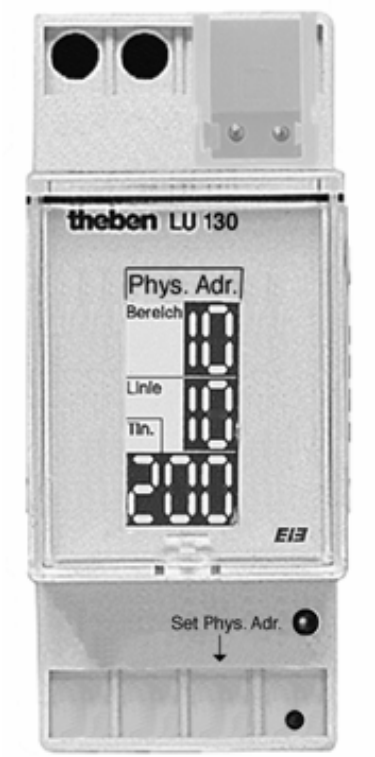
3-Channel Brightness Sensor

LU 130 - EIB



LU 130 – EIB
Order No. 130 9 200

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1 Operational Characteristics

The EIB brightness sensor LU 130 - EIB controls switching and dimming actuators depending on the ambient brightness. The ambient brightness is collected by one attached light sensor (max. conduction length 100 m).
Depending upon application the device possesses several transmission channels the switching levels of which can be parameterized with the ETS. Additionally any combination of transmission channels can temporarily be deactivated by a blocking object (1 byte).

Possibilities of Usage

- The LU 130 - EIB is very suitable for application cases where a comfortable brightness-dependent lighting control is to be implemented.

- Up to four different brightness areas can be surveyed with the device.

2 Technical Data

voltage supply: is effected via bus voltage

links:
- 1 bus link (via bus supply terminal)
- 1 light sensor (via 2 terminal screws, max. 100 m conduction length)

adjustment range: 1 ... 20 000 Lux

protection type

brightness sensor:	IP 21 according to DIN EN 60 529
light sensor:	IP 54 according to DIN EN 60 529

allowed ambient temperature:

brightness sensor:	-5°C ... +45°C
light sensor:	-40°C ... +70°C

housing measurements:

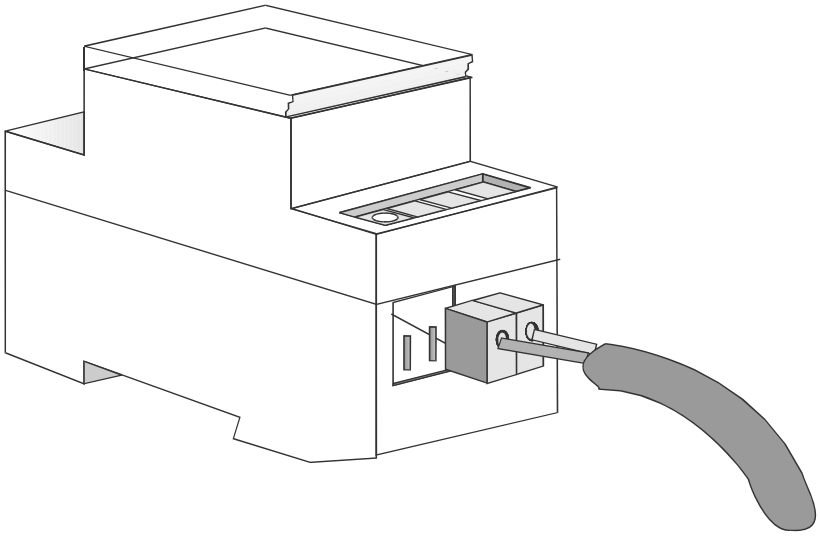
brightness sensor:	86 x 35,8 x 60 mm (H/B/T), REG-width 2 TE
light sensor with assembly angle:	86 x 27 x 38 mm max. 118 x 27 x 62 mm

weight:

