

Colour Mark Sensors

E3S-DC/E3NX-CA Series



- Suitable for highly reflective materials
- Subtle colour differences can be detected
- Stable even with an inconsistent background

Variety in packaging

Glossy materials and colourful designs

Recently, packaging materials and designs have grown much more diverse. For example there is now aluminium vapour deposition material to prevent oxidation, and there are very colourful packages to attract the attention of consumers. This has caused significant problems in colour mark detection.



Highly-reflective glossy packaging, such as aluminum vapor deposition material

Colourful packaging where there is little difference in colour between the mark and background

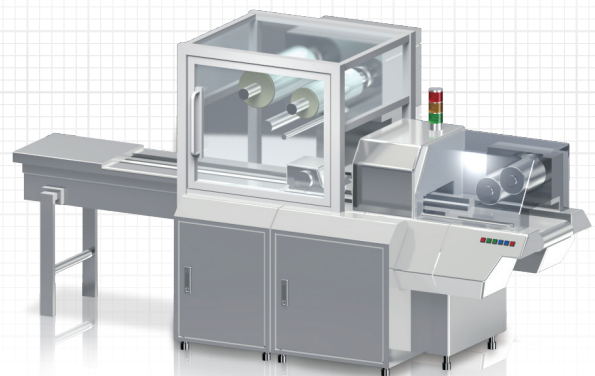
Low-reflection packaging, such as film with fine

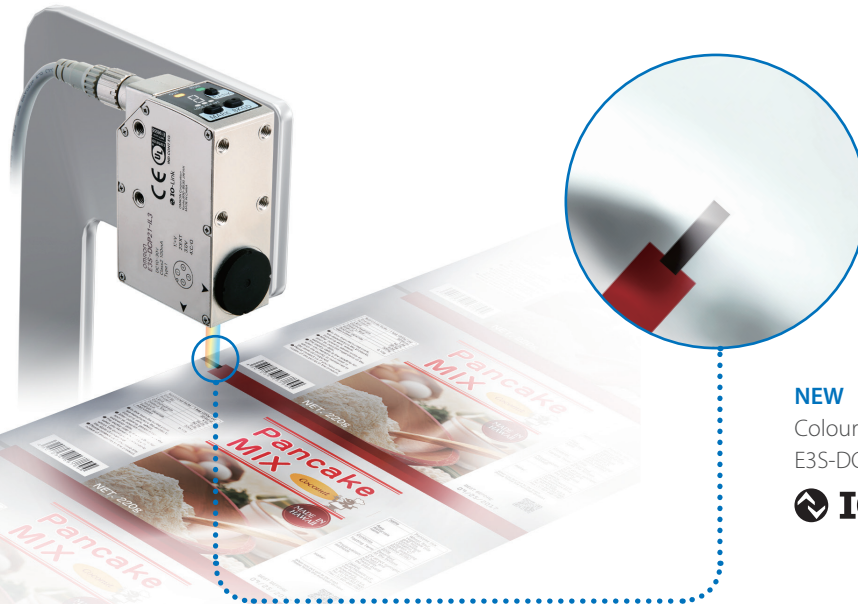


If we follow packaging trends, the number of false detections with colour mark sensors will increase, reducing productivity.

More and more people working with colour mark detection in the field are calling for the following:

- I want stable detection of aluminium vapour deposition material and other glossy packaging.
- I want stable detection of colourful packaging with little colour difference.
- I want stable detection of packaging even if the lot changes.

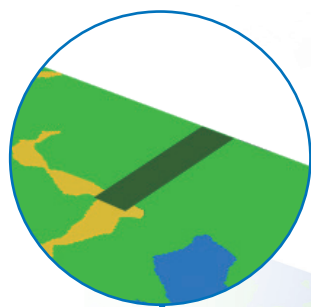




NEW
 Colour Mark Photoelectric Sensor
 E3S-DC
 **IO-Link**

Colour mark detection at full speed

The new Sensors can accurately detect colour marks on glossy and colourful packaging, which have been problematic for conventional systems. This means fewer machine stoppages caused by false detections leading to maximised productivity. The new Sensors also help reduce the number of troubleshooting requests made to packaging machine manufacturers.



