
DATASENSING
CR
REFLEX
CR2OI-1V
IO-Link

SUMMARY

1.0 ABOUT THIS DOCUMENT

Please read this document carefully before proceeding with the assembly, commissioning, use and maintenance of the **CR2** light curtains; contains detailed instructions that must be followed carefully.
This manual is specific to the Standard models, the button menu functions described below are similar to those of the IO-Link models, for example the reset function is more complex, the output configurations are not widely programmable and require use of different models.

1.1 Document function

This manual provides the user with instructions necessary for proper installation, electrical connection, commissioning, use and maintenance of the **CR2** retroreflection area sensor.

1.2 Description of the symbols used.

Warning!
A warning indicates actual or potential dangers.
It has the task of indicating procedures and behaviors that can avoid accidents.
Read and follow these warnings carefully.

Indication
I Indications that can contribute to obtaining better performance

Symbol
The symbol identifies optical devices that have a retro-reflection function.

2.0 SAFETY AND PROPER USE

Warning!
CR2 is NOT a security product. Consequently, it must not be used to ensure the safety of personnel.

Warning!
CR2 is a **Class III** sensor**,** it works in **DC** and with a low voltage (the maximum value is **30V$_{DC}$**); the proper operation is guarantee only in the range indicated in the technical data.
With voltages below **12V$_{DC}$** all outputs remain in the OFF state, with voltages more than 30V$_{DC}$ permanently, the device may be damaged.
When the device is switched ON, outputs are inactive for a certain amount of time known as **power on delay** (see the following documentation).

Warning!
Some optics emit visible light at **non-dangerous** levels, despite this, if they were observed for a long time, they could cause momentary glare; the device is classified **Group 1** in accordance with the **IEC 62471-7:2023** standard.

Indications
Make sure the sensor is used in proper environmental conditions.
Make sure that the ambient temperature does not exceed the limits indicated in the technical data section.
For best performance, the final automatic calibration should always be performed with excellent alignment.
Multiple calibrations and multiple alignments may be required to progressively refine the alignment.
Check for any reflective surfaces near the optical path, they could affect sensor performance.
Check the effect of any transparent panels (or similar) in the optical path, as they could affect the angular aperture of the sensor or reduce stability.
Avoid scratches and/or stains on the optical front of the sensor and reflector.
During operation, do not expose the sensor to strong natural or artificial light, including strobe lights.
During operation, do not expose the sensor to direct optical beams projected by other devices.
Keep in mind that fumes, vapors, liquids, and dusts can alter the transparency of the air or dirty the optical front of the sensor.
Dispose of unusable or non-serviceable devices always in accordance with national regulations regarding waste disposal.

3.0 PRODUCT DESCRIPTION

3.1 Brief description.

The **CR2** area sensors are photoelectric devices made in accordance with the **IEC 60497-5-1, 2** standard and must **not** be considered as safety devices. Consequently, they must not be used to ensure the safety of operators or to protect users from dangerous machinery. Instead, they should be used to detect objects that reduce or obscure the intensity of the light beams returning from the reflector.

The sensor body is made of aluminum painted blue **RAL5002**, with a section of **20x36mm** (20mm refers to the optical front).

The shape of the rear part of the sensor allows the use of a threaded **T insert** for the application of **L-shaped brackets**; the transparent upper part (with Teach-in button) is made of **PC**, while the cable gland is made of black **PBT**. The optical front is in **PMMA,** and the degree of protection is **IP67**.

In all models of the **CR2** series, the sensors have two **LED** indicators: **Red** and **Green** which, in combination, indicate the status of the sensor (alignment, optics status and fault indication); they are positioned in the upper part of the sensor and emit intense and diffused light to ensure optimal visibility in all conditions.

All **CR** models have optics made up of an array of **9x9mm lenses** with a **10mm pitch**. **CR2** has **31 lenses**, and the optical window height is **309mm**; the overall height of the sensor is **347mm**. Emitters and receivers are alternated in the following sequence: **E1, R1, E2, R2, E3, ……E14, R14, E15, R15, E16** with reference to the side of the cable. This makes it possible to create a continuous succession of **30 pairs** of emitted and reflected rays, for example R1 receives the ray emitted by E1 and E2. The emitted **light is polarized**, and its wavelength is **617nm**. The positioning range of the reflector is: **0.2-4.5m** with a pair of models **RL136** and can reduce for different or smaller reflectors, see **Tbl.:2; Ch.:4.** The minimum detectable object (**MDO**) is not constant over the entire controlled area, see **Ch.:4.**

All **CR2** models have a **Teach-in** button, in the upper part of the sensor, dedicated to activating the menu functions: two levels of **Teach-in**, **Standard** and **Precision** detection; **Progressive Blanking**; reactivation of the **Factory Configuration**. The functions are accessed progressively depending on the activation time of the button, see **Tbl.:4, 5, 6** and/or **Fig.:1, 2, 3**. On power up, all data prior to power down is recovered.

In difficult alignment conditions it is advisable to carry out a **Teach-in** with the optics engaged (Darkness) to activate the **Alignment function**, once the sensor is aligned in the best possible way and blocked it is necessary to carry out a Teach-in again, if it is **not** carried out a Teach-in, after **120s**, the parameters of the previous Teach-in, which may not be suitable, are automatically assumed.

The automatic calibration (Teach-in) equalizes the sensitivity of all the optics to have repeatable and constant performances in the whole area of the optical window. Repeatability is also based on a sophisticated thermal drift control system.

The **Blanking** function allows you to gradually eliminate pairs of beams; the active pairs (E+R) can vary from a maximum of **30** to a minimum of **1**, allowing you to define the height of the active optical window and use the sensor to control areas even lower than **309mm** in height.

All **CR2** models have an **M12** pigtail cable (240mm long).

CR2 models can have three interface circuits: two multifunctional digital outputs and one input, which can be combined in different ways depending on the model, see **Tbl.:2; Ch.:3 and Tbl.:7…10; Ch.:3**

3.2 Teach-in button functions

RIF.	FUNCTION	COMMENT
1	**Teach-in Standard**	Standard sensitivity, minimum detectable diameter (MDO) **5-55mm.**
2	**Teach-in Precision**	Fine Sensitivity (MDO) **3-20mm**, for use in clean, low vibration environments.
#	**Alignment**	Function that is activated automatically if, at the end of a Teach-in, the alignment is not sufficient.
3	**Blanking**	Optical window adjustment, from a height of **309** (all optics active) to **19mm** (only one) in **10mm** steps.
#	**Factory configuration**	Sensitivity suitable for maximum range, but without equalization, automatically assumed upon exiting Blanking.

Tbl.:1; Ch.:3.

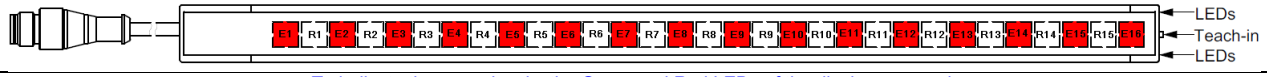
3.3 Models available

MODEL	OPTICAL PITCH	OPTICA HEIGHT	LENGTH BODY	OPTICS	BEAM PAIRS	REFLECTOR PLACEMENT	RESPONSE TIME LIGHT / DARK DARK / LIGHT	SWITCHING FREQUENCY	CONNECTOR	POLES	INTERFACE	
CODICE ARTICOLO	P	h	H			Sn	Tr	f max			INPUTS	OUTPUTS
	mm	mm	mm	N°	N°	m	ms	Hz	Type	No		
CR2/0B-1V	10	309	347	31	30	0,2... 4,5	2,81 / 4,66	190	M12	5	NC/NO	PNP; NPN
CR2/0T-1V										4	NC/NO	Push-Pull
CR2/BP-1V										4	NONE	PNP-NO; PNP-NC
CR2/BN-1V										4	NONE	NPN-NO; NPN-NC

Tbl.:2; Ch.:3 NOTE: See connections in Tab.: 7…10; Ch.:3

3.4 Detailed description of how to select functions with the Teach button

MEANING OF THE LED SIGNALING MODES



To indicate the menu levels, the Green and Red LEDs of the display are used.
To indicate the configurations of the **En** emission LEDs, which can be modified with Banking, these same LEDs of the optics are used.

