OPERATING INSTRUCTION

KT8 CAN

Contrast Scanner

SICK
Sensor Intelligence.

Contents

Tables

1 Terminology

Term/abbreviation	Explanation
Dark-switching	Switching output active at dark mark above bright background
Light-switching	Switching output active at bright mark above dark background
CAN	Controller Area Network
Material to be sensed	Film to be detected with appropriate contrast ratio (mark to background)
Repeated pattern	Smallest, repeated pattern on the material
0..1023	Value range of the system resolution 0 = no signal / 1023 = full signal
PON	Power on (voltage supply at L+ and ground)
SSN	Switching threshold tracking automatic switching threshold tracking (drift correction) manual switching threshold tracking
SDO	Service Data Object
PDO	Process Data Object

2 Safety Notes

Read the operating instructions, prior to commissioning.
Connection, assembly and adjustment only by specialist staff.
Protect device from humidity and contamination during commissioning.
Not a safety component according to EU Machinery Directive.

3 Proper Use

The KT8 CAN contrast scanner is an optoelectronic sensor and is used for the optical, non-contact acquisition of contrast marks or contrast runs following RGB colour components.

4 Technical Specifications

4.1 Optical Specifications

Scanning distance from lens front edge	10 ± 3 mm
Light sender	light type LED; red, green, blue
Wavelength (nm)	640, 525, 470
Light spot dimensions	4.0 x 1.2 mm
Light spot location	longitudinal

4.2 Electrical Specifications

Switching frequency max.	22000/s
Response time	22 µs
Supply voltage UV DC	10 ... 30 V
Residual ripple	< 5 V
Power consumption	< 120 mA
Switching outputs	PNP: HIGH = UV – < 2 V / LOW = 0 V
	NPN: HIGH = UV / LOW = < 2 V
Output current	IA max. < 100 mA
Teach-in-input	ET PNP: Teach > 10 V ... < UV Run 0 V or unswitched NPN: Teach 0 V Run UV or unswitched

4.3 Mechanical Specifications

Rating	IP 67
Ambient temperature Operation	-10 ... +55 °C
Ambient temperature Storage	-25 ... +75 °C
Shock loading	to IEC 68
Weight	400 g approx.
Housing	diecast zinc
Type of connection	plug connection M12, 8 pin

VDE protection	V
Protective circuits	A, B, C, D

4.4 Characteristics

Interface	CAN with CANopen functions
Functions	Heartbeat function, setting/reading of process parameters via SDO/PDO mechanism and object directory, contamination message, switching threshold tracking, sensor, light-/dark-switching fixed selectable or via Teach-in sequence, selection of Teach-in methods, selection of OFF delay
Data rate	20 kBaud, 50 kBaud, 100 kBaud, 125 kBaud, 250 kBaud, 500 kBaud, 800 kBaud 1 MBaud
Inputs	External Teach-in cable ET
Outputs	Switching output Q

4.5 Control Panel

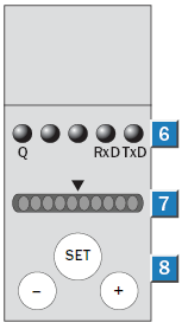
RxD – Receive Data

TxD – Transmit Data

Q – Switching output display

Bar display – function 1 = Quality of Teach
function 2 = Quality of Run
function 3 = Present Reflectance

Setting of CAN baud rate and CAN address



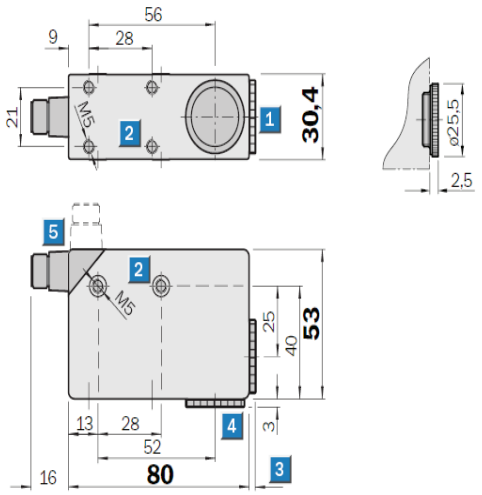
6...Function display, yellow

7...Bar display, green

8...Teach-in button: “+” and “–“ button

5 Assembly

The sensor has M5 fixing threads. Optionally, light emission may be on the short or long side of the device.



1 Objektiv (Lichtaustritt), austauschbar gegen Pos. 3
2 Befestigungsgewinde M5 – 5,5 mm tief
3 Siehe Maßbild des Objektivs
4 Blindverschraubung, austauschbar gegen Pos. 1
5 Stecker 8-polig, M12 x 1 (drehbar 90°)

1 Lens (light exit), interchangeable with item 3

2 M5 fixing thread – 5.5 mm deep

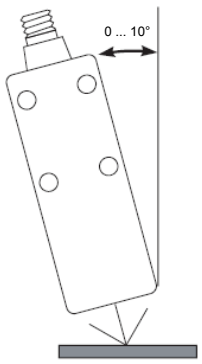
3 See dimensional drawing for lens

4 Blind screw connection, interchangeable with item 1

5 Plug, 8 pin, M12 x 1 (90° rotatable)

Mount sensor with fixing holes in the position where the test object makes the smallest side and height movements.

