Line-Beam Mapping Sensors

BWML Series (EtherCAT)

PRODUCT MANUAL

For your safety, read and follow the considerations written in the instruction manual, other manuals and Autonics website.
The specifications, dimensions, etc. are subject to change without notice for product improvement. Some models may be discontinued without notice.

Features

- Stable glass substrate detection using line beam detection with minimal non-detection area (patent)
- Sensing distance: 95 ±10 mm
- Customized models available
  : sensing channels (4 to 62 CH), sensing target pitch (≥ 20 mm),
  sensing area (280 to 1,775 mm)
- Communication output: EtherCAT
- Easy installation with installation instruction mode and background sensing mode
- Channel interference alarm, 5-stage sensing level setting, emitter / receiver error alarm
- Bright status indicators
- EtherCAT® is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

Safety Considerations

- Observe all 'Safety Considerations' for safe and proper operation to avoid hazards.
- ⚠ symbol indicates caution due to special circumstances in which hazards may occur.

⚠ Warning Failure to follow instructions may result in serious injury or death.

01. Fail-safe device must be installed when using the unit with machinery that may cause serious injury or substantial economic loss. (e.g. nuclear power control, medical equipment, ships, vehicles, railways, aircraft, combustion apparatus, safety equipment, crime / disaster prevention devices, etc.)
Failure to follow this instruction may result in personal injury, economic loss or fire.

02. Do not use the unit in the place where flammable / explosive / corrosive gas, high humidity, direct sunlight, radiant heat, vibration, impact, or salinity may be present.
Failure to follow this instruction may result in explosion or fire.

03. Do not connect, repair, or inspect the unit while connected to a power source.
Failure to follow this instruction may result in fire.

04. Check 'Connections' before wiring.
Failure to follow this instruction may result in fire.

05. Do not disassemble or modify the unit.
Failure to follow this instruction may result in fire.

06. This product is not safety sensor and does not observe any domestic nor international safety standard.
Do not use this product with the purpose of injury prevention or life protection, as well as in the place where economic loss maybe present.

⚠ Caution Failure to follow instructions may result in injury or product damage.

01. Use the unit within the rated specifications.
Failure to follow this instruction may result in fire or product damage.

02. Use a dry cloth to clean the unit, and do not use water or organic solvent.
Failure to follow this instruction may result in fire.

03. Do not use a load over the range of rated relay specification.
Failure to follow this instruction may result in fire, relay broken, contact melt, insulation failure or contact failure.

Cautions during Use

- Follow instructions in 'Cautions during Use'. Otherwise, It may cause unexpected accidents.
- 24 VDC⎓ power supply should be insulated and limited voltage / current or Class 2, SELV power supply device.
- Use the product, 1 sec after supplying power. When using separate power supply for the sensor and load, supply power to sensor first.
- When using switching mode power supply to supply the power, ground F.G. terminal and connect a condenser between 0 V and F.G. terminal to remove noise.
- When connecting a DC relay or other inductive load, remove surge by using diodes or varistors.
- Wire as short as possible and keep away from high voltage lines or power lines, to prevent surge and inductive noise.
- This unit may be used in the following environments.
  - Indoors (in the environment condition rated in 'Specifications')
  - Altitude max. 2,000 m
  - Pollution degree 2
  - Installation category II

Cautions during Installation

- Be sure to install this product by following the usage environment, location, and specified ratings. Consider the listed conditions below.
  - Installation environment and background (reflected light)
  - Sensing distance and sensing target
  - Direction of target's movement
  - Feature data
- When installing multiple sensors closely, it may result in malfunction due to mutual interference. Install it by referring to the interference protection and the installation method in the manual.
- Do not use in places where the light-receiving sensor is exposed to direct sunlight or where the ambient illumination is higher than the specification.
- Do not impact with a hard object or bend the cable excessively. That could decrease the product's water resistance.
- Use this product after the test. Check whether the indicator works appropriately for the positions of the detectable object.