	Indication of full and constant light.		Emission LED ON or OFF according to the Blanking configuration.
	Indication of low intensity, intermittent or with periodic rapid continuous flashing.		Any condition.
	Indication of slow and continuous flashing or of limited duration corresponding to the pressing of the button.		LED OFF.

Tbl.:3; Ch.:3

FACTORY CONFIGURATIONS (FC)

The factory configuration allows to obtain the maximum range, with the sensor parameters set as follows:
1-Maximum emission power. **2**-All optics active, **3**-Standard fixed threshold (1/2). To achieve optimal performance, a Teach-in is always required.
The **FACTORY CONFIGURATION** is automatic when exiting the third phase of the menu, i.e., after Standard Calibration, Precision Calibration, Banking.
The **FACTORY CONFIGURATION** is also recalled immediately by holding down the Teach key at START-UP and releasing it immediately afterwards, this is a mandatory maneuver to restore operation following a memory error, see **Tbl.:5.**

	Optics (Emitter and Receiver)							Display		State or Action	Comment ►: Navigate to the indicated table and/or row
	E1	R1	En	Rn	En	Rn	E16	LED G	LED R		
A	Power up and normal operation										
1	A		A		A		A	●	●		**INITIAL STATE** Normal condition (A), LED V ON; LED R ON (Light), OFF (Dark). **Press the button** and keep it pressed (the operation will take >4.5s).
2	A		A		A		A	●	●		Green LED goes OFF, Red LED goes ON (Standard Calibration). **Continue to hold the button** and proceed to the next step.
3	A		A		A		A	●	●		Red LED goes OFF, Green LED goes ON (Precision Calibration). **Continue to hold the button** and proceed to the next step.
4	A		A		A		A	●	●		When the green LED goes OFF and the red LED goes ON, (Blanking) **Release the button.**
5	◐		●		●		◐	●	●		**The Blanking menu is activated.** E1 and E4 flash E2…E3 steady ON, all emission LEDs are enabled.
6	◐		●		●		◐	●	●		**Blanking. Press the button,** the green LED lights up. **Keep it pressed** for at least 2.8s to exit without deactivating the optics.
7	◐		●		●		◐	●	●		When the green LED goes OFF and the red ON. **Release the button.** Blanking has been exited with all optics activated.
A	●		●		●		●	●	●		**Normal operation** is selected, all emission LEDs are active. It is necessary to perform a Teach-in to optimize the calibration. **►Tab.: 5; (A)**

Tbl.:4; Ch.:3

RECOVERY FROM A MEMORY ERROR

A memory error can rarely appear when the sensor is switched on again, in the event that, before a previous switch-off, the sensor power supply was very unstable during or at the end of a Teach-in, i.e. in the data storage phase.
The following maneuver recalls the **Factory Configuration** and allows you to restore correct operation, and therefore a new Teach-in.

	Optics (Emitter and Receiver)							Display		State or Action	Comment
	E1	R1	En	Rn	En	Rn	E16	LED G	LED R		
A	Power up										
1	●		●		●		●	●	●		**INITIAL STATE: MEMORY ERROR** Immediately after switching on, all emitters are OFF. The green LED is OFF, and the red LED flashes.
2	●		●		●		●	●	●		Turn off the sensor and press button. **Continue to hold the button** and proceed to the next step.
3	●		●		●		●	●	●		Turn on the sensor, the red LED lights up. **Continue to hold the button** and proceed to the next step.
4	●		●		●		●	●	●		Green LED is ON, red LED depend on State, all emission LEDs are active. **Release the button: Normal operation**, **Factory Configuration** is selected.
It is advisable to carry out a Teach-in, see Tab.:6											

Tbl.:5; Ch.:3

ACTIVATING THE TEACH-IN MENU (CALIBRATION)

	Optics (Emitter and Receiver)							Display		State or Action	Comment ►: Navigate to the indicated table and/or row
	E1	R1	En	Rn	En	R15	E16	LED G	LED R		
A	**Power up and normal operation**										
1											**The sensor is in Light**: V LED on, Red LED off. ►**B** (Standard Calibration) or **E** (Precision Calibration)
2											**The sensor is in Dark:** V LED on, Red LED on. ►**B** (Standard Calibration) or **E** (Precision Calibration)
B	**Standard calibration**										
3											**Press the button.** The Green LED turns off, the Red LED turns on, release within **1,6s**. If the signal is insufficient ► **(C)**; if the signal is sufficient ► **(D)**
C	**Standard Calibration with optic busy or insufficient signal: Alignment is activated**										
4											Insufficient signal, all active optics flash. Green LED proportional to the signal, Red LED inversely proportional.
5											**Align the optics at best** within **120s**. Sufficient signal with Green LED at maximum, Red LED at minimum ►**(B)**
D	**Standard Calibration: with free optics and sufficient signal**										
6											Calibration in progress (4,4s): Green LED flashes twice then lights up static. **Standard calibration accepted**, normal operation ► **(A)**
E	**Precision Calibration**										
7											**Press the button.** The Green LED turns OFF the Red LED lights up. **Keep the button pressed.**
8											Wait for the Green LED to light up; the Red LED turns off. (Release within 1,8s) If the signal is insufficient ► **(F)**; if the signal is sufficient ► **(G)**
F	**Precision Calibration with optic busy or insufficient signal: Alignment is activated**										
9											Insufficient signal, all active optics flash. Green LED proportional to the signal, Red LED inversely proportional.
10											**Align the optics at best** within **120s**. Sufficient signal with Green LED at maximum, Red LED at minimum ►**(E)**
G	**Precision Calibration with free optics and sufficient signal**										
11											Calibration in progress (4,4s): Green LED flashes twice then lights up static. **Precision Calibration accepted**, normal operation ►**(A)**

NOTE: Keeping the button pressed continuously for >4,5s you access the Blanking menus, see **Tbl.:6 ► (5)**
1) If the alignment condition **4**, **5** or **9**, **10** persists for more than **120s**, the sensor returns to the normal state with the previous setting ► **(A).**
2) Each time the power is turned ON, the stored parameters are used.

Tbl.:6; Ch.:3

ACTIVATION OF THE BLANKING MENU (EXCLUSION OF THE OPTICS)

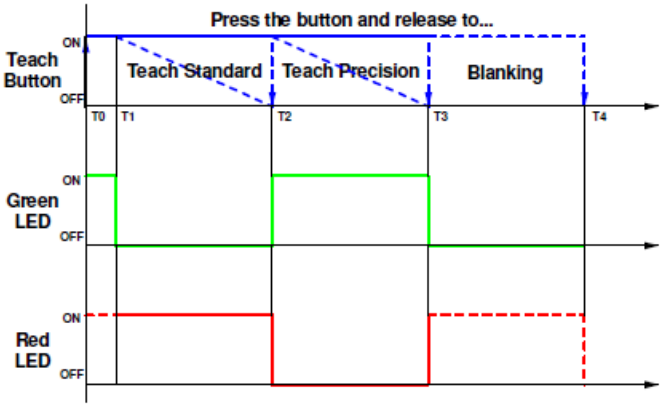
It is assumed that the sensor is on and in normal operation, in the previously selected optical configuration.
To be sure that you are not already in the menu function, you can switch the sensor off and on again.