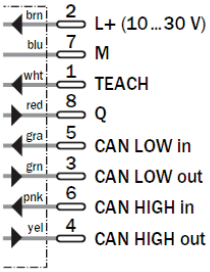
For reflective or shiny object surfaces, tilt the sensor through 0° to 10° to the material surface.



6 Electrical Connection

6.1 Pin Assignment

This is an M12 plug with 8 pin assignment.

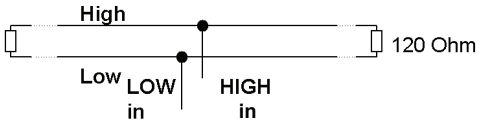


6.2 Integration into a CAN Network

There are 2 possible options for the electrical connection of the KT8 CAN in the CAN network.

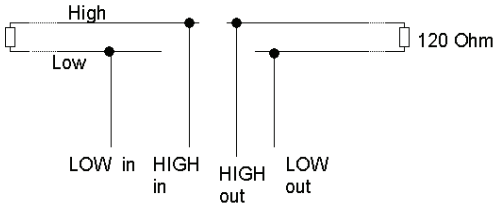
Option 1

Using 2 cables, the sensor is connected with the CAN network. The general CiA provisions regarding spur length depending on the baud rate, shall apply.



Option 2

The CAN network is split open, and all 4 CAN cables are connected appropriately. Thus, the complete bus node is moved into the device, in order to minimise the spur length.



7 Teach-in Function

7.1 Teach-in Method

During the Teach-in phase, the sensor determines all setting parameters required. These are permanently stored. It is possible to swap these parameters between sensor and controller.

The sensor provides 2 different Teach-in methods.

- 2-point Teach-in
- Dynamic Teach-in

The selection of the two Teach-in variants is made via the CAN interface (see parameter string).

7.1.1 2-point Teach-in

1st Teach-in operation:
Bring mark or background into the light spot and activate Teach-in. The red send light and the function display flash slowly.

2nd Teach-in operation:
Bring background or mark into the light spot and activate Teach-in.

Teach-in operation completed. If the Q function display and the switching are flashing fast: contrast not sufficient. Logic light-/dark-switching (see 7.3).

7.1.2 Dynamic Teach-in

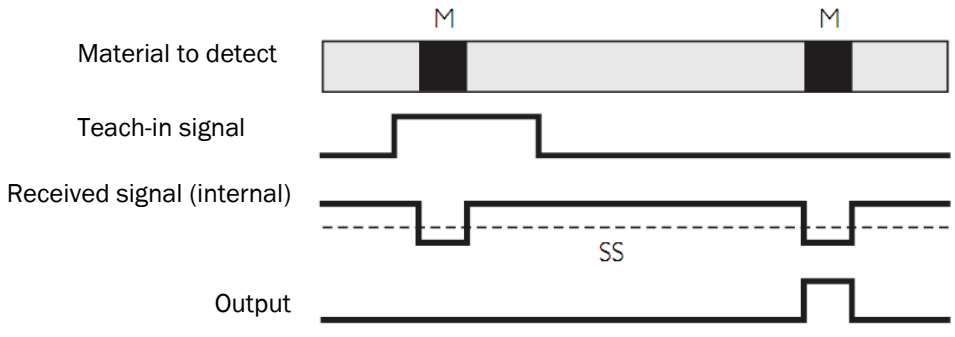
Map light spot onto the template before the mark.

Activate and hold Teach-in signal.

Move template with the mark in the scanning distance through light spot.

Deactivate Teach-in signal.

Teach-in operation completed. If the Q function display and the switching output are flashing fast: contrast not sufficient.



SS = Switching Threshold
M = Mark

Note:
- Logic light-/dark-switching (see 7.3)
- Select material speed < 10 m/min.

7.2 Quality of Teach-in

Display	Operation	Contrast
Bar display:	display of the detection safety	
The more LEDs are illuminated,	the better the Teach-in.	
One LED illuminated:	no safe operation possible	smallest contrast difference.
Two to four LEDs illuminated:	operation within the system reserve	sufficient contrast difference.
More than four LEDs illuminated:	safe operation	high contrast difference.

7.3 Output Logic Light-/Dark-Switching

There are three ways of setting the light- and dark-switching logic

7.3.1 Via Teach-in procedure:

Factory setting, the output logic is set by the sequence of the Teach-in operation. This shows as follows, for both Teach-in methods:

2-point Teach-in: The sensor switches to the grey value first taught in.

Dynamic Teach-in: The sensor switches to the contrast jump, which is incorporated during the Teach-in.

7.3.2 Always light-switching

Sensor always switches to the lighter grey value, irrespective of the Teach-in sequence.

7.3.3 Always dark-switching

Sensor always switches to the darker grey value, irrespective of the Teach-in sequence.

7.4 Activating a Teach-in

A Teach-in operation can, from the normal mode, be triggered via the following events:

- Teach-in via control panel on sensor
- Teach-in via the external Teach-in cable ET
- Teach-in via a CAN telegram

7.4.1 Teach-in via control panel

The Teach-in procedure is triggered via the Teach-in button on the sensor. Activation requires an unlocking time of 1 second, to protect the sensor from unwanted operating.

7.4.2 Teach-in via the external Teach-in cable ET

The Teach-in procedure is triggered via the external Teach-in cable. A trigger time of >2 ms is required.

7.4.3 Teach-in via a CAN telegram

The Teach-in procedure is triggered via sending an SDO telegram. For this, see CAN interface, “Teach” data string.