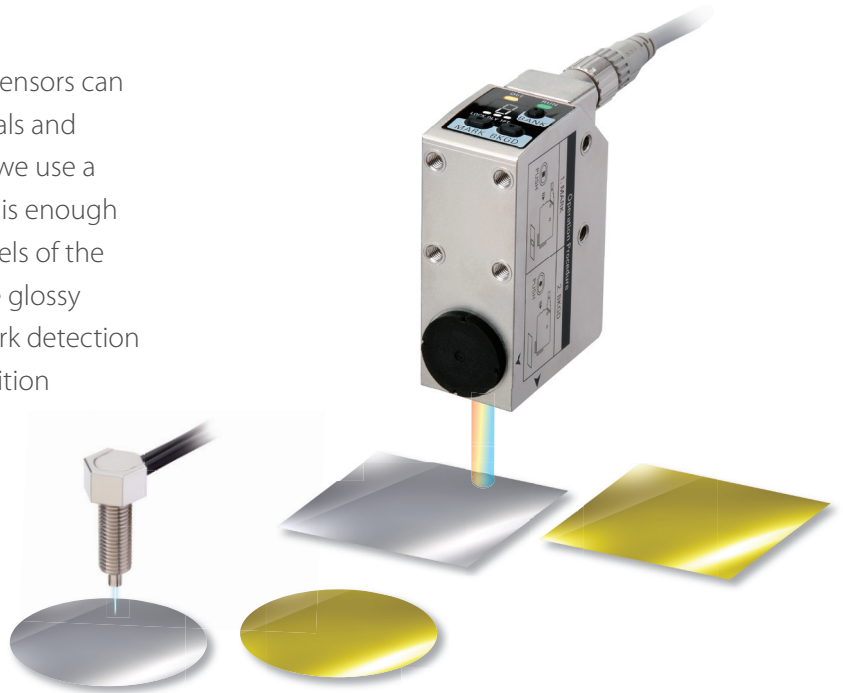
NEW
 Colour Fiber Amplifier Unit
 E3NX-CA



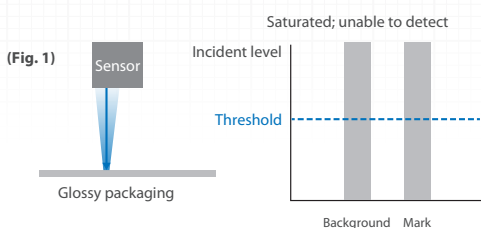
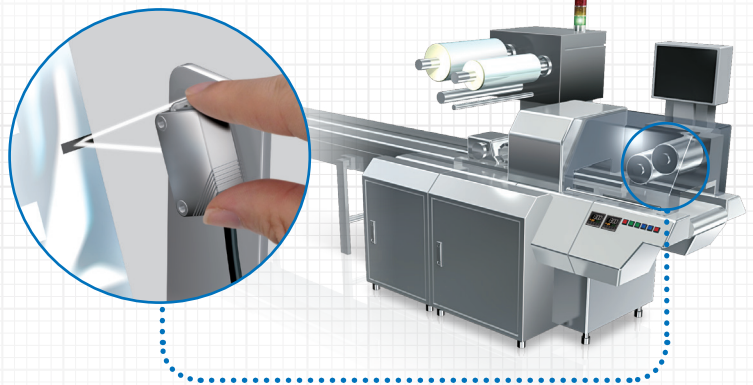

What makes them better sensors?