Passo		EMISSION LEDS USED AS INDICATORS: Emitters turned off	Emitter Flashing	Emitters turned on	Emitter Flashing	INDICATOR LEDS: Green LED	Red LED	Button	Comment and characteristics of the chosen setup (#)	
A (Normal)		Only the previous ones excluded	NO	Only the previous not excluded	NO	●	●		Normal condition **(A)**, **Press the button and keep it pressed** (For at least 4,5s). Skipping Standard Calibration and Precision Calibration	
Standard						●	●			
Precision						●	●			
Blanking						●	●		At the last lighting of the red LED **Release the Button: Blanking**	
BLANKING FUNCTION: BEAMS BYPASS LOOP	1 (1)	NO	1	2…15	16			Briefly press the button to advance from 1 to 30	**N**:30 / **E**:16 / **R**:15 / **H**:309mm	**N**: number of pairs of beams. **E**: active emitters; **R**: active receivers. **H (mm)**: height of the active optical window.
	2	1	NO	2…15	16				**N**:29 / **E**:15 / **R**:15 / **H**:299mm	
	3	1	2	3…15	16				**N**:28 / **E**:15 / **R**:14 / **H**:289mm	
	4	1, 2	NO	3…15	16				**N**:27 / **E**:14 / **R**:14 / **H**:279mm	
	5	1, 2	3	4…15	16				**N**:26 / **E**:14 / **R**:13 / **H**:269mm	
	6	1…3	NO	4…15	16				**N**:25 / **E**:13 / **R**:13 / **H**:259mm	
	7	1…3	4	5…15	16				**N**:24 / **E**:13 / **R**:12 / **H**:249mm	
	8	1…4	NO	5…15	16				**N**:23 / **E**:12 / **R**:12 / **H**:239mm	
	9	1…4	5	6…15	16				**N**:22 / **E**:12 / **R**:11 / **H**:229mm	
	10	1…5	NO	6…15	16				**N**:21 / **E**:11 / **R**:11 / **H**:219mm	
	11	1…5	6	7…15	16	●	●		**N**:20 / **E**:11 / **R**:10 / **H**:209mm	
	12	1…6	NO	7…15	16				**N**:19 / **E**:10 / **R**:10 / **H**:199mm	
	13	1…6	7	8…15	16				**N**:18 / **E**:10 / **R**:9 / **H**:189mm	
	14	1…7	NO	8…15	16				**N**:17 / **E**:9 / **R**:9/ **H**:179mm	
	15	1…7	8	9…15	16	◐	●		**N**:16 / **E**:9 / **R**:8 / **H**:169mm	
	16	1…8	NO	9…15	16				**N**:15 / **E**:8 / **R**:8 / **H**:159mm	
	17	1…8	9	10…15	16				**N**:14 / **E**:8 / **R**:7 / **H**:149mm	
	18	1…9	NO	10…15	16				**N**:13 / **E**:7 / **R**:7 / **H**:139mm	
	19	1…9	10	11…15	16	●	●		**N**:12 / **E**:7 / **R**:6 / **H**:129mm	
	20	1…10	NO	11…15	16				**N**:11 / **E**:6/ **R**:6 / **H**:119mm	
	21	1…10	11	12…15	16				**N**:10 / **E**:6 / **R**:5 / **H**:109mm	
	22	1…11	NO	12…15	16				**N**:9 / **E**:5 / **R**:5 / **H**: 99mm	
	23	1…11	12	13…15	16				**N**:8 / **E**:5 / **R**:4 / **H**: 89mm	
	24	1…12	NO	13…15	16				**N**:7 / **E**:4 / **R**:4 / **H**: 79mm	
	25	1…12	13	14…15	16				**N**:6 / **E**:4 / **R**:3 / **H**: 69mm	
	26	1…13	NO	14…15	16				**N**:5 / **E**:3 / **R**:3 / **H**: 59mm	
	27	1…13	14	15	16				**N**:4 / **E**:3 / **R**:2 / **H**: 49mm	
	28	1…14	NO	15	16				**N**:3 / **E**:2 / **R**:2 / **H**: 39mm	
	29	1…14	15	NO	16				**N**:2 / **E**:2 / **R**:1 / **H**: 29mm	
	30	1…15	16	NO	16			Briefly press the button to go back from 30 to 1	**N**:1 / **E**:1 / **R**:1 / **H**: 19mm	
Exit from Blanking confirming the choice of active beams										
EXIT	1	Last selected line (1…30)				●	●		**Press and hold the button** (For at least 3s)	
	2	The emitters of the activated pairs are on				●	●		**When the red LED turns on, release the button, The selection is confirmed**	
A		You return to normal operating status, ► Tab.:5; (A) When exiting the Menu, it is advisable to carry out a Teach-in, see Tab.:5								

Tbl.:7; Ch.:3

3.5 Graphs of how to select the functions with the Teach-in button

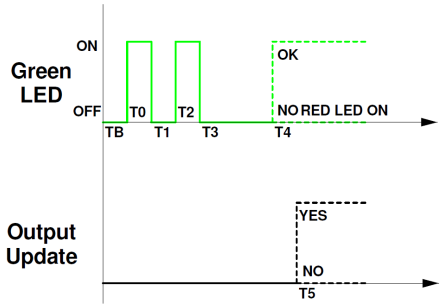
Activation of the desired function and behavior of the signal LEDs. The three-time windows, within which the button must be released, are marked by the complementary on/off sequences of the green and red LEDs.



T'	T''	s	s tot	Type of Calibration
T0	T1	0,35	0,35	Press to enter the Menu
T1	T2	1,6	1,95	Release to run Standard
T2	T3	1,6	3,55	Release to run Precision
T3	T4	∞	>3,55	Release to enter Blanking
Press and release the button to exit the menu when the LED configuration changes to match the required function				

Ch.: 3; Fig.:1

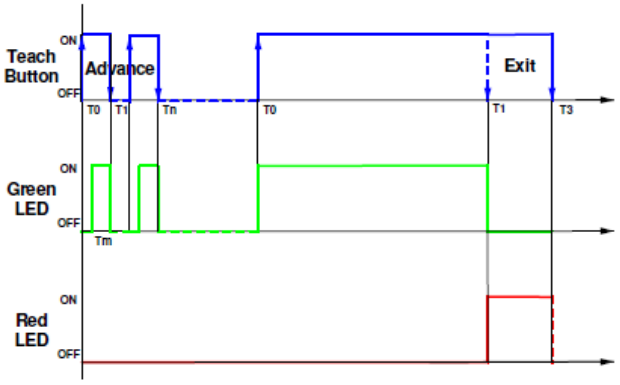
Automatic Calibration, to enter see Fig.:1: LED behavior during Teach Standard or Precision, total duration **4.40s**



T'	T''	s	s tot	Calibration phases
TB	**T0**	0,40	0,40	**TB: button release, LED OFF**
T0	**T1**	0,40	0,80	Green LED: OFF/**ON**
T1	**T2**	0,40	1,20	Green LED: ON/**OFF**
T2	**T3**	0,40	1,60	Green LED: OFF/**ON**
T3	**T4**	2,10	3,70	Green LED: ON/**OFF**
T4	**T5**	0,70	**4,40**	Green LED: OFF/ **(OFF or ON)**
T5	**>T5**	**Output status updated, normal operation**		
The calibration phase proceeds automatically from the release of the button in TB, if it is successful at the end only the green LED remains on, if it fails the Alignment function is (re)activated, green and red LEDs on.				

Ch.: 3; Fig.:2

Blanking Menu, to enter see Fig.:1: As soon as you enter Blanking all the optics are selected active,
pressing the button for more than 2.8s exits immediately restoring the Factory Configuration.
1) All optics activated. 2) Maximum emitted power. 3) Sensitivity at ½ dynamic range,
by pressing the button briefly, however, the optics are progressively excluded, finally returning to the activation of all,
having reached the desired configuration, pressing the button for more than 2.8s confirms the choice of optics and their Factory Calibration.
1) Selected optics activated. 2) Maximum emitted power. 3) Sensitivity at ½ dynamic range.
Leaving this phase, it is advisable to carry out a Teach-in, with which the sensitivities of all the activated optics are equalized.
If you want to exit without confirming the selection in progress (keeping the previous one), switch the sensor off and on again.