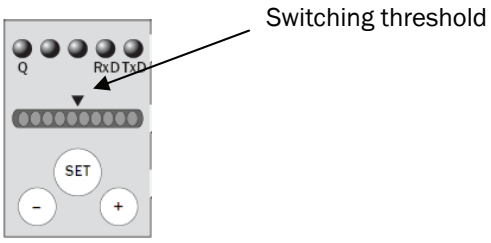
8 Switching Threshold Adjustment

8.1 Manual Switching Threshold Adjustment

The taught-in switching threshold can be manually readjusted. For this, the component SSN = manual (01) must be set in the configuration string. The automatic SSN is enabled in the factory setting.

1. Operate PLUS or MINUS button > 1 s to unlock.
2. The switching threshold increases/decreases with every button operation (MINUS or PLUS).

Tip: For better adjustment, activate the “current reflectance” display in the bar display. The switching threshold lies in the middle (arrow). Once the switching threshold is run through, the output changes its state.



8.2 Automatic Switching Threshold Tracking

If the automatic switching threshold tracking (drift correction) is activated, the sensor independently readjusts the switching threshold. This happens depending on the light values. With this function, irregular environmental conditions (print quality, scanning distance change, flutter etc.) can be compensated for.

8.3 Contamination Message Output

If this function is activated, there will be a message that the external lens surface of the sensor is contaminated. The message is sent, via PDO message, to the controller.

9 Setting the Bus Address and Baud Rate on the Sensor

The CAN-Bus address (point A) and the CAN baud rate can be set via the control panel on the sensor. The factory setting is address decimal d‘64‘ = hexadecimal 0x40.

The bus address is binary via the green 10-position bar display at the sensor, coded right-justified.

No.	Parameter	Q-LEDs	Display bar	Value/description	Default
1.	CAN Bus address			Address (binary represent.) min. 0x01	
				...	
				0x3F	
				0x40 (standard) = d‘64‘	X
				0x41	
				...	
				Maximum 0x7F = d’127	
2.	CAN baud rate			20 kBaud	
				50 kBaud	
				100 kBaud	
				125 kBaud	
				250 kBaud	
				500 kBaud	X
				800 kBaud	
				1 MBaud	

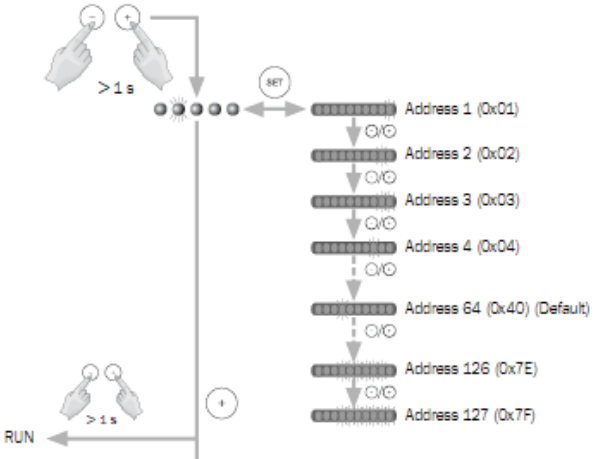
Setting procedure via control panel:

“PLUS” and “MINUS” > 1 s: Entering the special mode/leaving the special mode.

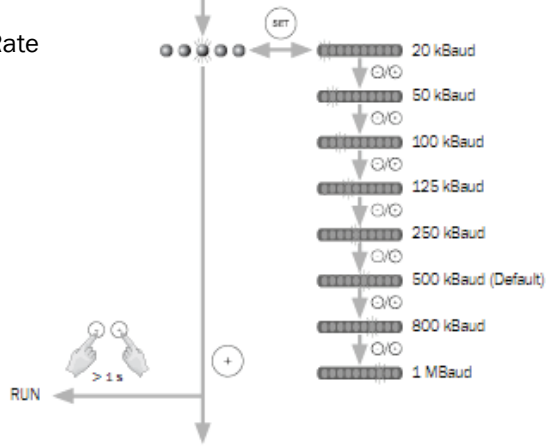
“PLUS” or “MINUS”: Navigating;

“SET”: Confirming/saving

a.) Setting Adress



b) Setting Rate



10 CAN Interface

10.1 Overview

10.1.1 Summary

The interface structure of the KT8 CAN is neatly based on seven data strings (objects). The individual data strings are thematically summarised such that they are integrated into the machine control concept as effectively and simply as possible.

The reading and writing of parameters is possible through SDO telegrams. For example, this also enables changing the sender colour, or even triggering a “Teach”. Furthermore, the user can have PDO telegrams sent, for certain states of the sensor.

The sensor features the heartbeat function according to CANopen definition.

The objects and the information contained therein, in part, have different access privileges, e.g. “read/write” (r/w), read-only (ro).
If an object is to be described, which must only be read, an appropriate error message according to CANopen definition is returned.
If a component of an object is to be described with the read-only access privilege, this will be ignored without returning an error message.

The objects with the application-specific user parameters are deposited from index 0x3000.

The user can perform a job protection and job backup via the CAN bus. For this, the objects “Parameter String” and “Config String” must be communicated via CAN.
When writing the “Parameter String” (i.e. job backup), all system parameters are recalculated.

The sensor needs 200 ms processing time after receipt of an SDO telegram. Exception: enquiry for a measurement value string. This happens more quickly.