We use a wide spectrum

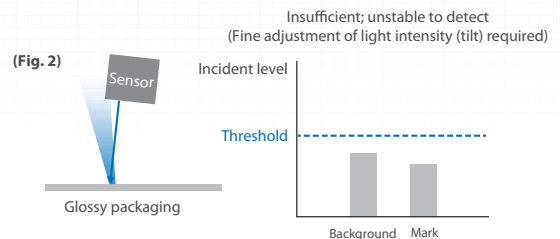
There are many reasons why these new sensors can better handle the new packaging materials and colourful designs. The first reason is that we use a wide light spectrum to ensure that there is enough difference between the incident light levels of the colour mark and reflected levels from the glossy packaging. This enables stable colour mark detection even on glossy aluminium vapour deposition packaging.



I want stable detection of aluminum vapor deposition material and other glossy packaging.



The intensity of the light received by the sensor from highly reflective glossy packaging is too strong, so there is not enough difference in incident levels to perform colour mark detection (i.e. saturation, Fig. 1).



The angle needs to be finely adjusted to avoid saturation and allow the sensor to detect the mark. However, if the sensor is tilted too much, detection will become unstable as the incident level is reduced (Fig. 2).

The new Sensors also have a high dynamic range

So no saturation even with 99% Reflective Optical Mirrors

Colour Mark Photoelectric Sensor (E3S-DC)

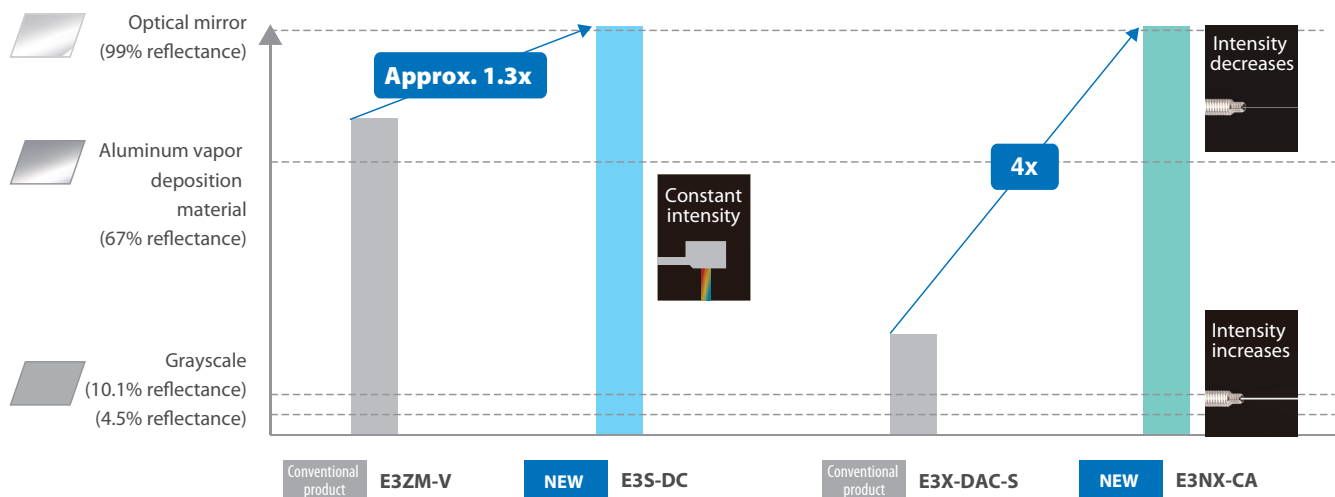
No saturation - no adjustment needed

A high luminance RGB LED in the Photoelectric Sensor significantly improves light intensity. So more incident light is returned to the Sensor. And Smart Noise Reduction technology in the Fibre Amplifier Sensor reduces noise, resulting in a high dynamic range, so the new Sensor is not saturated even when detecting a mirror surface.

Colour Fiber Amplifier Unit (E3NX-CA)

Optimal light intensity - with just two button presses

The high luminance white LED and Smart Noise Reduction technology expand the light intensity adjustment range for the emitter and receiver to 1/100x and 1/3x respectively. You can automatically adjust the optimal intensity by just pressing a button once with a mark and once without it.