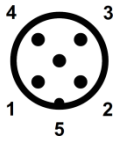
T0	Tm	100ms		**Button integration**
T'	**T''**	**s**		**Advance selection**
T0	T1	>0,13	<2,8	Press and release
Tn	Tn+1	>0,13	<2,8	Press and release
Repeat the action to progressively exclude the current optic. After the last optic, you return to the activation of all.				
Min.	**Max**	**s**		**Exit by confirming**
T0	T1	>2,8	∞	Press and hold, Green LED ON Wait Green LED OFF, Red ON Release the button
On exiting this phase, the red LED lights up briefly, then the standard operation: LED green on, red off if in Light state LED is green on, red on if in dark state Perform a Teach-in to optimize operation.				

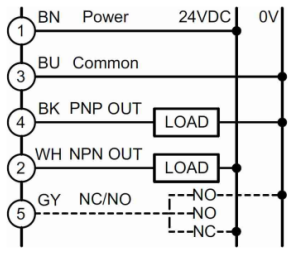
Ch.: 3; Fig.:3

It is possible to perform a maneuver to recover sensor operation following a memory reading error, or to quickly perform a Factory Reset:
Turn the sensor off and on again by keeping the button pressed, the red LED lights up, the green LED is off, when the button is released, the Factory Configuration is recalled.
1) All optics activated. 2) Maximum emitted power. 3) Sensitivity at ½ dynamic range.
It is advisable to perform a Teach-in to optimize operation.

3.6 Electrical drawing

SERIE CR2	REFLEX CURTAIN	CR2/0B MODEL PNP and NPN outputs, NC/NO selectable
M12, 5 poles Male connector	Wiring	Connector



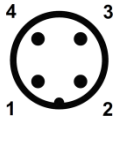


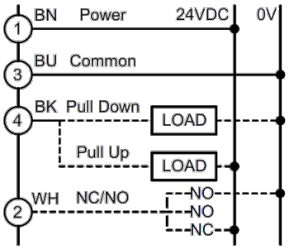
Pin	Color	Signal	Description
1	BN	$24V_{DC}$	Power supply input from 12 to 30V.
2	WH	NPN Out	Apply a load connected at the positive, maximum current 160mA
3	BU	0V	Supply voltage reference
4	BK	PNP Out	Apply a load connected to the common, maximum current 160mA.
5	GY or YE/GR	NC/NO	Input for outputs logic selection.

NOTE: The NC/NO input is read only when the sensor is switched ON. If it is left open or permanently wired to the common, it selects the output as DARK ON. If it is connected to the positive, it selects the output as LIGHT ON.

Tbl.:7; Ch.:3

SERIE CR2	REFLEX CURTAIN	CR2/0T MODEL Push Pull output, NC/NO selectable
M12, 4 poles Male connector	Wiring	Connector



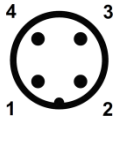


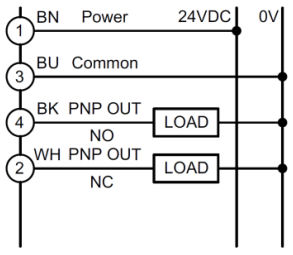
Pin	Color	Signal	Description
1	BN	$24V_{DC}$	Power supply input from 12 to 30V.
2	WH	NC/NO	Input for outputs logic selection.
3	BU	0V	Supply voltage reference.
4	BK	Push Pull Out	Apply a Pull up or a Pull down load, maximum current 160mA.

NOTE: The NC/NO input is read only when the sensor is switched ON. If it is left open or permanently wired to the common the Push driver is Dark switching and the Pull driver is Light switching. If it is connected to the positive the Push driver is Light switching and the Pull driver is Dark switching. Using the button it is possible to execute the Teach.

Tbl.:8; Ch.:3

SERIE CR2	REFLEX CURTAIN	CR2/BP MODEL PNP outputs NO and NC
M12, 4 poles Male connector	Wiring	Connector



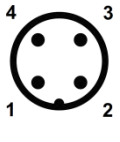


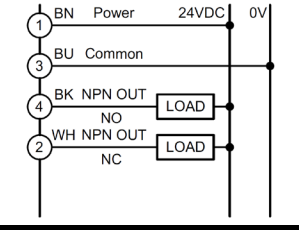
Pin	Color	Signal	Description
1	BN	$24V_{DC}$	Power supply input from 12 to 30V.
2	WH	PNP Out NC	Apply a load connected to the common, maximum current 160mA.
3	BU	0V	Supply voltage reference
4	BK	PNP Out NO	Apply a load connected to the common, maximum current 160mA.

NOTE: Using the button it is possible to execute the Teach.

Tbl.:9; Ch.:3

SERIE CR2	REFLEX CURTAIN	CR2/BN MODEL NPN outputs NO and NC
M12, 4 poles Male connector	Wiring	Connector





Pin	Color	Signal	Description
1	BN	$24V_{DC}$	Power supply input from 12 to 30V.
2	WH	NPN Out NC	Apply a load connected to the positive, maximum current 160mA.
3	BU	0V	Supply voltage reference
4	BK	NPN Out NO	Apply a load connected to the positive, maximum current 160mA.

NOTE: Using the button it is possible to execute the Teach.

Tbl.:10; Ch.:3

4.0 TECHNICAL SPECIFICATIONS

OPTICAL DATA					
PARAMETRI	U.M.	Min.	Nom.	Max.	NOTE
Standard detection range[1]	m	0		4,5	It depends on the reflector, see Tbl.: 2
Standard reflector range (ExG≥1.5)[1]	m	0,20		4,5	It depends on the reflector, see Tbl.: 2
Reflector range with ExG= 1[1]	m	0,15		5,5	It depends on the reflector, see Tbl.: 2
Total angle	°			2,5	Emitted beam
Detection Chability Standard	mm	5		55	MDO, minimum and maximum values of Tbl.:4
Detection capability Precision	mm	3		20	MDO, minimum and maximum values of Tbl.:4
LED wavelength	nm		617		Red/Orange color, vertically polarized
LED life expectancy	h		100K		With maximum temperature and current
Margin for a Teach_in Standard			1,5		See note2
Hysteresis for a Teach_in Standard	%		20		See note2
Margin for a Teach_in Precision			1,1		See note2
Hysteresis for a Teach_in Precision	%		12		See note2
Immunity for artificial light, direct	Klux	50			Incandescent lamp
Immunity for artificial light, direct	Klux	5			Fluorescent lamp
Optical safety classification		Group 1			IEC 62471-7:2023