Name	Index (0x...)	Subindex (0x...)	Data type	Access	
Parameter String	3000	00	U32	r/w	Parameter set for a particular material to be sensed
Service String	3001	00	U32	ro	Additional information on current detection data
Measurement Value String	3002	00	U32	ro	Output of the raw values in red, green and blue component
Config String	3003	00	U32	r/w	Configuration of the sensor
Teach String	3004	00	U32	r/w	Triggering of a Teach-in
Bank Store/Select String	3005	00	U32	r/w	Saving of parameter sets in sensor (max. 5 off)
Communication String	3006	00	U32	r/w	Device-specific information

10.1.2 Node address

An individual CAN node address can be allocated to each sensor. This is saved, protected against power failure. The change/setting of the node address can be performed in two ways:

1. Input via control panel on sensor
2. Via CAN telegram

Factory setting address: 0x40

10.1.3 Baud rate

The baud rate can be set in different ways. This is saved, protected against power failure. The change/setting of the node address can be performed in two ways:

1. Input via control panel on sensor
2. Via CAN telegram

Factory setting of the baud rate: 500 kBaud

10.1.4 Optical return message on sensor

As an optical return message to the user, when sending and receiving CAN telegrams, the Rx and Tx LED on the control panel (Q LEDs 3 and 4) are selected separately.
When receiving a telegram, the Rx LED is switched on for 200 ms approx.
When sending a telegram, the Tx LED is switched on for 200 ms approx.

10.2 Description of the String Structure

Using the example of the Parameter String (object 30 00), the composition of a Parameter String is illustrated here.

Structure of parameter string			
r/w	r/w	r/w	r/w
Teach value inactive	Switching threshold	Teach value active	Send colour
31 30 29 28 27 26 25 24 23 22	21 20 19 18 17 16 15 14 13 12	11 10 9 8 7 6 5 4 3 2	1 0
D3	D2	D1	D0
0 0 0 0 0 0 0 0	0 0 0 1 1 1 1 1	1 1 1 1 1 1 1 1	1 1 1 1 1 1 0 1
0 (default)	511 (default)	1023 (default)	01 (default)
Value range 0 ... 1023	Value range 0 ... 1023	Value range 0 ... 1023	00 = red 01 = green 10 = blue 11= invalid

The controller sends a query “Readout of Object 3000” to the KT8 CAN.

Example: SDO query to KT8 CAN								
ID	Length	CCD	Index	Subindex	D0	D1	D2	D3
600H +Addr	8	40	00	30	00	00	00	00

The KT8 CAN responds to the controller with the appropriate message.

SDO reply from KT8 CAN								
ID	Length	CCD	Index	Subindex	D0	D1	D2	D3
580H +Addr	8	43	00	30	FC	FF	1F	00

The data contents here comprises of the following values:

Teach value inactive	0
Switching threshold	512
Teach value active	1023
Send colour	grün

10.3 SDO/PDO Message Description

10.3.1 SDO message

Using Service Data Objects (SDO), it is possible to access the entries of a user parameter, via index and subindex. The values of the objects can be read and – if allowed – also be changed. The message structure is implemented similar to CANopen.

The data frame of an SDO message consists of:

- Command code (CCD), in which the SDO message type and the data length of the transmitted value are encrypted
- Index and subindex, which point to the object, whose data is transported with the SDO message. In case of error, the faulty SDO itself is specified with index and subindex.
- **Data comprising of up to four bytes**

Index and data are transmitted left-justified in the Intel format. If the SDO contains numerical values over byte in length, the data must be rearranged byte-wise, before and after a transmission.

Component to KT8 CAN

Identifier	**DLC**	**Data**							
		CCD	**Index**		**Subindex**	**D0**	**D1**	**D2**	**D3**
0x600 + node id	8H	XX	XX	XX	XX	XX	XX	XX	XX

KT8 CAN to component

Identifier	**DLC**	**Data**							
		CCD	**Index**		**Subindex**	**D0**	**D1**	**D2**	**D3**
0x580 + node id	8H	XX	XX	XX	XX	XX	XX	XX	XX

10.3.2 CCD coding

The following table shows the command code for writing parameter values. It is dependent on the message type and on the transmitted data length (data type U32 = 4Byte, data type U16 = 2Byte...) .

Message type	**Data length used**				**Meaning**
	4Byte	3Byte	2Byte	1Byte	
write request	23h	27h	2Bh	2Fh	Send parameter
write response	60h	60h	60h	60h	Confirmation
error response	80h	80h	80h	80h	Error

The following table shows the command code for transmitting a read value. It is dependent on the message type and on the transmitted data length.

Identifier: 0x600 + node ID Ex.: node ID =1 -> identifier =0x601

Measurement value Red: 119dez= 0001110111b
Measurement value Green: 457dez= 0111001001b
Measurement value Blue:: 638dez= 1001111110b

Data: 00100111111001110010010011101111b = 27E72477 hex

Controller to KT8 CAN: read out measurement value string										
Identifier	RTR	DLC	CCD	Index		Sub-ind.	D0	D1	D2	D3
601	0	8	40	02	30	00	00	00	00	00
KT8 CAN to controller as response										
581	0	8	43	02	30	00	77	24	E7	27
KT8 CAN to controller as error response										
581	0	8	80	02	30	00	00	00	00	00

10.3.3 PDO message (akin to CAN OPEN)

There is the option of having a PDO telegram sent, for particular states of the sensor.