Ordering Information

This is only for reference, the actual product does not support all combinations.
For selecting the specified model, follow the Autonics website.

BWML ❶ - ❷ ❸ ❹ - ❺

❶ Sensing target pitch
Number: Optical axis pitch (≥ 20 mm)

❷ Sensing CH
Number: 4 to 62 CH

❸ Control output
EC: EtherCAT

❹ Operation mode
L: Light ON
D: Dark ON

❺ CH ordering orientation
No-mark: Forward (bottom = 1 CH)
R: Backward (top = 1 CH)

Product Components

- Product × 1
- Instruction manual × 1
- Bracket A × 4
- Bracket B × 4
- Fixing bolt × 8

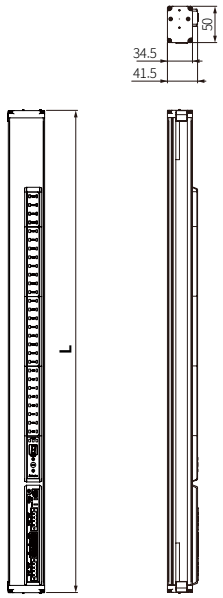
Output Connector

- 4-pin connector: TS04515B0000G (green) (5.08 mm pitch)
- Connector socket specification: Contact the manufacture for the socket and cable.

	Specifications	Manufacture
Connector socket (4-pin, green)	OQ0455510000G	ANYTEK

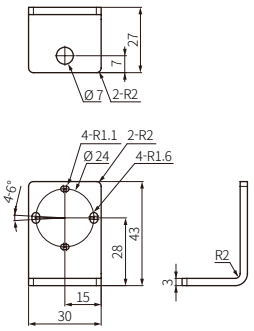
Dimensions

- Unit: mm, For the detailed drawings, follow the Autonics website.
- Length of the product can be different by its ordered specification.
  Refer to the followings
  Max. sensing area = 20+{sensing target pitch × (the total number of sensing target-1)}

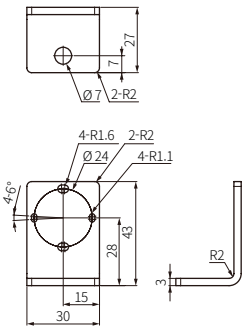


Length of the product (L)	Max. sensing area (mm)
384	280
434	310
484	335
564	460
614	490
664	515
744	640
794	670
844	695
924	820
974	850
1024	875
1104	1000
1154	1030
1204	1055
1284	1180
1334	1210
1384	1235
1464	1360
1514	1390
1564	1415
1644	1540
1694	1570
1744	1595
1824	1720
1874	1750
1924	1775

■ Bracket A

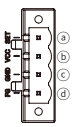


■ Bracket B

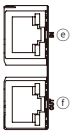


Connections

■ Power cable connector

Connector	Pin no.	Cable color	Func.
	ⓐ	Black	SET
	ⓑ	Brown	VCC
	ⓒ	Blue	GND
	ⓓ	Yellow	F.G.

■ Comm. input / output connector

Connector	Pin no.	Func.
	ⓔ	IN
	ⓕ	OUT

Specifications

Model	BWML
Sensing method	Diffuse reflective type
Beam pattern	Line-beam type
Light source	Infrared LED (850 nm modulated light)
Sensing distance	95 mm ± 10 mm
Sensing target	Transparent or opaque glass plate
CH ordering orientation 01)	Forward (bottom = 1 CH) / Backward (top = 1 CH) (parameter setting)
Sensing CH 01)	4 to 62 CH
Sensing target pitch 01)	20 mm to ordered specification
Response time	≤ 120 ms
Operation mode 01)	Light ON / Dark ON (parameter setting)
Function	Background sensing mode, installation guide mode, sensing level setting, output option, self-diagnosis
Indicator	Output indicator (red), stability indicator (green), status indicator (green, yellow, red)
Approval	CE UKCA EtherCAT
Weight (packaged)	≈3.64 kg (≈ 4.8 kg) (based on BWML82-20ECL)

01) This product is order made.