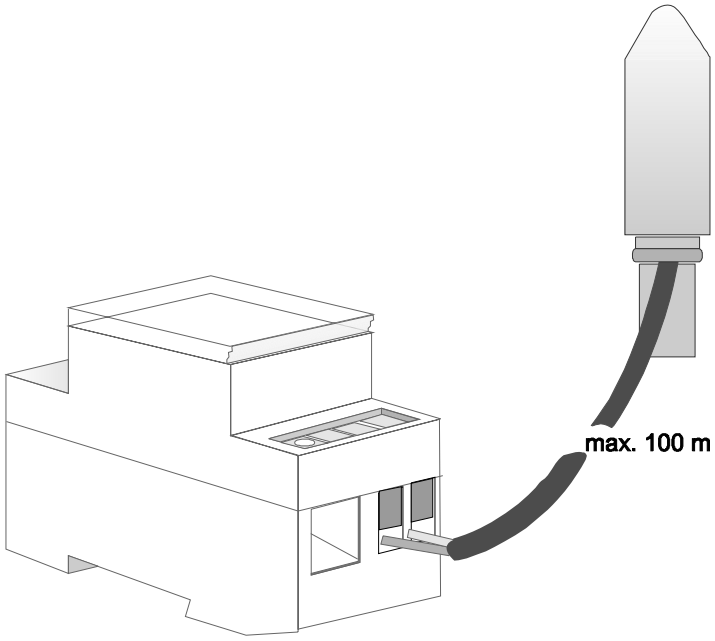
brightness sensor:	0,09 kg
light sensor:	0,05 kg

2.1 Dimensional Drawing / Connection Diagram

Connecting an installation bus EIB



Connecting a light sensor



3 Application Programs

The following application programs are available.

Application	Function
brightness sensor with 3 threshold	With this application, LU 130 takes over the function of a 3-channel limit count switch with a range of adjustment from 1 to 10.000 lux. Each limit count can be set separately. The transmission behaviour of each channel can be parameterized when it is below or above a barrier.
brightness sensor with 4 scenes	With this application, LU 130 takes over the function of a brightness-controlled scene component with a range of adjustment from 1 to 10.000 lux. The scene consists of 3 switching and 1 value object. A scene is assigned to different brightness ranges. If the measured brightness value is in such an area, then corresponding switching and value messages are sent on the bus.

3.1 Selection of the product data base

Manufacturer:	THEBEN AG
Product familie:	phys. sensors
Product type:	brightness
Product name:	Luna 130 EIB

Download the application from: http://www.theben.de

3.2 Auxiliary chart to parameterize the brightness values

Justified by the tolerance of the light sensor, the switching barrier of the brightness value is specified as resistance value.

brightness	**resistance from**	...	**to**	**mean value**	**resolution**
1 Lux	2.000 MOhm	...	3.000 MOhm	2.400 MOhm	resolution 20 KOhm
1,5 Lux	1.400 MOhm	...	2.500 MOhm	2.000 MOhm	
2 Lux	1.000 MOhm	...	2.000 MOhm	1.500 MOhm	
3 Lux	700 KOhm	...	1.500 MOhm	1.000 MOhm	
5 Lux	450 KOhm	...	1.000 MOhm	700 MOhm	
10 Lux	250 KOhm	...	550 KOhm	350 KOhm	
20 Lux	120 KOhm	...	300 KOhm	200 KOhm	
30 Lux	95 KOhm	...	200 KOhm	130 KOhm	
50 Lux	60 KOhm	...	120 KOhm	90 KOhm	
100 Lux	35 KOhm	...	75 KOhm	50 KOhm	resolution 400 Ohm
200 Lux	20 KOhm	...	40 KOhm	28 KOhm	
300 Lux	12 KOhm	...	30 KOhm	20 KOhm	
500 Lux	9 KOhm	...	20 KOhm	13 KOhm	
1000 Lux	5,5 KOhm	...	11 KOhm	8,5 KOhm	
2000 Lux	3,5 KOhm	...	7,5 KOhm	5 KOhm	
5000 Lux	2 KOhm	...	4 KOhm	2,8 KOhm	
10000 Lux	1,2 KOhm	...	3 KOhm	2 KOhm	
20000 Lux	0,8 KOhm	...	2,4 KOhm	1,2 KOhm	

3.3 Application Program „Brightness Sensor with 3 Threshold “

Operational Characteristics

In this application, the LU 130 - EIB has three switching channels which can be parameterized independently. Adjustable for each channel are:
- switching threshold (adjustment range from 1 to 10.000 lux)
- switching attitude when "brighter than threshold"
- switching attitude when "darker than threshold"

For the three channels together the following can be parameterized:
- time for cyclic transmission behaviour
- delay time
- hysteresis

Via a byte object any combination of channels can be deactivated or activated temporarily.