There are the following PDO telegrams:

1. a PDO telegram which contains the state of the switching output and of the VMA output
2. a PDO telegram for the measurement value mode
3. a PDO telegram for the heartbeat function

Switching output and contamination

Identifier	RTR	DLC	Data							
			D0	D1	D2	D3	D4	D5	D6	D7
0x180 + node id	0h	1H	XX							

RTR=0: Transmission of data

DLC=1: one byte is transmitted

D0	VMA	Switching output Q
00hex	inactive	inactive
01hex	inactive	active
10hex	active	inactive
11hex	active	active

Example of contamination (node id =1)

181 0 1 10 Sensor sends without request, will not be confirmed

Example of switching output

181 0 1 00 Switching output inactive and VMA inactive, will not be confirmed

181 0 1 01 Switching output active and VMA inactive, will not be confirmed

Measurement value mode

Identifier	RTR	DLC	Data							
			D0	D1	D2	D3	D4	D5	D6	D7
0x280 + node id	0h	4H	XX	XX	XX	XX				

RTR=0: Transmission of data

DLC=4: four bytes are transmitted

In the data part, the PDO contains the same parameters as the measurement value string.

Heartbeat

Identifier	RTR	DLC	Data							
			D0	D1	D2	D3	D4	D5	D6	D7
0x700 + node id	0h	1H	XX							

RTR=0: Transmission of data

DLC=1: one byte is transmitted

D0:= 0x05 Operational Mode

Using the Heartbeat object, the user can select at what interval (in ms) a cyclical Heart-Beat-PDO (HB-PDO) is to be sent.

- For the value 0, NO HB-PDO is sent,
- For the value 1, the PDO is sent every 1 ms,
- For the value 10, the PDO is sent every 10 ms,
- For the value 0xFFFF, the PDO – accordingly – is sent every 65535 ms.

10.4 Parameter String (Object 30 00)

Four values (see table) are necessary for the detection of an individual material to be sensed. These values are defined by the Teach-in. After Teach-in, these values can be read out and stored in the controller. In case of changeover of material to be sensed, the sensor can then be described with the appropriate parameter set from the formulation management of the controller.

Parameter name	Access	Value/value range	Default value	No. of bits	Sum of bits
Sender colour	r/w	00 = red 01 = green 10 = blue 11 = invalid	green	2	2
Teach value active	r/w	0...1023	1023	10	12
Switching threshold	r/w	0...1023	511	10	22
Teach value inactive	r/w	0...1023	0	10	32

10.4.1 Send colour

According to the contrast, the sensor selects the optimum send colour for each material to be sensed, during the Teach-in process.

10.4.2 Teach-in value active

The value determined during teach-in, for which an Active level is applied to the output, is allocated to the “Teach-in value active”. For the 2-point Teach-in, this value is determined when triggering the first Teach-in operation. For the dynamic Teach-in, this value is determined during the Teach-in operation (jump from background signal to mark signal) (see chapter 7).

10.4.3 Teach-in value inactive

The value determined during Teach-in, for which an Inactive level is applied to the output, is allocated to the “Teach-in value inactive”.

10.4.4 Switching threshold

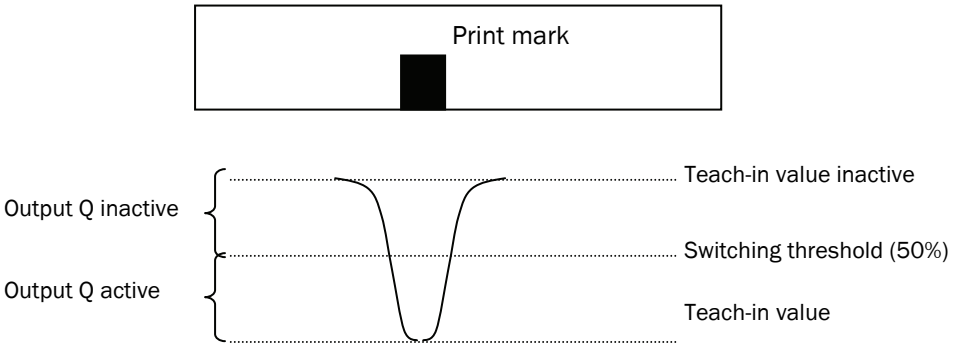
The switching threshold is determined during the Teach-in and is the value from which the sensor changes the state of the switching output. To avoid faulty switching, the switching threshold is provided with a hysteresis band.
The logic below follows whether the device is light- or dark-switching.

- Teach value active > Teach value inactive -> Light-switching
- Teach value active < Teach value inactive -> Dark-switching

Note: If the switching threshold is manually readjusted (manual SSN), this is seen as a Teach-in operation and thus affects the value of the switching threshold.

10.4.5 Example

The following example shows a material to be sensed which, with the 2-point Teach-in, was first taught in on black (mark) and then on white (background)
Allocation:
black -> Teach-in value active
white -> Teach-in value inactive
If the current reflectance is above the switching threshold (in the direction of the inactive value), the switching output is inactive. If the current level (in the direction of the active value) is below the



10.5 Service String (Object 30 01)

Using the “Service String“, the user can query additional information about the current signal and parameter values.

Parameter name	Access	Value/value range	Default value	No. of bits	Sum of bits
Switched state (Q)	ro	0: low (inactive) 1: high (active)	0	1	1
Light-/dark-switching	ro	0: dark-switching 1: light-switching	1	1	2
Last light value (in the repeated pattern)	ro	0..1023	0	10	12
Last dark value (in the repeated pattern)	ro	0..1023	0	10	22
Current switching threshold	ro	0..1023	0	10	32

Table 10-1: CAN object “Service String”

10.5.1 Switched state

Displays the status of the digital output.