Power supply	24 VDC⎓ (ripple P-P: ≤ 10 %)
Current consumption	≤ 1.0 A
Control output	EtherCAT
Comm. protocol	EtherCAT protocol
Physical layer	100BASE-TX (IEEE 802.3u)
Comm. medium	Over CATEGORY 5 / E (must be shield cable)
Connection method	Daisy chain
Transmission speed	100 Mbps
Address range	0 to 65535 (16-bit)
Address setting	Software (EtherCAT Master)
Comm. range	Distance between nods: ≤ 100 m
Protection circuit	Reverse power protection circuit, output short overcurrent protection circuit
Insulation resistance	≥ 20 MΩ (500 VDC⎓ megger)
Noise immunity	The square wave noise by the noise simulator (voltage: 500 V, period: 10 ms, pulse width: 1 us)
Dielectric strength	Between the charging part and the case : 500 VAC~ 50 / 60 Hz for 1 min
Vibration	1.5 mm double amplitude at frequency of 10 to 55 Hz in each X, Y, Z direction for 2 hours
Shock	210 m / s² (≈ 21 G) in each X, Y, Z direction for 3 times
Ambient temperature	15 to 35 °C, storage: -10 to 50 °C (no freezing or condensation)
Ambient humidity	35 to 55 %, storage: 35 to 85 % (no freezing or condensation)
Protection rating	IP40 (IEC standard)
Material	Case: AL, sensing part and Indicator part: PMMA

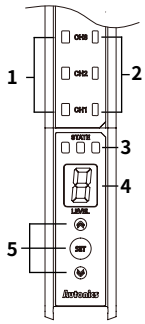
EtherCAT I/O DATA Structure

- HIGH: ON, LOW: OFF for bit status.
- Since the above is based on the product of 24 CH, the number of I/O is changeable by product.
- EtherCAT I/O data structure consists of the number of CH+ERROR output BIT+ALARM output BIt.

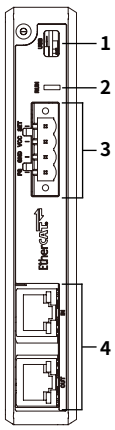
Address	Description	Address	Description
I/O0 [BIT0]	CH1 status	I/O0 [BIT0]	CH17 status
I/O1 [BIT1]	CH2 status	I/O1 [BIT1]	CH18 status
I/O2 [BIT2]	CH3 status	I/O2 [BIT2]	CH19 status
I/O3 [BIT3]	CH4 status	I/O3 [BIT3]	CH20 status
I/O4 [BIT4]	CH5 status	I/O4 [BIT4]	CH21 status
I/O5 [BIT5]	CH6 status	I/O5 [BIT5]	CH22 status
I/O6 [BIT6]	CH7 status	I/O6 [BIT6]	CH23 status
I/O7 [BIT7]	CH8 status	I/O7 [BIT7]	CH24 status
I/O8 [BIT8]	CH9 status	I/O24 [BIT0] 01)	ERROR output BIT
I/O9 [BIT9]	CH10 status	I/O25 [BIT1] 01)	ALARM output BIT
I/O10 [BIT10]	CH11 status	-	-
I/O11 [BIT11]	CH12 status		
I/O12 [BIT12]	CH13 status		
I/O13 [BIT13]	CH14 status		
I/O14 [BIT14]	CH15 status		
I/O15 [BIT15]	CH16 status		

01) It operates as a-contact. (0: normal state, 1: error state)

Unit Descriptions



1	Output indicator (red)
2	Stability indicator (green)
3	Status indicator (green, yellow, red)
4	Status display
5	Mode setting key

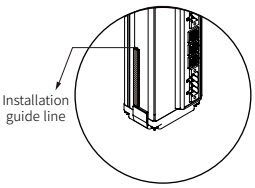


1	USB port: This port is only for firmware upgrade, run mode change, and A / S. Do not use this port for the another purpose, or the product can malfunction.
2	Comm. status indicator: It displays the communication status through LED.
3	Power cable connector
4	EtherCAT comm. input / output connector: It is with the communication status indicator which turns on or flashes according to the communication status.