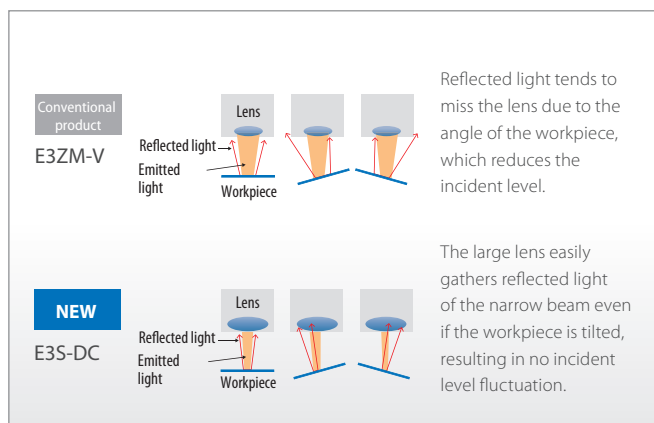


* Optical mirror and aluminium vapour deposition material measured at the distance with maximum incident level (13 mm); grayscale measured at the distance with minimum incident level (7 mm or 13 mm).

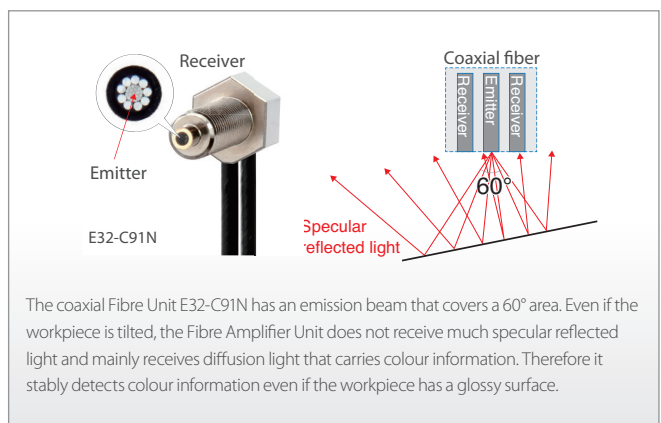


Stable detection even on tilted surfaces and soft paper with shifting angles

Colour Mark Photoelectric Sensor



Colour Fiber Amplifier Unit



Identifies minor colour differences

High S/N ratio system design

Three technologies to obtain a high S/N ratio
 Firstly, a high signal (or incident level) is ensured thanks to the Fibre Amplifier Unit's high luminance white LED, and the Photoelectric Sensor's high luminance RGB LEDs.. Then "Smart Noise Reduction" (a light reception algorithm) and "N-Core" (a high-speed, high-precision IC) work together to dramatically reduce noise. The result is a high S/N ratio even when colour differences are minor.