10.5.2 Light-/dark-switching

Information about the output logic. If the device is light-switching, the output is active on the lighter grey value. If the device is dark-switching, the output is active on the darker grey value.

10.5.3 Last light value

Displays the lightest detected grey value (greatest signal) in the last repeated pattern.

10.5.4 Last dark value

Displays the darkest detected grey value (smallest signal) in the last repeated pattern.

10.5.5 Current switching threshold (incl. automatic or manual SSN)

Displays the current switching threshold with which the sensor works.
In contrast to the switching threshold, which is learnt during the Teach-in procedure, the current switching threshold is a dynamic parameter. If the automatic switching threshold tracking is activated (see parameter string), the switching threshold is dynamically tracked in relation to changing environmental conditions (contamination, colour run, scanning distance etc.).

10.6 Measurement Value String (Object 30 02)

With the measurement value string, the measurement data of the red, green and blue component can be read out.

Normal operation is paused during processing.
The measurement values thus captured are returned in the measurement value string.
Thereafter, the system works in the Run mode.
The current state of the switching output is held during telegram processing.

Caution: This operational mode is NOT identical with the measurement value mode.

Parameter name	Access	Value/value range	Default value	No. of bits	Sum of bits
Measurement value Red	ro	0..1023		10	10
Measurement value Green	ro	0..1023		10	20
Measurement value Blue	ro	0..1023		10	30
not used	ro	0	0	2	32

Table 10-2: CAN-Objekt „Messwert-Value String“

A cyclical measurement value output is adjustable via the configuration string (component: the sensor’s operational mode).

10.7 Configuration String (Object 30 03)

In the configuration string, an individual adjustment of the sensor for varied applications is possible.

Via the “Config String”, the user can read out the current device configuration of the system and save it on a data carrier. Furthermore, defined configurations can be written into the device. The sensor then recalculates all variables required for normal operation and works with the configuration transmitted by the user.

Parameter name	Access	Value/value range	Default value	No. of bits	Sum of bits
SSN (switching threshold tracking)	r/w	00 = inactive 01 = manual 10 = automatic 11 = invalid	automatic	2	2
VMA (contamination message output via PDO)	r/w	00 = do not send 01 = invalid 10 = send PDO 1x 11 = PDO is sent cyclically, about every 1..2 s.	do not send	2	4
The sensor’s operational mode	r/w	00 = normal operation 01 = PRÜF_1 10 = PRÜF_0 11 = MESS	normal operation	2	6
Repeat frequency for operational mode measurement value mode	r/w	00 = 1000 ms 01 = 500 ms 10 = 100 ms 11 = 10 ms	10 ms	2	8
Teach-in method	r/w	0 = dynamic 1 = 2-point	Dynamic	1	9
Teach-in threshold value definition Position of the switching threshold between light and dark value	r/w	00 = 50% l/d 01 = d + 25 % 10 = l - 25 % 11 = invalid	50% between light and dark	2	11
Output logic	r/w	00 = via Teach-in 01 = dark 10 = light 11 = invalid	via Teach-in	2	13
OffDelay timer	r/w	00 = 0 ms 01 = 10 ms 10 = 20 ms 11 = 40 ms	No OffDelay	2	15
Teach-in function (via control panel) released	r/w	0 = locked 1 = released	released	1	16
Special mode released via control panel	r/w	0 = locked 1 = released	released	1	17

Parameter name	Access	Value/value range	Default value	No. of bits	Sum of bits
Function of the bar display in RUN	r/w	00 = off 01 = curr. reflectance 10 = Quality of Run 11 = invalid	show current reflectance	2	19
If state of Q changed → send PDO (i.e. for every "flank")	r/w	0 = do not send 1 = send PDO	do not send	1	20
not used	ro	0	0	12	32

Where different configurations are used during production, then – for each material to be sensed – not only must the appropriate parameter set of the material to be sensed be saved, but also the configuration string additionally used for this.

10.7.1 Switching threshold tracking (drift correction)

There are two types of switching threshold tracking (SSN). On the one hand, the manual SSN (=01). Here, the threshold can be tracked via the + and – buttons on the control panel of the sensor. A keystroke increases or decreases the threshold in steps.

In the automatic SSN (=10), the sensor independently controls the switching threshold according to the current grey value run, to ensure maximum detection safety. Algorithmically, the sensor uses the light values.

10.7.2 Contamination message output (VMA)

The VMA function can be selected via the operational mode and effects a monitoring of the sensor for contamination events.
If a certain degree of contamination is found here, a PDO message can be output once (=10) or cyclically with the frequency of 1 Hz (=11) via the CAN bus.

10.7.3 The sensor's operational mode

Using the parameter "operational mode", the sensor can be set to four different operational states.

Normal mode (00)

In this mode, the switching output is operated with a response time of 25 µs.
Note: The switching frequency cannot be achieved for CAN communication.