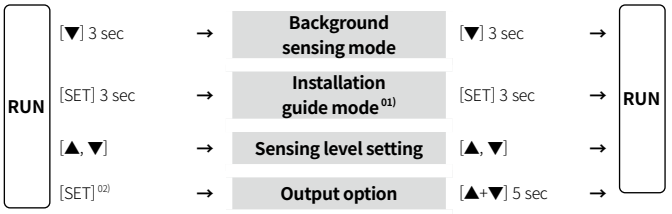
Installation and Adjustment

- If there is disturbing light (fluorescent light) near the product, install the product vertically away from the disturbing light (fluorescent light).
- Use the product only for sensing the glass over the 6.5 generation.
  If the product is used for sensing the glass under the 6.5 generation, the product can malfunction.

01) Install the product on the right side of the sensing target with the bracket.
02) Adjust the height of the product to the place where the first glass of the full cassette is aligned with the installation guide line.
03) Supply the power.
04) Enter to the background sensing mode to detect background. If any background object is detected, reinstall the product, changing the installation angle.
05) Finish installation, when all channels are turned on after placing full cassette.
06) If all channels are not turned on, enter to the installation guide mode and adjust the product up and down. Return to the run mode and finish installation, when all channels are turned on.



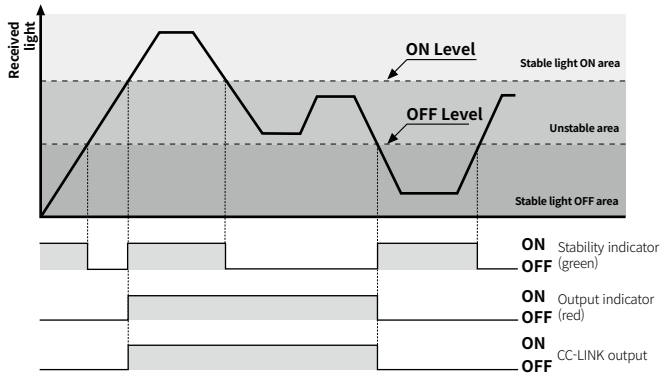
Mode Switching Method



01) Entering to the installation guide mode and pressing [SET] key starts teaching, and the product returns to the run mode after teaching completed.
02) When the status display is 0, press [SET] key to return to the run mode.

Operation Timing Chart

■ Light ON mode



• In Dark ON mode, the waveforms are reversed.

Operation Indicator

☼	ON	●	OFF	◑	Flashing at 0.5 sec interval

■ CH indicator

Item	Output (red)	Stability (green)	Item	Output (red)	Stability (green)
Stable light ON	☼	☼	Unstable light OFF	●	●
Unstable light ON	☼	●	Stable light OFF	●	☼