Tbl.:1; Ch.:4

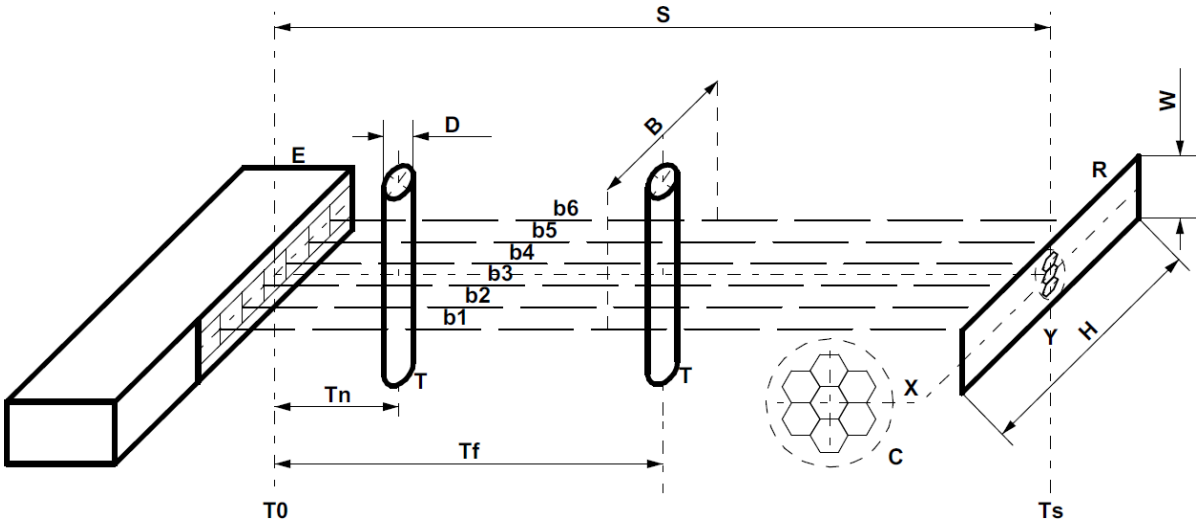
NOTE: **1)** The data shown refer to the **2xRL136** reflectors, but depend on the size and type of reflector, if placed close to the sensor, the granularity of the reflector causes instability, if there are vibrations. A fine grain determines an increase in the minimum distance, the type and area determine the maximum distance; the best compromise is a reflector active area dimension of **20x340mm**, a dimension that can be obtained by shielding standard reflectors, and a prismatic cell dimension of **4mm**. The data in **Tab.:4** is obtained by performing a **Teach-in**, at the specific distance **S** of the reflector. The factory calibration data allow you to work at the maximum flow rate, but to obtain the optimal **MDO** it is still necessary to always perform a calibration. If the desired margin is not available, the calibration function is interrupted and the sensor remains in **Alignment** mode for **120s**, then the parameters of the previous Teach-in are applied

2) S_G: Light signal reached in calibration; S_L: Light threshold; S_D: Dark threshold; **Margin** or **ExG**: S_G / S_L; **Hysteresis%:** $((S_L-S_D) / S_L) * 100$.

RANGE WITH SPECIFIC REFLECTORS						
Reflector	ExG 1 (m)	ExG ≥1.5 (m)	ExG 1 (m)	Reflector active area (mm)	Reflector size (mm)	Material
2x RL136 (coppia)	0,15	0,2...4,5	5,5	38 x 395	40 x 400	Plastic
RL100DCR2	0,25	0,3...2,5	3	40 x 380	40 x 380	Paper/Tape

Tbl.:2; Ch.: 4

IDENTIFICATION OF THE ELEMENTS OF AN APPLICATION

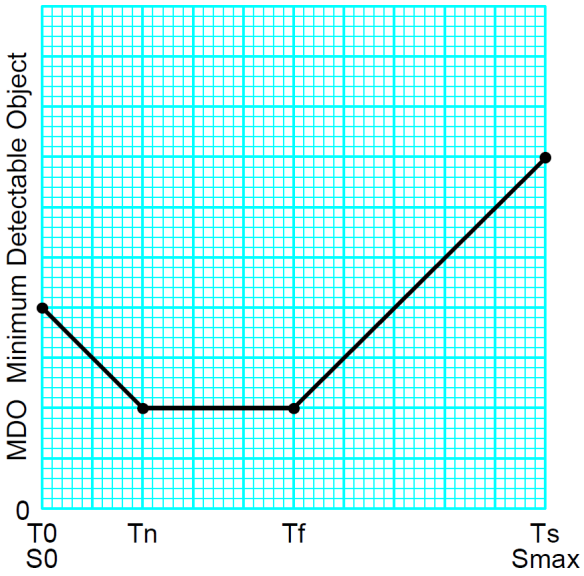


Ch.: 4; Fig.:1

E	**CR2** polarized reflex sensor, has **31 optics** (only 7 are represented)
R	Reflector, only the corner type is capable of handling polarized light.
H	Length of the active surface of the reflector, dimensions optimized for best compromise range and resolution: **340…400mm.**
W	Width of the active surface of the reflector, dimensions optimized for best compromise range and resolution: **20…40mm**
C	Optimum cell dimension of the reflector: **4mm**
S	Distance between sensor and reflector, from **Smin** (dark area) to **Smax** (maximum range). The controlled area goes from **T0** to **Smax**
b1...b30	The boundaries between **16 emitters** and **15 receivers** determine an array of **30 pairs of beams**
B	Minimum width of the controlled area (varies slightly according to dimension Tx and S) on average **310mm**
T	Test rod of D diameter, the minimum diameter intercepted **with continuity** is indicated as **MDO**
D	Diameter of the test rod
T0	Minimum dimension assumed by Tx (grazing at the front of E), to which test rod, of diameter D_1, is continuously intercepted.
Tn	Minimum distance assumed by T where you start to get the best MDO D2 (<D_1 and <D_3), in some cases Tn and Tf coincide.
Tf	Distance assumed by T beyond which MDO (D_3) is worse than what is obtained between Tn and Tf
Ts	Maximum distance assumed by T (grazing the reflector) in which the MDO (D_3) is worst (increases linearly between Tf and Ts).
Refer to Tbl.:4	

Tbl.:3 ; Ch.: 4

DEFINITION OF THE MINIMUM DETECTABLE OBJECT WITHOUT INTERRUPTION DETERMINED BY THE DISTANCE OF THE REFLECTOR AND THE POSITION OF THE SAME OBJECT



Ch.:4; Fig.:2; Shape of the characteristic curve and identification of reference points on the graph.

Range (mm)	MDO (mm) @ Tx (mm)								
	Standard Teach-in				PrecisionTeach-in				
Smax	T0	Tn	Tf	Ts	T0	Tn	Tf	Ts	
100	0	0	100	100	0	0	100	100	Tx
	8	8	8	8	6	6	6	6	MDO
150	0	0	150	150	0	0	150	150	Tx
	7	7	10	10	5	5	6	6	MDO
200	0	0	200	200	0	0	200	200	Tx
	7	7	10	10	5	5	6	6	MDO
250	0	0	250	250	0	0	175	250	Tx
	7	7	10	10	4	4	5	6	MDO
500	0	0	250	500	0	0	400	500	Tx
	6	6	7	12	3,5	3,5	4,5	5	MDO
1000	0	0	400	1000	0	100	600	1000	Tx
	5	5	6	14	3.5	3	3	5	MDO
1500	0	0	250	1500	0	300	800	1500	Tx
	5	5	6	20	3,5	3	3	7	MDO
2000	0	300	800	2000	0	300	800	2000	Tx
	5	5	7	25	3,5	3	3	10	MDO
2500	0	400	800	2500	0	200	700	2500	Tx
	5	5	7	30	3.5	3	3	10	MTO
3000	0	500	800	3000	0	200	800	3000	Tx
	6	6	8	35	3,5	3	3	12	MDO
4000	0	600	800	4000	0	200	800	4000	Tx
	6	6	8	50	4	3.5	3.5	16	MDO
4500	0	700	900	4500	0	200	800	4500	Tx
	6	6	8	55	4	3	3	20	MDO

Tbl.:4; Ch.:4

Between T0 ... Tn and Tf ... Ts MDO varies in a quasi-linear way, so formulas can be used to obtain an approximate MDO value in these traits.
Formula for calculating an MDO for a Tx between Tf and Ts
$(((MDO_{Ts} - MDO_{Tf})/(Ts-Tf))*(Tx-Tf))+MDO_{Tf}$
Formula for calculating an MDO for a Tx between T0 and Tn
$(((MDO_{Tn} - MDO_{T0})/Tn)*Tx)+MDO_{T0}$

Tbl.:5; Ch.:4

4.1 Optical interference

This sensor is completely insensitive to interfering lights with **λ > 650nm** (deep red or infrared), possibly emitted by other systems. Due to the small optical angle of **2.5°** and the use of **polarized light**, the sensors of this **CR** series do not interfere with each other even if mounted with the same orientation (parallel or 180° axes), side by side or opposite each other. With different orientations (e.g., at 90°) it is advisable to guarantee at least a distance of **40mm** between the two closest optical axes.

