## CRT 448

## Colour sensors with digital outputs

40 mm

10 - 30 V DC

- Scanner with visible light spot for colour detection
- Independent teach-in of up to 4 reference colours (channels)
- Separately adjustable tolerance steps for each colour (channel)
- Easy adjustment through clearly organised control panel with 3 buttons or via control input

CE ISO 9001 IP 67

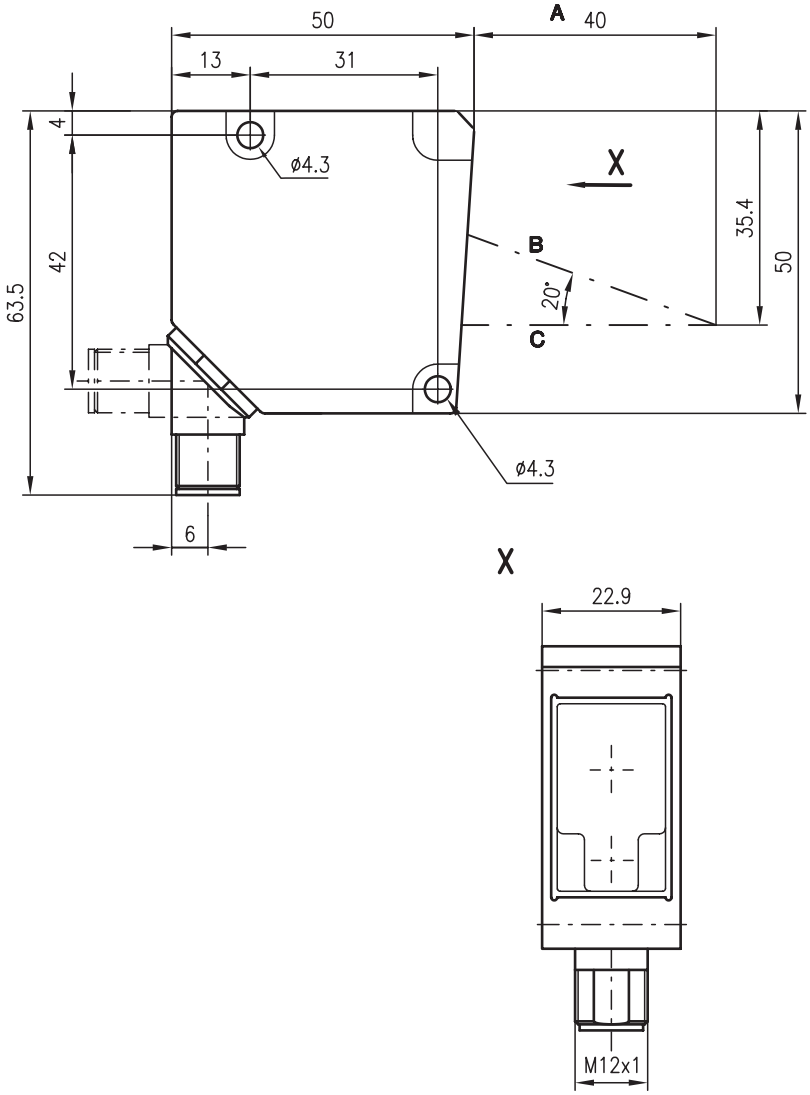
IEC 60947... IEC 60947... 1,6 kHz

## Accessories:

**(available separately)**

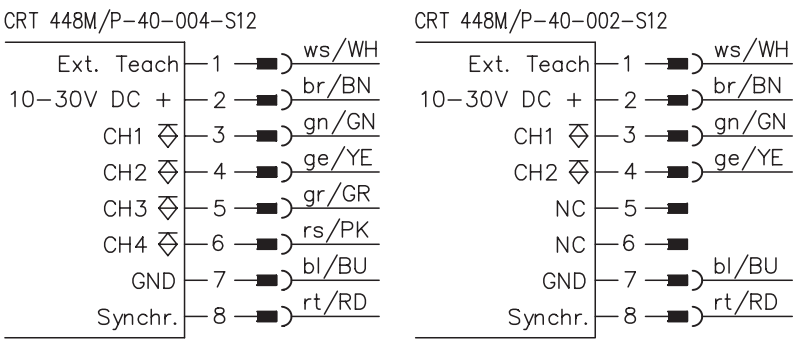
- M12 connectors, 8-pin (KD …)
- Ready-made cables (KB …)

## Dimensioned drawing




**A** Scanning range
**B** Transmitter axis
**C** Receiver axis

## Electrical connection



## Specifications

**Optical Data**

| | |
|---|---|
| Scanning range [1] | 40 mm |
| Light source | LEDs (red, green, blue) |
| Light spot | 3 x 5 mm |