Communication Objects

no.	object name	function	type	behaviour
0	channel 1	switching at barrier channel 1	1 Bit	transmit
1	channel 2	switching at barrier channel 2	1 Bit	transmit
2	channel 3	switching at barrier channel 3	1 Bit	transmit
3	blocking	reception message blocking	1 Byte	receive

Max. amount of communication objects: 4
Max. amount of group addresses 5
Max. amount of associations: 5

- **Objects „0,1,2-channel 1,2,3,“**

The parameterized value is sent (see Chart 3-1: Parameter on the pages „channel 1, channel 2 and channel 3“), when it is darker or brighter than the set barrier.

- **Object „3-blocking“**

The transmitting behaviour of each channel can be blocked or released via this byte object.

value of the blocking object (type 1Byte)		transmitting behaviour of the channels A = active G = blocked (i.e. any transmitting on the corresponding channel object is suppressed;)		
decimal	binary	channel 1 (object 0)	channel 2 (object 1)	channel 3 (object 2)
0	0000 0000	A	A	A
1	0000 0001	G	A	A
2	0000 0010	A	G	A
3	0000 0011	G	G	A
4	0000 0100	A	A	G
5	0000 0101	G	A	G
6	0000 0110	A	G	G
7	0000 0111	G	G	G
255	1111 1111 Bit 3 to 7 have no function	G	G	G

Attention!

When resetting a blocking bit, the corresponding channel object immediately transmits its current value. With bus voltage failure the entire check object is set to the value 0.

Note: Transfer of a bit-blocking message into a byte-blocking message

The transfer of a bit-message into a byte-message can be implemented for example with the Busch-Jaeger logic component of the type 6198.

Parameter

Chart 3-1: Parameter on the pages „channel 1, channel 2 and channel 3“

Description	Value	Meaning
switching barrier:	2,0 kOhm appr.10 000 lux to 2,40 MOhm appr. 1 lux	Adjustment of the switching barrier where a message is sent over the appropriate channel (obj. 0.1 or 2). A resistance value must be input due to the tolerance of the light sensor. The appropriate value can be read from the auxiliary table (see 3.2.
darker than barrier:	not sending a message sending OFF - message sending ON - message OFF-message, sending cyclically **ON-message, sending cyclically**	Adjustment which message is to be sent via channel object, when it is darker than the set barrier.
brighter than barrier:	not sending a message sending OFF - message sending ON - message **OFF-message, sending cyclically** ON-message, sending cyclically	Adjustment which message is to be sent via channel object, when it is brighter than the set barrier.

Tabelle 3-2: Parameter on the „measuring behaviour“

Description	Values	Meaning
delay time	appr. 10 sec appr. 20 sec **appr. 30 sec** appr. 45 sec appr. 60 sec appr. 90 sec appr. 2 min appr. 3 min	In order to avoid wrong switchings caused by light reflexes or by brief shading, an on and off switching delay can be parameterized. This parameter adjustment applies to all 3 switching thresholds . A message is only then transmitted when the measured brightness value exeeds or falls below the adjusted barrier value (hysteresis included) for the parameterized time.
hysteresis	appr. 6% appr. 12,5% appr. 25 %	Adjust ment of an hysteresis can prevent multiple siwtching, if the measured brightness valve lies in the range of the adjusted barrier. Note that this concerns only a positive hysteresis valve.