ELECTRO-MECHANICAL DATA					
PARAMETER		**Min.**	**Nom.**	**Max.**	**NOTE**
Power supply					
Operatin voltage	**V**	**12**	**24**	**30**	From PELV power supply according to EN 60204-1 Ch.6.4
Ripple	**V**			**1,2**	Supply voltage must stay within the stated limits
No load supply current	**mA**	**63 (!)**	**77**	**150 (!)**	**(!)** Maximum current with the minimum voltage range (constant power)
Absorbed power	**W**		**2**		Constant absorbed power as the voltage varies
Class			**III**		500V Isolation
Digital Outputs					
Output type (model **0B**)			**1xPNP, 1xNPN**		Completely protected, selectable NO or NC, 5 wires
Output type (model **0T**)			**1xPush-Pull**		Completely protected, selectable NO o NC, 4 wires
Output type (model **BP**)			**1xPNP NO; 1xPNP NC**		Completely protected, 4 wires
Output type (model **BN**)			**1xNPN NO, 1xNPN NC**		Completely protected, 4 wires
Load current	**mA**		**100**	**160**	Higher values are interpreted as overload or short circuit
Voltage drop @100mA	**V**	**1,0**		**1,6**	Reduction in output voltage compared to the supply voltage
Resistive load (@24V)	**Ω**	**145**			Lower values are interpreted as short circuit
Leakage current	**µA**			**1**	Load current in OFF state
Tolerated capacitive load	**µF**			**0,4**	Higher values can be interpreted as short circuit.
Rise Time (PNP); Fall (NPN)	**µs**			**0,3**	Output OFF>ON; with a load of 1000Ω
Fall Time (PNP); Rise (NPN)	**µs**			**10**	Output ON>OFF, with a load of 1000Ω
Response times					
Time delay before availability	**s**			**0,95**	All outputs are in the OFF state during this time
Outputs response time, Light to Dark (T_{LD})	**ms**	**1,20**		**2,81**	All beams active, it is reduced if Blanking is active
Outputs response time, Dark to Light (T_{DL})	**ms**	**3,06**		**4,66**	All beams active, it is reduced if Blanking is active
Switching frequency (1/(T_{LD}+ T_{DL})	**Hz**		**133**		All beams active, increases with less beams; Dark / Light ratio = ½;
Switching frequency (measured)	**Hz**			**190**	All beams active, increases with less beams; Dark / Light ratio = ½;
Input levels NC/NO (only for 0B and 0T models, see also Tab.:8, 9; Ch.:3)					
Low level	**V**	**0**		**0,8**	Normally connected to common
Open level	**V**	**1,3**	**1,9**	**2,35**	In these models, the Open level equals Low
High level	**V**	**5,8**		**30**	Normally connected to supply voltage
Integration time	**ms**		**20**		The input state must persist for at least this time
Input current for low level	**µA**	**-250**		**520**	Outgoing or incoming current
Input current for high level	**mA**	**0,52**		**1,2**	Incoming current
Menu button activation times		**a**	**b**	**c**	**a:** Minimum progressive duration; **b:** Window Duration**; c:** Maximum
Standard Teach-in	**s**	**0,35**	**1,6**	**1,95**	Release at **Green** LED: **OFF** and **Red** LED: **ON**
Teach-in Precision	**s**	**2,95**	**1,6**	**3,95**	Release at **Green** LED: **ON** and **Red** LED: **OFF**
Enter Blanking Menu	**s**	**3,95**	∞	∞	Release at **Green** LED: **OFF** and **Red** LED: **ON**
Progress Blanking Menu	**s**	**0,13**	∞	∞	Release at **Green** LED: **ON**; The optics are progressively excluded or reactivated
Confirm and exit Blanking Menu	**s**	**2,8**	∞	∞	Release at **Green** LED: **OFF;** Normal operation, perform a Tech.
Duration of the Teach-in	**s**			**4,40**	From the release of the button
Environmental parameters					
Enclosure rating			**IP67**		Dust and water protection (immersion for 60 min. at a depth of 1m)
Working temperature	**°C**	**-10**		**55**	Without condensation
Storage temperature	**°C**	**-25**		**70**	D To be respected also during transportation
Humidity	**%**			**95%**	Without condensation
Vibrations		**Acc. IEC 60947-5-2**			It complies with limits and conditions stated in the rule. Edition 4.0, 2019-10
Shock		**Acc. IEC 60947-5-2**			It complies with limits and conditions stated in the rule. Edition 4.0, 2019-10
Sensing range correction factors					
Environmental factors			**0,50 / 0,25**		In presence of dust, fog, smoke (approximate values)
Electrical connections					
Cable sections	**mm²**		**0,34**		Da rispettare per garantire la massima lunghezza indicata
Total length of power cables	**m**			**100**	With cable of the indicated sections, standard models
Size/Materials					
Housing section	**mm**		**20 (frontal) x 36**		Alluminio verniciato, colore blue **RAL5002**
Total height	**mm**		**347**		
Fixing groove, for T shaped insert	**mm**		**2/10/6,5**		In the rear part of the sensor: depth/width/opening width
Width of the frontal window	**mm**		**15**		Active width: 9mm central, material: PMMA
Height of the frontal window			**344**		Active height: 69mm top
Number/Size/Pitch of the lenses			**31/9*9mm/10mm**		Central part of the window, see Pic.: 1
Top closure	**N°**		**1**		Material: PC, transparent
Bottom closure	**N°**		**1**		Material: PBT + 30%GF, black colour
Closing screws	**N°**		**2+2**		M2, FE37 burnished
Weight	**g**		**310**		Sensor only
Connectors and Cables					
Models **0T, BP, BN**			**1xM12, 4p, male**		Pigtail length 240mm, PVC, Ø 4,7mm, 0,34mm²
Models **0B**			**1xM12, 5p, male**		Pigtail length 240mm, PVC, Ø 4,7mm, 0,34mm²

Tbl.:6; Ch.:4

5.0 START-UP INSTRUCTIONS

5.1 Mechanical mounting of CR models

It is extremely important to fix the sensors and the reflectors to a rigid structure, not subject to deformation or to strong vibrations.
Choose the position of the sensor so as not to expose it to strong sources of natural or artificial light and to light interference with other sensors in the visible emission.

Keep in mind that the devices are not suitable for outdoor installation, IP67 despite being declared, it is not guaranteed that the long exposure to the weather does not cause water penetration and performance degradation.
Choose the most suitable reflector to the required detection capabilities and sensing range.

Mount the sensor with the optical axes as much as possible perpendicular to the reflector surface. The mutual distance depends on the type of reflector and must be included in the field of specification. To secure the sensors to a support, use the corresponding inserts to be applied in the rear groove and the brackets in the normal provisioning. If the wall to which the sensor is fixed is not flat, check that this does not involve a mechanical distortion of the body, if necessary, use washers to compensate for the non-flatness.

If the application is subject to vibrations, which anyway do not prevent the optical alignment, use damping supports.

Though used polarized light, the light beams can in part be deflected by reflective surfaces parallel and near to the beams, this can lead to a missed detections of the interruption of direct path of the of the optical beam, or incorrect calibration values that may generate unstable operation, so all reflective surfaces and reflective objects should maintain a minimum distance from the direct path of the rays. This distance depends on the aperture angle of optics.
Keep in mind that even if a surface is black, if it is shiny, it can be highly reflective.
If you can't eliminate or reduce the effect of a reflective surface, it is important that this effect remains stable or that the system behaves in an acceptable and predictable manner.
Temporarily block the sensor and reflector so that they are aligned and parallel to each other.

5.2 Electrical installation

Use **PELV** power supplies, in compliance with Ch.6.4. of EN 60204-1.
If using a non-stabilized power supply, the transformer must have double insulation and adequate power, the secondary winding must not exceed $18V_{AC}$. Use a bridge rectifier, a filtering capacitor with a minimum value of 1000µF.
Connect the supply cables directly to the source and not downstream of other power or highly inductive devices.
Lay the sensor cables in dedicated raceways or where only signals pass; do not use wireways containing power cables or cables for switched loads of high-power devices.
Comply with the specification of the maximum length of the connection cables.
If the sensors, their power supplies, and their loads are installed on metallic structures, make sure that these structures are all effectively connected to the same ground.