Test mode PRÜF_1 (01) and PRÜF_0 (10)

Using this mode enables optical checking of which sensor is currently being addressed via the CAN bus. If the sensor is set to test mode, it remains in this operational state until it is, through a CAN telegram, explicitly set back to another operational mode – or it might, following a new (scheduled or non-scheduled) power-on, return to the normal mode or the measurement value mode depending on which mode was previously selected. That is, the "PRÜF_0" and "PRÜF_1" modes will NOT be stored in the EEPROM.
In test mode, the sensor behaves as follows:

1. The red send LED and the switching output display Q are flashing at a frequency of 2 Hz
2. The left-hand green LED of the bar display (RUN display) illuminates
3. The switching output Q is active for the PRÜF_1 mode or inactive for PRÜF_0 mode.

Measurement mode (11)

In this mode, measurement data of the red, green and blue components is sent via the interface. This happens via the measurement value PDO. If the sensor is set to measurement mode, it remains in this operational state until it is, through a CAN telegram, explicitly set back to another operational mode. In measurement mode, the sensor behaves as follows:

1. There is no further evaluation, comparison with thresholds etc., the switching output Q is inactive.

2. The RUN display LED is switched on.

3. The measurement values captured are output on the CAN bus, via the measurement value PDO (similar to the measurement value string).
   The measurement value PDO has the COB ID 0x280 + node ID (i.e. 0x281..0x2FF).
   The PDO contains the same data as the measurement value string in the data part (see chapter 10.5).

10.7.4 Repeat frequency for the measurement value mode

If the sensor is in the “measurement mode”, the send frequency can be adjusted in 4 steps with the times of 1000 ms, 500 ms, 100 ms or 10 ms.

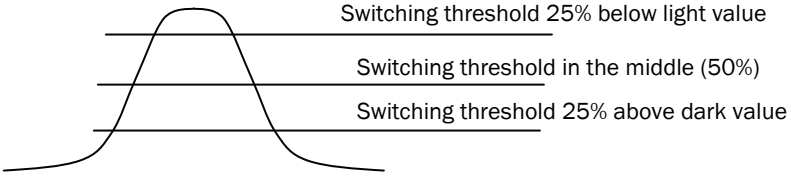
10.7.5 Teach-in method

Two Teach-in methods are available. One the one hand, there is the “dynamic teach-in” (=0) and, on the other hand, the “2-point Teach-in” (=1). Definition of the two Teach-in methods see chapter 6.

When locked, Teach-in is not possible.

10.7.6 Definition of Teach-in threshold value

The switching threshold, as standard, is placed in the middle (=00) between light value and dark value. However, it has proved advantageous to place the switching threshold 25% above the dark value (=01) or 25% below the light value (=10). The state 11 is not permitted.

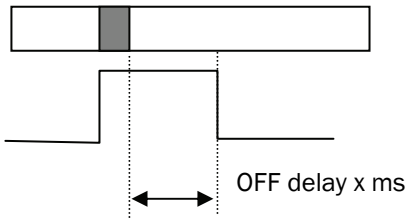


10.7.7 Output logic

In the factory setting, the light-/dark-switching logic is defined according to the Teach-in sequence (=00). Besides, however, the logic can always be set to dark-switching (=01) or light-switching (=10). Then the Teach-in sequence does not affect the logic.

10.7.8 Off delay timer

There are four selection options regarding OFF delay. These are time stage inactive 0 ms (=00), 10 ms (=01), 20 ms (=10) and 40 ms (=11). The switching output lengthens the Active level for the time selected.



10.7.9 Release Teach-in function

When the Teach-in function is locked (=0), Teach-in is possible neither via buttons nor cable nor CAN.

10.7.10 Release special mode via control panel

The adjustment function for changing the CAN baud rate and address via the control panel on the sensor can be locked (=0), to protect the sensor from unintentional actuation and adjustment during operation.

10.7.11 Function of the bar display in RUN

The bar display of the control panel on the sensor can be assigned two different functions. On the one hand hand, the current reflectance (=01) can be displayed. If too much signal (light object to be sensed, shine) is received, the bar display has a great deflection. If little signal (black object to be sensed) is received, the bar display has a small deflection.

Quality of Run (=10) shows, in an absolute representation, the current quality of the sensor. The more LEDs illuminate, the greater the detection safety. The display can be switched off except for the left-hand RUN mode LED (=00).

10.7.12 Switching output change message

In addition to the switching output (response time 25 µs) it is possible to define that, in case of state or flank change, a PDO message is sent via the CAN bus. If, then, the state of 0 changes to 1 or 1 to 0, a PDO message is sent.

10.8 Teach String (Object 30 04)

Using the “Teach String”, the user can trigger a Teach-in within the device, as well as activate the blanking and read out the quality of the last Teach-in value (“Quality of Teach”).

Component	Access	Value/value range	Default value	No. of bits	Sum of bits
Teach request	r/w	0 = inactive 1 = Teach active	inactive	1	1
Blanking	r/w	0 = inactive 1 = AT. active	inactive	1	2
Quality of Teach (%)	ro	0...100	50	7	9
not used	ro	0	0	23	32

Table 10-3: CAN object “Teach String”

10.8.1 Teach request

If the Teach bit = 1 is sent, the sensor triggers a Teach-in. For this, see the various Teach-in methods (refer to chapter 10.7.5).

10.8.2 Blanking

The following applies to blanking:
If a telegram with blanking bit = 1 is sent, the switching output is not operated. This function is of importance if the application is used with reading window.
A telegram with blanking bit = 0 means no blanking (free-running mode).

10.8.3 Quality of Teach (%)

The data contents transmit the signal quality of the Teach-in learnt last. The quality figure has a value range between 1 and 100%, with 0% signalling an invalid Teach-in.