Chart 3-3: Parameter on the page „time for sending cyclically“

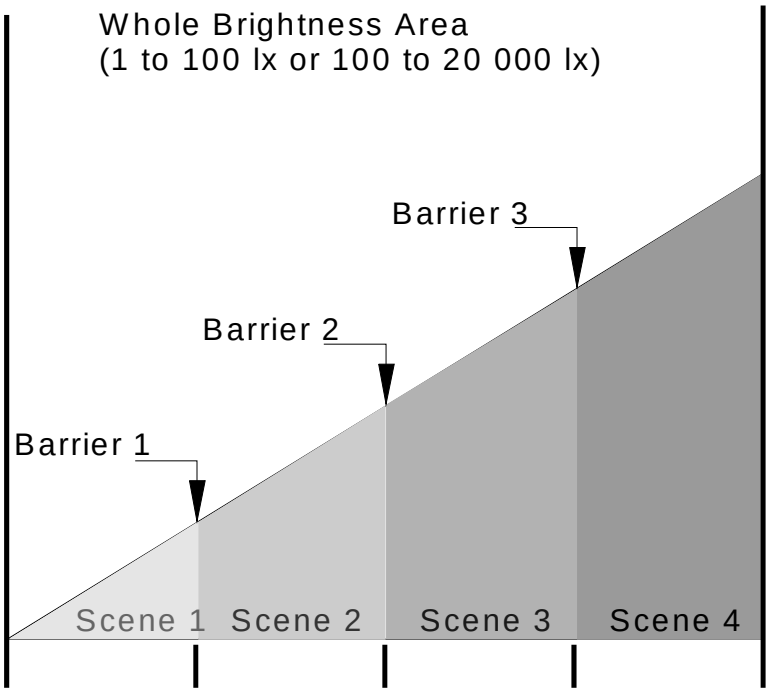
Description	Values	Meaning
cycle time	appr. 3 min. **appr. 5 min.** appr. 10 min. appr. 15 min. appr. 20 min. appr. 30 min. appr. 45 min. appr. 45 min.	Adjustment of the cycle time, with which the message is transmitted repeatedly on the bus. This parameter applies to all transmission objects, where the sending behaviour "transmitting cyclically" is adjusted.

3.4 Application Programm „Brightness Sensor with 4 Scenes“

Operational Characteristics

In this application the LU 130 - EIB takes over the function of a brightness-controlled scene building block with a range of adjustment from 1 to 100 lux or 100 to 20.000 lux.

4 brightness areas can be defined by 3 different switching levels. Thereby a light scene, consisting of three switching and a value object, is assigned to each brightness area. If the measured brightness value for an adjustable delay time is in an area, the parameterized switching and value messages are transmitted on the bus. Additionally each scene object can be force-controlled over a so-called blocking object.



Object	Brighter than barr. 1	Between S1 and S2	Between S2 and S3	Darker than barrier 3	Blocking
Switch obj. 1	OFF	ON	ON	ON	OFF
Switch obj. 2	OFF	OFF	ON	ON	OFF
Switch obj. 3	OFF	OFF	OFF	ON	OFF
Value obj.	0	80	160	255	0

Illustration 3-1: Function example of the application „brightness sensor with 4 scenes“

Communication objects

No.	Object name	Function	Type	Behaviour
0	value object	sending message value	1 Bit	send
1	switching object 1	sending message switch	1 Bit	send
2	switching object 2	sending message switch	1 Bit	send
3	switching object 3	sending message switch	1 Bit	send
4	blocking	receiving message block	1 Byte	receive

Max. number of communication objects: 5
Max. number of group addresses : 5
Max. number of classifications: 5

- **Object „0-value object“**

A value message (8 bit) is transmitted, depending on which brightness area the up-to-date measured brightness value is. According to the adjusted transmission behaviour, the message is transmitted cyclically or only with change into another brightness area.

- **Objects „1,2,3 – switching objects 1,2,3“**

Switching messages (1 bit) are transmitted, depending on which brightness area the up-to-date measured brightness value is. According to the adjusted transmission behaviour, the messages are transmitted cyclically or only with change into another brightness area

- **Object „4 - blocking“**

If in this 8-bit receipt object one bit is set, then the appropriate switching or value object adopts a parameterized status (see parameter page "behaviour when blocking").

After the receipt of a blocking bit the following transmission behaviour can be parameterized for the appropriate switching or value object:

not sending a message	After reception of the appropriate blocking bit, no further message is sent to the corresponding switch or value object.
sending OFF-message	After reception of the appropriate blocking bit, an OFF message is sent once to the corresponding switch or value object.
sending ON-message	After reception of the appropriate blocking bit, an ON message is sent once to the corresponding switch or value object.