Warning!
To carry out the following operations, a voltage supply to the sensor is needed. Before starting this phase, make sure that the outputs' switch cannot lead to any danger.
Before inserting the connector, check that the mains voltage and the supply voltage are within the required limits.
Apply the connector and check again that the supply voltage has a correct nominal value and remains within the limits defined in all working conditions.
Check the limits in the two extreme conditions of minimum and maximum absorption of all devices connected to the same power supply, especially if this is **not** a stabilized power supply.
Suitably connect the NC/NO input if available, bear in mind that this input status is acquired only when the power is applied.

5.3 Alignment of CR2 models

Once the supply voltage has been applied, one or both green and red indicator LEDs and the emission LEDs must be on, otherwise the power supply does not reach the sensor, or it has a very low voltage. If the Green LED flashes at 1.5Hz, the supply voltage is present, but insufficient. If both the Green and Red LEDs are on, the signal is insufficient. If only the Green LED is lit, the sensor is already aligned and in light. To guarantee excellent alignment, it is advisable to perform a Tech-in without visibility of the reflector, to force the activation of the **Alignment** function. If possible, observe the reflector from a point close to the optical axis and correct the aiming so that the spot of light completely illuminates the reflector; simultaneously or alternatively use the indication of the Red and Green LEDs and adjust the aim to minimize the red light.
Fix the sensor firmly while remaining in Alignment condition, to verify that during the fixing the aiming does not worsen, at this point perform a Teach-in Precision, if the Red LED is off and the Green LED is on, the alignment is acceptable and the Tech-in was successful. If both LEDs flash again, it means that the alignment is not correct, so try to get a better alignment and then perform a second Teach-in Precision, if accepted check the mechanical stability by stressing the structure. Finally, perform the desired Teach-in (Precision or Standard) and verify that the sensor correctly detects as expected. If the LEDs show no recognizable behavior, carry out a factory setup (Tab.:4; Ch.:3) or check the error codes (Tab.:1, 2).

Indication
A correct optical alignment with a good signal margin prevents unstable functioning of the light curtains, reduces optical interferences and reflection by shiny surfaces and guarantees better stability in general.
If the range is short, the graininess of the reflector can cause instability, check the behaviour of the system by shifting the reflector, as an alternative use of reflective paper composed of micro prisms.
Please do not forget to reconnect all the cables and to control the correct functioning of the application.
A Teach-in follows every even small change in trim.
Do not forget to also check the correctness and stability of the wiring.

5.4 Display indications and diagnostics.

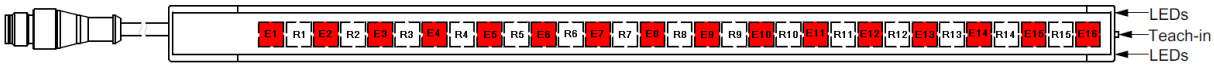
MEANINGS OF LEDs SIGNALLING MODES	
	Indication of full light and steady
	Indication of low intensity or intermittently with fast periodic flashing
	Indication of slow continuous flashing
	Any
	OFF

Tbl.:1; Ch.:5

 LEDs INDICATIONS					
GN		No power supply or below 5V. Memory reading error.	RD		Light state. No power supply.
		Power supply dropped below 12V. Emission LEDs failed. Outputs in short circuit.			Memory reading error.
		Alignment. Outputs in short circuit.			Alignment. Some optics in Dark
		Normal operation.			Many or all optics in the DARK Fault or outputs in short circuit

Tbl.:2; Ch.:5

COMBINED INDICATIONS



GN							
RD							
STATUS	Power 						Out 
	OFF or LOW	MEMORY ERROR	FAULT	LIGHT	DARK	ALIGNEMENT	OVERLOAD

Tbl.:3; Ch.:5

If the green or red LED flashes at a **low frequency**, there is a situation where it is not possible to continue working.
With flashing green, check if the power supply is too low, if the load is C.C. or draws too much current when triggered.
With the red LED flashing, carry out a recall of the factory configuration: **Tbl.:4; Ch.:3.**
If these actions are unsuccessful, the sensor probably has an unrecoverable fault.

6.0 MECHANICAL DIMENSIONS OF LIGHT CURTAINS AND STANDARD ACCESSORIES

6.1 Mechanical dimensions of CR2/**-1V

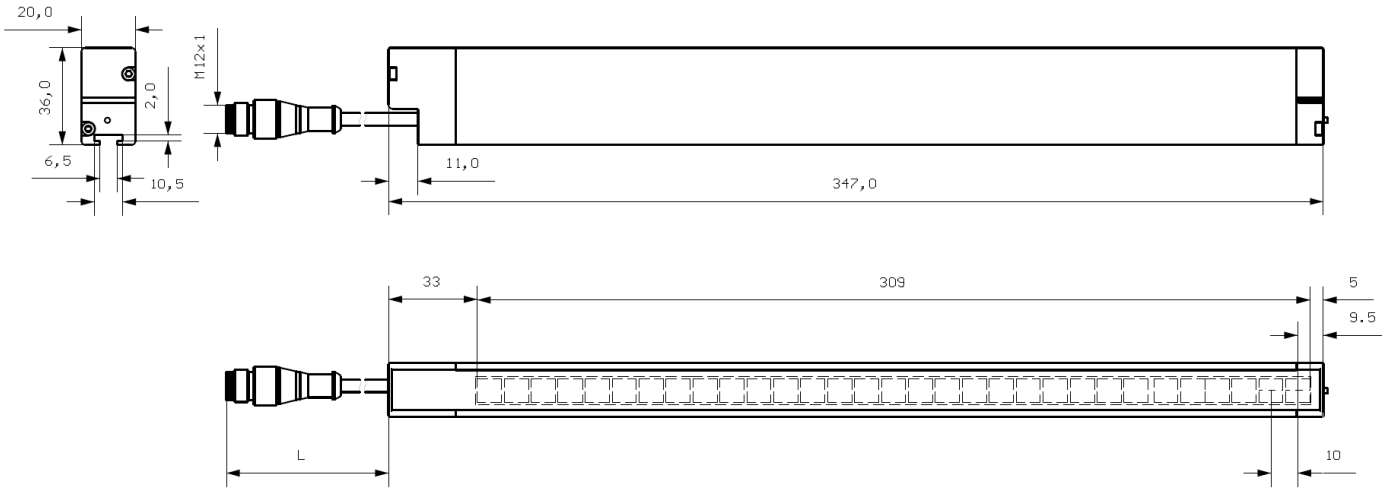


Fig.:1; Ch.:6
Pigtail cable length **L= 240mm**

6.2 Standard Mounting accessories

Kit ST151, accessori di montaggio

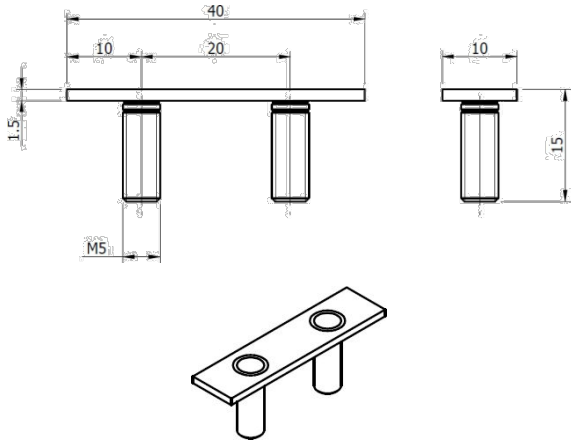


Fig.:2; Ch.:6
T-shaped insert, with two M5 nuts and two split washers.

