL S</td>
<td></td>
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<tr>
<td>Pulse extension</td>
<td>adjustable 0 ms-100 ms</td>
<td></td>
</tr>
<tr>
<td>Signal amplification</td>
<td>8 stage (AMP1 - AMP8), adjustable</td>
<td></td>
</tr>
<tr>
<td>Housing material</td>
<td>Aluminium, black anodised</td>
<td></td>
</tr>
<tr>
<td>Operating temperature</td>
<td>-20 °C - +55 °C</td>
<td></td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-20 °C - +85 °C</td>
<td></td>
</tr>
<tr>
<td>Protection class</td>
<td>IP 67 (lens), IP 64 (electronics)</td>
<td></td>
</tr>
<tr>
<td>EMC test according</td>
<td>DIN EN 60947-5-2</td>
<td></td>
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</table>

\(^1\) suitable for illumination testing
Dimensions

All dimensions in mm
Connection to PLC:
8-pole fem. connector Binder Series 712

Pin: Color: Assignment:
1. white GND (0V)
2. brown +24VDC (+10%)
3. grey IN0
4. yellow OUT0
5. grey OUT1
6. pink OUT2
7. blue OUT3
8. red OUT4

Connecting cable:
CAB-M9-8P-St-ge; 2m-PUR; open
CAB-M9-8P-St-ge; 5m-PUR; open
(Standard length 2 m)

Connection to PC:
4-pole fem. connector Binder Series 707

Pin: Assignment:
1 +24VDC (+Ub, OUT)
2 GND (0V)
3 RxD
4 TxD

Connecting cable:
CAB-M5-4P-St-ge; 2m-PUR; RS232
CAB-M5-4P-St-ge; 5m-PUR; RS232
(Standard length 2 m)

Alternatively:
Connecting cable (incl. driver software):
CAB-M5-4P-St-ge; 2m-PVC; USB
CAB-M5-4P-St-ge; 5m-PVC; USB
(Standard length 2 m)
Measuring Principle

Measuring principle of the color sensors of colorSENSOR OT-3 series:

The colorSENSOR OT-3 provides highly flexible signal acquisition. For example, the sensor can be operated in alternating-light mode (AC mode), which makes the sensor insensitive to extraneous light. It also can be set to constant-light mode (DC mode), which makes the sensor extremely fast and allows a scan-frequency of up to 35 kHz. An OFF function turns off the integrated light source at the sensor and changes to DC operation. The sensor then can detect so-called "self-luminous objects". In PULSE operation extremely dark surfaces can be reliably detected. With the stepless adjustment of the integrated light source and the selectable gain of the receiver signal the sensor can be set to almost any surface or any "self-luminous object".

When the integrated light source of the colorSENSOR OT-3 color sensor is activated, the sensor detects the radiation that is diffusely reflected from the object. As a light source the colorSENSOR OT-3 color sensor uses a white-light LED with adjustable transmitter power. An integrated 3-fold receiver for the red, green, and blue content of the light that is reflected from the object, or the light that is emitted by a "self-luminous object", is used as a receiver. As mentioned above, a special feature here is that the gain of the receiver can be set in 8 steps. This makes it possible to optimally adjust the sensor to almost any surface and to different "self-luminous objects".

The colorSENSOR OT-3 color sensor can be "taught" up to 31 colors. For each of these taught colors it is possible to set tolerances.

In X/Y INT or s/i M mode these tolerances form a color cylinder in space. In X/Y/INT or s/i/M mode the tolerances form a color sphere in space. Color evaluation according to s/i M is based on the lab calculation method. All modes can be used in combination with several operating modes such as "FIRST HIT" and "BEST HIT". Raw data are represented with 12 bit resolution.

Color detection either operates continuously or is started through an external PLC trigger signal. The respective detected color either is provided as a binary code at the 5 digital outputs or can be sent directly to the outputs, if only up to 5 colors are to be detected. At the same time the detected color code is visualised by means of 5 LEDs at the housing of the colorSENSOR OT-3.

With a TEACH button at the sensor housing the color sensor can be taught up to 31 colors. For this purpose the corresponding evaluation mode must be set with the software. The TEACH button is connected in parallel to the input IN0 (green wire at cable CAB-M9-8P-St-ge; xm-PUR; open). Parameters and measurement values can be exchanged between a PC and the colorSENSOR OT-3 color sensor through the serial RS232 interface. All the parameters for color detection also can be saved to the non-volatile EEPROM of the colorSENSOR OT-3 color sensor through this serial RS232 interface. When parameterisation is finished, the color sensor continues to operate with the current parameters in STAND-ALONE mode without a PC.

The sensors of the colorSENSOR OT-3 series can be calibrated (white-light balancing). Balancing can be performed to any white surface. A ColorChecker™ table with 24 color fields is available as an alternative.

Visualization

Visualization of the color code:

The color code is visualised by way of 5 yellow LEDs at the housing of the colorSENSOR OT-3 color sensor. At the same time in the binary mode (OUT BINARY) the color code indicated on the LED display is output as 5-bit binary information at the digital outputs OUT0 to OUT4 of the 8-pin colorSENSOR OT-3-/PLC socket.

In the DIRECT mode (OUT DIRECT HI or OUT DIRECT LO) the maximum numbers of colors to be taught is 5 (color no. 0, 1, 2, 3, 4). If DIRECT HI is activated, the specially digital output is set to HI, while the other 4 are set to LO. If the current color does not correspond with any of the teach-in colors, all digital outputs are set to LOW (no LED is lighting).

If DIRECT LO is activated, the specially digital output is set to LO, while the other 4 are set to HI. If the current color does not correspond with any of the teach-in colors, all digital outputs are set to HIGH (all LED are lighting).
LED display:

The color code is visualized by means of 5 yellow LEDs at the housing of the color sensor. At the same time the color code indicated at the LED display is output as 5-bit binary information at the digital outputs OUT0 ... OUT4 of the 8-pole PLC connector.

In the DIRECT mode the maximum number of color codes to be taught is 5. These 5 color codes can be directly output at the 5 digital outputs. The respective detected color code is displayed by means of the 5 yellow LEDs at the color sensor housing.
Mounting Accessories

**FL-34 (flange):**

Example: FL-34 with colorSENSOR OT-3-GL-30 mounted

**WFL-34 (flange, angle type 90°):**

Example: WFL-34 with colorSENSOR OT-3-GL-30 mounted

*(All dimensions in mm)*