ATTENTION !

If any blocking bit is set, then all scene objects (Obj. 0-3) transmit their current value.

That means that the scene objects, which are not in the blocking state, transmit the value on the basis of the current brightness area and the assigned scene. The scene objects, which are in the blocking state, behave as if this was adjusted on the parameter page "behaviour when blocking".

There is the following connection between the value of the blocking object and the scene objects 0 to 3:

value of the blocking object (object 4 / type 1Byte)		transmitting behaviour of the channels A = aktive G = blocked (i.e. the transmitting object adopts the status which is adjusted on the parameter page "behaviour when blocking" after reception of the corresponding blocking bit)			
decimal	binary	object 3	object 2	object 1	object 0
0	0000 0000	A	A	A	A
1	0000 0001	A	A	A	G
2	0000 0010	A	A	G	A
3	0000 0011	A	A	G	G
4	0000 0100	A	G	A	A
5	0000 0101	A	G	A	G
6	0000 0110	A	G	G	A
7	0000 0111	A	G	G	G
8	0000 1000	G	A	A	A
9	0000 1001	G	A	A	G
10	0000 1010	G	A	G	A
11	0000 1011	G	A	G	G
12	0000 1100	G	G	A	A
13	0000 1101	G	G	A	G
14	0000 1110	G	G	G	A
15	0000 1111	G	G	G	G
16 to 255	Bit 4 to 7 have no function	A	A	A	A

Chart 3-4 : Function of the blocking object in the application "brightness sensor with 4 scenes"

Behaviour when bus voltage stops

As it is not predictable, how long the failure will last, the scene objects 0 to 3 lose their current value. Therefore only the value of the blocking object is secured.

Behaviour when bus voltage returns

After voltage return all scene objects, which are not in the blocking state, are initialized again and transmit messages according to the measured brightness value. The messages are, however, only transmitted to the adjusted delay time (see parameter "delay time when barrier change") on the bus. Those scene objects, which are in the blocking state, adopt the status, which was adjusted on the parameter page "behaviour when blocking" after 17 seconds. If messages are transmitted in the blocking state, then the adjustments on the page "transmission behaviour" apply.

Parameter

Tabelle 3-5: Parameter on the page „switching threshold “

Description	Values	Meaning
Basis for the following threshold :	**10 kOhm, measuring range 1 – 100 Lux** 200 Ohm, measuring range 100 – 20000 Lux	The brightness value for the individual switching levels is inserted by the tolerance of the light sensor as resistance value. With this parameter the common base value is adjusted with the appropriate measuring range, for all threshold . The resistance value for a barrier is calculeted from: **Resistance value = base x factor** The appropriate resistance value to the pertinent lux value, can be read in the auxiliary table (see 3.2).
Adjustment help basis 10 kOhm (only info)	1.5 Lux: factor appr. 200 : 100 Lux: factor appr. 5	This parameter only serves as adjusting help for rough orientation when parameterizing the factors for the threshold 1 to 3. That means that the parameter does not have influence on the application program.

Adjustment help basis 200 Ohm (only info)	100 Lux: factor appr. 250 : 20 000 Lux: factor appr. 5	same as mentioned above
factor for barrier 1 (bright)	5 : 250	Input of the factor for the resistance value of barrier 1: The factor for barrier 1 must be smaller than the factor for barrier 2.
factor for barrier 2 (middle)	5 : 250 not used	Input of the factor for the resistance value of barrier 2: The factor for barrier 2 must be smaller than the factor for barrier 3.
factor for barrier 3 (dark)	5 : 250 not used	Input of the factor for the resistance value of barrier 3.
Hysteresis of the switching threshold		
Hysteresis of the switching threshold	appr. 6% **appr. 12,5%** appr. 25 %	Multiple switchings can be prevented by adjustment of a hysteresis, if the measured brightness value falls in the range of the adjusted barrier .Note that this concerns only a positive hysteresis value.
time of delay when changing the barrier	appr. 20 sec **appr. 30 sec** appr. 45 sec appr. 60 sec appr. 90 sec appr. 2 min appr. 3 min appr. 4 min	In order to avoid wrong switchings by light reflexes or by brief shading, an ON and OFF switching delay can be parameterized. This parameter adjustment applies to all 3 switching threshold . Messages are only then transmitted when the measured brightness value falls above or below the adjusted barrier value (incl. hysteresis) for the parameterized time.