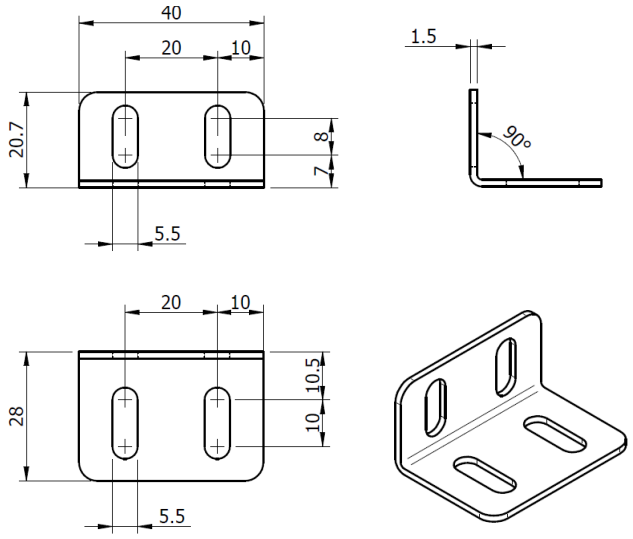
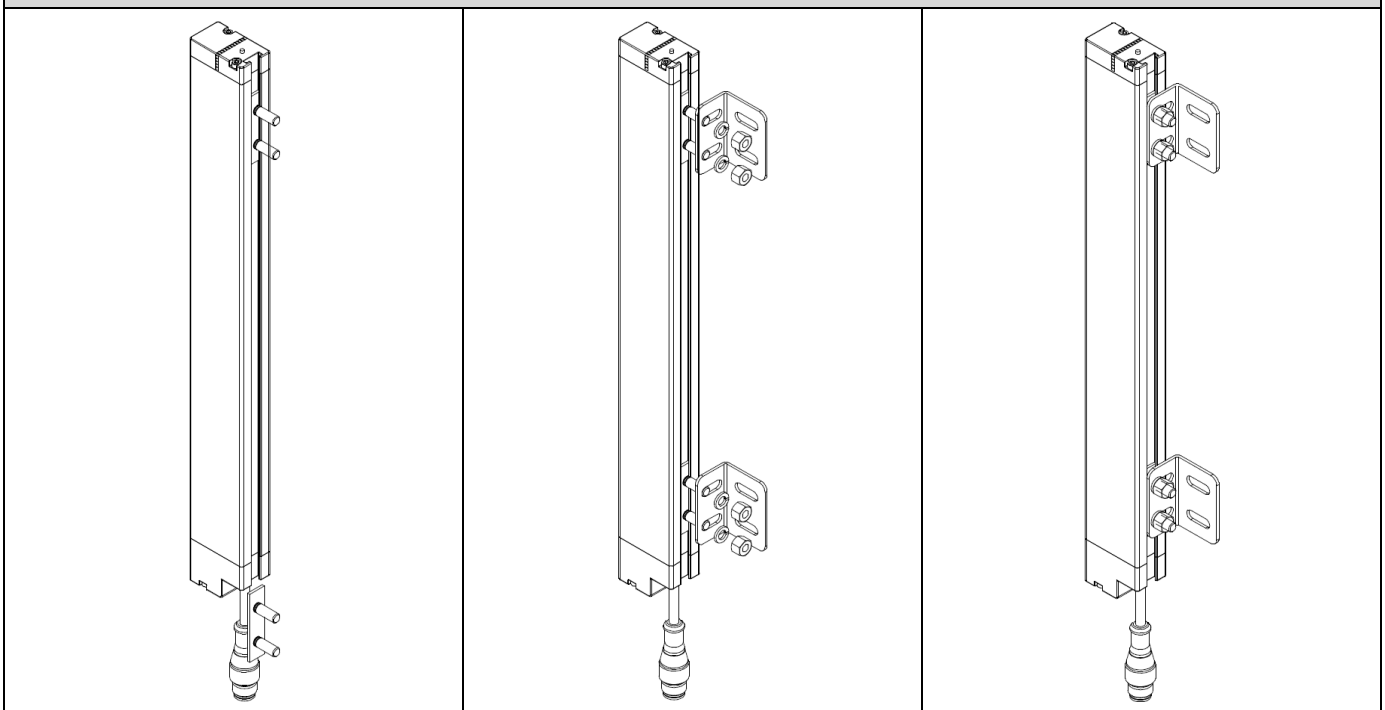


Fig.:3; Ch.:6
L-shaped mounting bracket

7.0 INSTALLATION

Securing CR2 light curtains with two accessories' kit ST151



Place the two T-shaped insert	Mount the L-shaped brackets on the Two T-shaped insert	Secure light curtains to the wall

NOTE: When using two brackets it is necessary to avoid that the sensor body is subjected to mechanical tensions which cause a mechanical deformation of the sensor body and consequently a deterioration of the accuracy of the optical alignment. To try to avoid this, tighten the fixing nuts and screws to the wall progressively and alternately.

Fig.:1; Ch.:7

8.0 LIST OF AVAILABLE ACCESSORIES

M12 PVC CONNECTORS, 4 POLES, WITH CABLE	
CD12M/0B-020A1	M12 connector, straight, 4 poles, female, 2m PVC cable
CD12M/0B-050A1	M12 connector, straight, 4 poles, female, 5m PVC cable
CD12M/0B-100A1	M12 connector, straight, 4 poles, female, 10m PVC cable
M12 PUR CONNECTORS, 4 POLES, WITH CABLE	
CD12M/0B-050A5	M12 connector, straight, 4 poles, female, 5m PUR cable
CD12M/0B-100A5	M12 connector, straight, 4 poles, female, 10m PUR cable
M12 PUR CONNECTORS, 5 POLES, WITH CABLE	
CD12M/0H-050A5	M12 connector, straight, 5 poles, female, 5m PUR cable
CD12M/0H-100A5	M12 connector, straight, 5 poles, female, 10m PUR cable
STANDARD MOUNTING KIT FOR LIGHT CURTAINS	
ST151	Kit with T-shaped insert with four M5 screws complete with nuts and washers and an L-shaped bracket
SUPPORTI ANTI-VIBRANTI	
ST 4V S	Kit of 4 vibration-damping supports

Tbl.:1; Ch.:8

9.0 PACKAGE CONTENT

Each package has the following content:

- A retro reflective area sensor **CR2.**
- Two accessories' kits **ST151** (T-shaped insert and L-shaped bracket).
- Two reflector **RL136,** to be mounted side by side with the 40mm.
- A short multilingual installation manual.
- Total weight 660g

10.0 CONTROL OF THE INSTALLED RETROREFLECTIVE AREA

10.1 Purpose of controls.

The controls described here below are meant to ensure the functional and reliable performances required.

10.2 Preliminary controls before start-up

- All devices must be correctly installed and well secured.
- The maximum response time must be adequate to the application. Make sure that the sensor's response time is compatible with the specific application, detecting objects of minimum and maximum size, in different positions and, if possible, with even faster movements compared to what the application allows.
- Make sure that no optically interfering devices are in the visual field of the sensor. Make sure that other devices do not undergo interferences by the emitted light.
- Make sure that sensors and reflector are not exposed to any substance which might dirty or damage the optics.
- Make sure that the sensors and reflector are not exposed to possible mechanical damage or misalignment due to impact and falling materials.
- Make sure that technical documentation is available for operators in charge of maintenance.

10.3 Check the efficiency of the device

- State and efficiency of the device can be checked using a test stick, which must be detected in a way that is repetitive in time.
- Make sure that there are no damages nor dirt on sensor and reflector optical windows' surface. Scratches and tarnished surfaces can negatively affect the light curtain's resolution.
- If necessary, clean the optical surface with a humid antistatic cloth. Do not use any alcohol, nor solvents, nor abrasive substances.
- Finally, if you are enabled, to compensate for even a small change in trim, perform a specific Teach-in.