■ Status indicator

Item		Output indicator (red)	Stability indicator (green LED)	Operation indicator			Operation display	EtherCAT output 01)
				Green	Yellow	Red		
Normal operation		-		☼	●	●	Sensing level	-
Background sensing mode	Sensed	ON (all CHs)	OFF (all CHs)	●	●	☼	b	Outputting ON at All CHs, outputting 'H' at N+1
	Not sensed	OFF (all CHs)	ON (all CHs)	☼	●	●		Outputting ON at All CHs
Installation guide mode	Optical axis coinciding CH	ON (LED of the CH)	ON (all CHs)	☼	●	●	n	Outputting ON at All CHs
	Optical axis not coinciding CH	OFF (LED of the CH)		●	◑	●		
	While teaching	OFF (all CHs)		☼	●	●	Flashing t twice	Outputting ON at All CHs
	Teaching passed	Displaying result and flashing all CHs twice		☼	●	●	Flashing t twice	-
	Teaching failed	Flashing alternately passed / failed CH twice		●	◑	●	Flashing E twice	Outputting ON at All CHs, outputting 'H' at N+1
Channel interference error		Flashing alternately relevant CH at 0.5 sec interval	ON (all CHs)	☼	◑	●	-	Outputting ON at All CHs, outputting 'H' at N+1
Disturbing light sensing alarm		Flashing alternately even and odd CH at 0.5 sec interval	ON (all CHs)	◑	☼	☼	-	Outputting alternately even and odd CH, outputting 'H' at N+2
Emitter / receiver damage alarm 02)	Emitter damage	ON (damaged CH)	ON (emitter)	●	◑	☼	b	Outputting 'H' at emitter / receiver damaged CH, outputting 'H' at N+1
	Receiver damage	ON (CH 7, 8)	ON (receiver)					
Comm. error	Product ↔ CH indicator	Flashing at 0.25 sec interval		◑	●	◑	E	Outputting ON at All CHs, outputting 'H' at N+1
	Product ↔ emitter / receiver	Flashing (malfunctioning CH)	ON (CH 1)	●	☼	☼	C	

01) N stands for all channel.

02) If emitter and receiver are damaged at the same time, output of receiver is prior to that of emitter, and lower number of channel indicator is turned on. The indicator of damaged channel is flashed at 0.25 second interval.

■ Communication status indicator

Item		Comm. status indicator (green)
RUN	Initial status	OFF
	Pre operation status	Flashing at 200 ms interval
	Safe operation status	Repeating 200 ms ON and 1000 ms OFF
	Operation status	ON
L / A IN, L / A OUT	No connection	OFF
	Operation status	Flashing at 50 ms interval
	Disconnection in operation	ON

Functions

■ Background sensing mode

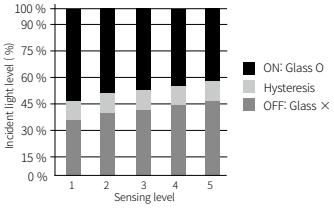
This function instructs adjusting angle to install the product by displaying presence of the background object in the status display when installing the product.
Use this function when sensing is unstable due to the reflection from the background object or any obstacle.

■ Installation guide mode

This function displays whether the sensing target is in the stable position of the guide line when installing the product through the output indicator.
Entering installation guide mode and pressing [SET] key starts teaching.

■ Sensing level setting

This function sets sensitivity by dividing receiving light into 5 levels for stable sensing. Use this function when some of the channels shows low sensing level due to the bent glass plate or diffused reflection. Factory default is level 5.



■ Output option

After setting output option, press [SET] key to set additional option.

Output option (status display)	Description	Additional option	Output option (status display)	Description	Additional option
0	Returning to operation mode	—	3	Operation mode	L : Light ON d : Dark ON
1	Status display orientation	F : Forward b : Backward	4	Changing error output	A : A point b : B point
2	Channel ordering				

■ Self-diagnosis

This function runs self-diagnose periodically in normal operation and displays the part in error at the status display when error occurs.

- Channel interference alarm
  : Outputs alarm when interference from another sensing target and external object in a channel area.
- Disturbing light sensing alarm
  : Outputs alarm when the receiver received external light besides light from the emitter. When the amount of disturbing light is under the affective level, the product operates normally in disturbing light operation mode.
- Emitter / receiver damage alarm
  : Outputs alarm when emitter / receiver is damaged due to the long-term usage of emitter / receiver elements or strong impact to the product.

Troubleshooting

Malfunction	Cause	Troubleshooting
Non-operation	Power supply	Supply the rated power.
	Cable cut, disconnection	Check the wiring.
Non-operation in sometimes	Sensor cover pollution by dirt	Remove dirt by soft brush or cloth and set sensitivity again.
	Connector connection failure	Check the connection area of connector.
Output is ON without a target	Initial sensitivity setting goes wrong	Remove the cause and set sensitivity again.
	There is a strong electric wave or noise generator.	Put away motor, electric generator, or high voltage line.