Important notes when parameterizing switching threshold

- The input of the factors for threshold 1 to 3 must take place in ascending order. That means that the **factor for barrier 1 < factor for barrier 2 < factor for barrier 3.**

- As regards the factors for barrier 2 and 3 the adjustment "not used" can be selected. The following should be noted:

  Case "not using a barrier"
  - to adjust factor for barrier 3 to "not used"
  - consequence: scene 4 is not executed.

  Case "not using two threshold "
  - to adjust factor for barrier 2 and 3 to "not used"
  - consequence: scene 3 and 4 are not executed.

Chart 3-6: Parameter on the pages „Brighter than barrier 1, between barrier 1 and 2, between barrier 2 and 3, darker than 3“

Description	Values	Meaning
To send on first switching object?	yes, following message do not send any message	Adjustment, if on the switching object 1 a message is to be transmitted, when the barrier value is exceeded.
Message of the first switching object:	to send ON-message to send OFF-message	Adjustment which message is to be sent.
To send on the second switching object?	yes, following message do not send any message	Like first switching object
Message of the second switching object:	to send ON-message to send OFF-message	Like first switching object
To send on the third switching object?	yes, following message do not send any message	Like first switching object
Message of the third switching object:	to send ON-message to send OFF-message	Like first switching object
To send on the value object?	yes, following message do not send any message	Like first switching object
Message of the value object	0 ... 255	Adjustment which value shall be sent (0 ... 255)

Chart 3-7: Parameter on page „behaviour when blocking“

Description	Values	Meaning
To send on first switching object?	yes, following message do not send any message	Adjustment if on the switching object 1 another message is to be transmitted immediately after setting the appropriate blocking bit (see Chart 3-4).
Message of the first switching object:	to send ON-message to send OFF-message	Adjustment which message shall be sent once more.
To send on the second switching object?	yes, following message do not send any message	Like first switching object
Message of the second switching object:	to send ON-message to send OFF-message	Like first switching object
To send on the third switching object?	yes, following message do not send any message	Like first switching object
Message of the third switching object:	to send ON-message to send OFF-message	Like first switching object
To send on the value object?	yes, following message do not send any message	Like first switching object
Message of the value object	0 ... 255	Adjustment which value shall be sent (0 ... 255)

Chart 3-8: Parameter on the page „transmitting behaviour“

Description	Values	Meaning
transmitting behaviour:	**cyclic** only when changing the scenes	The adjusted transmitting behaviour is applied to all objects together (0 to 3).
cycle time::	appr. 2,5 min : appr. 60 min	Adjustment of the cycle time with which the message is send repeatedly on the bus.

4 Examples of Usage

4.1 External light-dependent switching of a lighting system at 3 levels

In a functional building the lighting system is to be switched at 3 levels depending on external brightness.

Requirements

⇒ With exterior lighting strength of more than 50 lux all exterior lights have to be switched off. If the external brightness falls below the value 50 lux, external lighting is switched on again.

⇒ With interior lighting strength of more than 200 lux the lighting in corridors, staircases and entrance area have to be switched off. If this value falls below 200 lux, automatic switch on takes place.

⇒ With interior lighting strength of more than 500 lux all remaining lights in the rooms with daylight have to be switched off.

Realization:

To solve the type of problem a ***Luna 130-EIB*** with the ***Application "brightness sensor with 3 threshold "*** is used. The light sensor is installed on an outdoor wall facing "East".[1]

Via the so-called ***" daylight quotient "*** you get to know, what external brightness is necessary in order to achieve the necessary density of light at one point of reference in the internal area. The daylight quotient is indicated in per cent and sets the interior lighting strength E_{inside} and the exterior lighting strength $E_{outside}$ in relationship to one another.