10.9 Bank Store / Select String (Object 30 05)

Up to five different parameter sets can be stored in the sensor. After the Teach-in, using Select/Store bit = 1 and the selection of the appropriate memory location (bank 1 to 5), a parameter set can be permanently stored in the EEPROM. With Select/Store Bit = 0 and selection of the memory location, a parameter set can be loaded.

Parameter name	Access	Value/value range	Default value	No. of bits	Sum of bits
Bank access type Select / Store (for internal memory banks!)	r/w	0 = Select 1 = Store	Select	1	1
Number of the (internal) memory bank to be accessed	r/w	001 = Bank 1 010 = Bank 2 011 = Bank 3 100 = Bank 4 101 = Bank 5 Rest = invalid	Bank 1	3	4
not used	ro	0	0	28	32

Table 10-4: CAN object “Bank Store/Select String”

10.10 Communication String (Object 30 06)

Using the “Communication String”, the user can change the current settings of the CAN interface, i.e. the CAN address and the baud rate.
This string also offers the possibility of resetting the user parameters, i.e. all parameters adjustable via the “Config String” and via the “Teach String”, to factory default values.

Parameter name	Access	Value/value range	Default value	No. of bits	Sum of bits
CAN address (node ID)	r/w	1..127	0x40	7	7
CAN baud rate (values acc. to CANopen Spec)	r/w	0 = 1 MBaud 1 = 800 kBaud 2 = 500 kBaud 3 = 250 kBaud 4 = 125 kBaud 5 = 100 kBaud 6 = 50 kBaud 7 = 20 kBaud Rest: invalid	500 kBaud	4	11
Reset of the user parameters to factory default values	r/w	0 = trigger reset 1 = no reset	no reset	1	12
not used	ro	0	0	20	32

Table 10-5: CAN object “Communication String“

10.10.1 Setting CAN address and baud rate via Communication String

The change of the CAN address and baud rate runs as follows:
The controller sends a Communication String with the required address and baud rate to the KT8 CAN. It evaluates the telegram and confirms the correct receipt of the telegram still with its old CAN address and baud rate. Then the controller and the KT8 CAN have time to re-initialise. After completing the initialisation, both communicate with the new CAN address and baud rate. The KT8 CAN, however, outputs NO bootup message or similar by itself, but waits until it again receives a CAN message from the controller.

10.10.2 Reset via Communication String

With the reset bit, all system parameters in the device, which are adjustable via the Config String and the Teach String, can be reset to default values (factory setting). This setting, however, does NOT change the CAN address and baud rate!

10.11 Communication Profile CAN Objects (from Object 0x1000)

The objects for the description of the CAN interface can be read out from index 0x1000, see Table 10-6. Writing these objects via the CAN interface is NOT possible.

Name	Index (0x...)	Subindex (0x...)	Data type	Access	Value	Description
Hardware version	1009	00	U32	ro		Hardware version
Software version	100A	00	U32	ro		Software version
Identity object	1018	ARR		ro		Identity of the sensor see following subindices
Number of subindices	1018	00	U8	ro	4	there are 4 subindices to this index
Vendor ID	1018	01	U32	ro		SICK vendor number
Product code	1018	02	U32	ro		Product code “KT8 CAN”
Revision number	1018	03	U32	ro		Revision number
Serial number	1018	04	U32	ro		Serial number not allocated
Heart-Beat	1017	00	U16	rw		Activate Heart-Beat PDO. This value indicates at what time interval (in ms) a Heart-Beat PDO is to be sent.

Table 10-6: Object directory “Communication Profile“

According to specification of CANopen, a maximum of 4 bytes of useful data can be output. In the CAN telegram, these are accommodated in bytes 4..7. The useful data is always output first with the LowByte.
I.e. this means:
Telegram byte 4 contains data byte D0,
Telegram byte 5 contains data byte D1,
Telegram byte 6 contains data byte D2 and
Telegram byte 7 contains data byte D3.

HW version number
Numerical example: V01.23 is output via CAN as (D0..D3): 0x23 01 00 00

SW version number
Numerical example: V01.23 is output via CAN as (D0..D3): 0x23 01 00 00

Vendor ID
It is: 0x01000056 and is output via CAN in the form (D0..D3): 0x56 00 00 01

The product code is composed of the ASCII numbers of the string “KT8” together and is output via CAN as (D0..D3): 0x38 54 4B 00

Communication profile															
Activate Heartbeat PDO															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
D1								D0							
0	0	0	0	0	0	1	1	1	1	1	0	1	0	0	0
1000 (ms)															
Decimal value in ms (0 .. 65536 ms), 0 = switched off															

11 Order Information

11.1 Sensor

Bestell-Information	
Typ	Bestell-Nr.
KT8W-P111C	1 027 919
KT8W-N111C	1 028 223

11.2 Cable

Rundsteckverbinder M12, 8-polig geschirmt				
Typ		Bestell-Nr.		
DOL-1208-W02MAS01		6 029 224		
Beschreibung		**Schirm**	**Leitungslänge [m]**	**Leitung**
Dose	gewinkelt	360° auf Rändelmutter	2	PUR

Round plug connector M12, 8 pin, screened

Type	**Part no.**
DOL-1208-W02MAS01	6 029 224

Description		**Screen**	**Cable length [m]**	**Cable**
Box	angled	360° on knurled nut	2	PUR

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