**Timing**

| | |
|---|---|
| Switching frequency | 1,667 kHz |
| Response time | 0.3 ms |

**Electrical data**

| | |
|---|---|
| Operating voltage $U_B$ | 10 … 30 V DC (incl. residual ripple) |
| Residual ripple | ≤ 15 % of $U_B$ |
| Bias current | ≤ 80 mA |
| Switching output/channels (CH…) | 4 PNP transistor outputs or<br>2 PNP transistor outputs |
| Function | light switching |
| Signal voltage high/low | ≥ ($U_B$-2 V)/≤ 2 V |
| Output current | max. 100 mA per channel |
| Adjustment | adjustable/teachable via 3 buttons<br>(channel selection, tolerance selection, teach-in mode) |

**Indicators**

| | |
|---|---|
| LED yellow | switching state per channel |
| LED green | ready/tolerance selection |
| LED orange | display during teach-in mode |
| LED orange flashing | fault indication during teach-in mode |

**Mechanical data**

| | |
|---|---|
| Housing | diecast zinc |
| Optics cover | glass |
| Weight | 125 g |
| Connection type | M12 connector, 8-pin, can be turned by 90° |

**Environmental data**

| | |
|---|---|
| Ambient temperature (operation) | -10 °C … +55 °C |
| Protection class | IP 67 |
| LED class | 1 (acc. to EN 60825-1:1994 +A1:2002 +A2:2001) |
| Protective circuit [2] | 2, 3 |
| Standards applied | IEC 60947-5-2 |

**Options**

| | |
|---|---|
| Synchronisation input (Synchr.) | active ≤ 1/3 $U_B$ or not connected, not active ≥ 2/3 $U_B$ |
| Control input (Ext. Teach) | protocol with response via channel 1 (CH 1) |

1) Scanning range: recommended scanning range
2) 2=polarity reversal protection, 3=short-circuit protection for all outputs

## Tables

## Diagrams

## Order guide

| | Designation | Part No. |
|---|---|---|
| 4 channels | CRT 448M/P-40-004-S12 | 500 61177 |
| 2 channels | CRT 448M/P-40-002-S12 | 500 61175 |

## Remarks

- With shiny objects, the sensor is to be mounted at an angle to the object surface.
- Normally use dry, clean, and soft cloth for cleaning the optics cover. Use pure alcohol for intensive cleaning.

## CRT 448

## Function principle of the colour sensor

Many sensors are capable of differentiating between light and dark or matt and shiny. As soon as colour is to serve as a distinguishing criterion, however, normal sensors are quickly pushed to their limits.
As a result, colour sensors are of increasing importance in industrial automation.
The applications range from sorting coloured objects to the detection or inspection of coloured surfaces. Materials such as powders, granulates, fluids as well as metals, glasses, papers, plastics and textiles can be reliably detected in this way.

Simple operation makes it possible to teach-in the reference colour and to adjust the tolerance range.

During operation, the colour sensor compares the taught-in colour with the measured colour. If the values lie within the set tolerance range, the sensor passes on the match to the controller via a switching output.

## Controls and indicators

Indicator LED CH (yellow)

Indicator LED TOL (green)

Indicator LED SET (orange)


Button for channel selection (CH button)

Button for tolerance selection (TOL button)

Button for teach mode (SET button)

| Indicator LED | Run mode | Teach-in mode |
|---|---|---|
| CH4 x yellow | Switching state display of output/channel 1 to 4. | Display of the selected channel from 1 to 4. |
| TOL3 x green | Run mode is indicated by illumination of all LEDs. | Display of the selected tolerance level (1 … 5) of the selected channel. |
| SET1 x orange | | Illuminated LED indicates the teach mode. Flashing LED indicates measurement in progress. Slowly or fast flashing LED indicates errors during the measurement procedure. |

| Control button | Run mode | Teach-in mode |
|---|---|---|
| CH button for channel selection | Without function | a) Selection of the next channel<br>b) Back to run mode on error |
| TOL button for tolerance selection | Without function | a) Selection of the next level with higher tolerance<br>b) Back to run mode on error |
| SET button for teach mode | The device changes to teach mode after the button is pressed for more than 1.5s. | a) Measurement procedure is started.<br>b) The values are stored and the device goes back to run mode |

## Run mode/operating mode

The sensor is in run mode after application of the operating voltage.