The daylight quotient T is calculated as follows.

$$\mathbf{T = E_{inside} / E_{outside}}$$

After specification of the desired density of light at the points of reference in the internal area and a measured daylight quotient, the appropriate barrier value $E_{barrier}$ for the parameter adjustment can be calculated.

lighting installation	daylight quotient	$E_{desired}$	$E_{barrier}$
external lighting	100 %	50 lx	50 lx
interior lighting	10 %	200 lx	2000 lx
interior lighting	10 %	500 lx	5000 lx

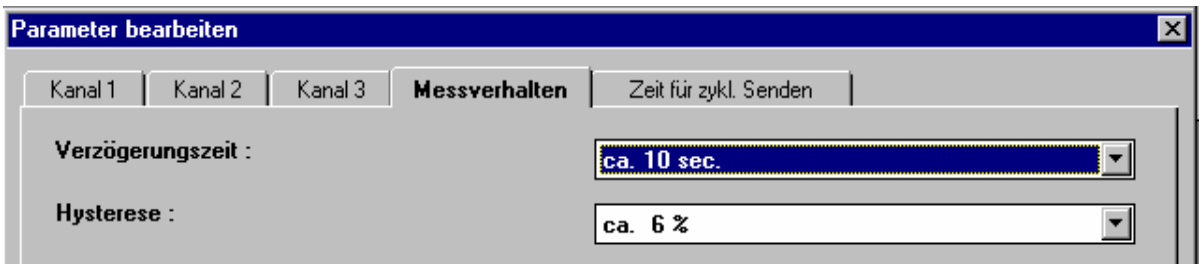
[1] If an external light-dependent lighting control is to take place depending on the direction, a Luna 130-EIB must be used for each direction.

Project engineering steps

⇒ Insert a brightness sensor ***Luna 130 - EIB*** into the trade "brightness sensor with 3 threshold ".

Manufacturer:	THEBEN-WERK ZEITAUTOMATIK
Product family:	phys. sensors
Product type:	brightness
Program name:	brightness sensor with 3 threshold

⇒ Adjust the following parameters in the Luna 130 application "brightness sensor with 3 threshold ":



⇒ Install the appropriate bus communication for the bus users involved (assign group addresses to the communication objects of the EIB devices).

Extension of the task by the function "time-controlled release of the brightness control"

Requirement

The channels of the brightness sensor for external dependent switching of the lighting system are to be activated or deactivated time-dependently.

The following time control process is to be implemented:

Time	Function of the switching channels of the brightness sensor
22:00	All brightness dependent channels are blocked.
05:00	Release brightness dependent switching of the external lighting. (K1 activated, K2 & K3 blocked)
06:00	Releases of the brightness dependent switching of the lighting in corridors, staircases and entrance area. (K1 & K2 activated, K3 blocked)
07:00	Release of brightness dependent switching of all channels. (K1, K2, K3 activated)
17:00	Blocking of the brightness dependent switching in working rooms with day light. (K1 & K2 activated, K3 blocked)
20:00	Blocking of the brightness dependent switching of the lighting in corridors, staircases and entrance area. K1 activated, K2 & K3 blocked
vacation	All brightness dependent channels are blocked.

Realization

For the implementation of the task, a 3 or 4 channel week time switch is used, which writes a byte message with different values depending on the switching status of its channels into the blocking object of the brightness sensor. In this way each brightness-dependent switching channel is released or blocked.

The 3- or 4-channel time switch must have following functions:

Time	**Condition of the time channels**			**Value which must be sent**	**Bit-combi. for the blocking object**	**Function method of the switching channels of the brightness sensor**
	C3	**C2**	**C1**			
22:00	0	0	0	7	111	All brightness dependent channels are blokked.
05:00	0	0	1	6	110	K1 activated, K2 & K3 blocked
06:00	0	1	1	4	100	K1 & K2 activated, K3 blocked
07:00	1	1	1	0	000	All brightness dependent channels are activated.
17:00	0	1	1	4	100	K1 & K2 activated, K3 blocked
20:00	0	0	1	6	110	K1 activated, K2 & K3 blocked
vacation	0	0	0	7	111	All brightness dependent channels are blokked.