- All three green tolerance LEDs (TOL-LEDs) are illuminated
- The four yellow LEDs (CH-LEDs) display the state of the outputs (channels)

### Manual teach-in mode

To teach the colours and the tolerance level, proceed as follows:

1. Position the sensor correctly towards the object (scanning distance, angle, etc.).
2. Pressing the SET button for at least 1.5s switches the sensor to the teach mode and switches on the orange SET LED.
3. Pressing the CH button always selects the next channel, which is indicated by the associated yellow LED. Channel 1 follows channel 4.
4. Pressing the TOL button always selects the next-higher tolerance level (1 to 5), which is indicated by the corresponding green LED(s). Tolerance level 1 follows tolerance level 5.

Tolerance levels:

|  |  |  |  |  |
|---|---|---|---|---|
| Tolerance level 1 | Tolerance level 2 | Tolerance level 3 | Tolerance level 4 | Tolerance level 5 |
| For distinguishing between subtle differences in colour | | | | For distinguishing between coarse differences in colour |

5. Pressing the SET button starts the measurement of the reference colour which is to be taught in. During this process, the orange SET LED flashes (approx. 4Hz). If the orange SET LED flashes slowly or quickly, no reference colour can be taught in. The old reference colour remains stored. Return to run mode by pressing the TOL or CH button (cancel function).
   If the orange SET LED flashes slowly (approx. 2Hz), the object which is to be taught in is too dark or possibly too far away.
   If the orange SET LED flashes quickly (approx. 10Hz), the object which is to be taught in is too light or shiny. This may be corrected by using a tighter angle to between the sensor and object.
6. Pressing the SET button concludes the teach process. The orange LED switches off and the transmitter diode is briefly switched off. The new values (colour and tolerance level) are stored and the sensor returns to the run mode.

## The synchronisation input

With the synchronisation input, you can specify exactly when colour matching is to begin and end.
This corresponds to the activation and deactivation of the sensor. After changing from passive to active, the detection commences after max. 0.3ms, after which time the switching outputs are actualised.
When switching from active to passive, all switching outputs are switched off after max. 0.14ms.
With an unconnected input (Synchr.) or input (Synchr.) $\leq 1/3U_B$, the sensor is active.
With input (Synchr.) on $\geq 2/3U_B$, the sensor is passive.
The visible light spot is always visible independent of the state of the input.
A typical application is, for example, a multicoloured object on which the colour is to be inspected at only a certain location and other areas are to be suppressed.
Any possible erroneous detections which occur as the object passes to the background can be prevented in this way.

## External teach-in mode

In this mode, full remote operation and adjustment of the sensor are possible. The sensor continues to return important acknowledgements. This is ensured by a serial interface similar to the RS 232. The device is operated using a standard terminal program.
Data transmission occurs at 9600baud, without parity, as well as 8 data bits and 1 stop bit.
The pin assignments are as follows:

| | | | |
|---|---|---|---|
| Input | Ext. Teach | Pin 1 | ws/WH |
| GND | GND | Pin 7 | bl/BN |
| Output | CH 1 | Pin 3 | gr/GN |

To enter the external teach-in mode, the synchronisation input must be passive for at least 300ms.

**Note:** Synchronisation input passive = voltage is being applied $\geq 2/3U_B$
To exit external teach-in mode, a command must be entered via the terminal program.

**The following commands, which are entered via the terminal program, are available:**

| | |
|---|---|
| **@** | Start command for the external teach mode (together with synchr. passive) |
| **cx**<CR><LF> | Selection of the channel. The parameter x ([1 … 4] resp. [1 … 2] in two-channel operation) Indicates the respective channel |
| **tx**<CR><LF> | Selection of the tolerance. The parameter x [1 … 5] indicates the respective tolerance level |
| **e**<CR><LF> | Execution command (execute). With the execution command, the previously set channel is taught in with the selected tolerance and the result stored. If no channel and/or no tolerance are/is selected before executing the execute command, the command is ignored and an error message is output by the sensor. If the object which is to be taught-in is either too light or too dark, the command is ignored and a corresponding error message returned. |
| **q**<CR><LF> | Exit external teach mode without saving. |

**The following messages are returned in external teach mode by the sensor:**

| | |
|---|---|
| <SPC>**ok**<CR><LF> | ok<br>The previously entered command was executed |
| <SPC>**??**<CR><LF> | General error<br>This error message occurs in the following cases:<br>- Command could not be interpreted (invalid input)<br>- Parameter lies outside of the valid range<br>- No tolerance and/or no channel selected prior to executing the execute command(s) |
| <SPC>**hi**<CR><LF> | Intensity too high. The object is too light or shiny. |
| <SPC>**lo**<CR><LF> | Intensity too low. The object is too dark. |