High power to achieve stable detection
 High-luminance LED

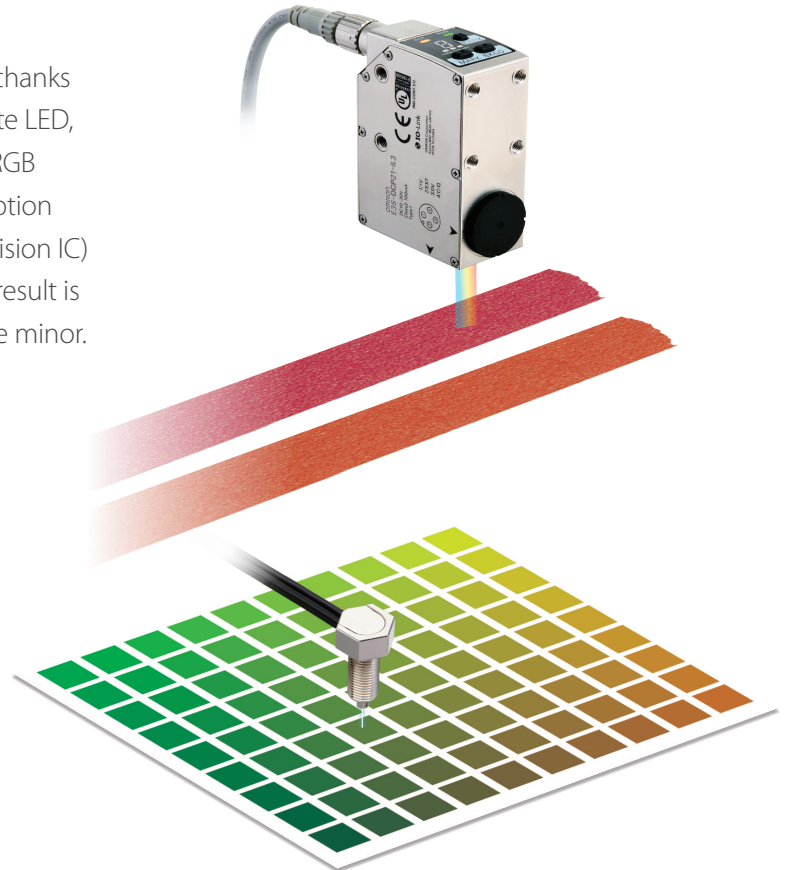
High Luminance Device

Low noise for accurate capturing
 Small signals light reception algorithm

Smart Noise Reduction

High-speed, high-precision signal processing
 High-speed, high-precision IC

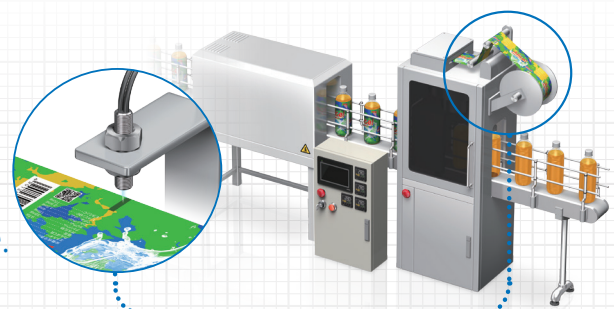
N-Core



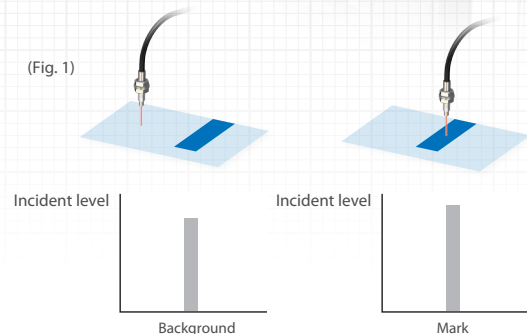
I want stable detection of colourful packaging with little colour difference.

With designs becoming more colourful, there are times where there is little difference in colour between the colour mark and the design elements (background). When colour differences are minor, the S/N ratio*1 required for detection cannot be obtained, and the colour mark cannot be detected (Fig. 1).

*1 This is the ratio of incident levels at which a workpiece is and is not detected. For example, if this is 1,000 when detecting the workpiece and 100 when not detecting the workpiece, the S/N ratio is 10:1. The higher the S/N ratio is, the more stable the detection becomes.



(Fig. 1)



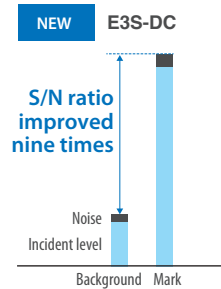
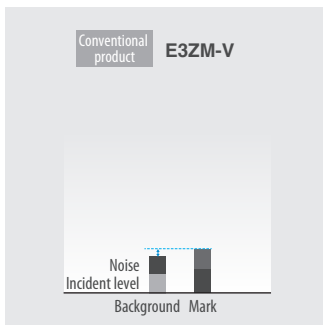
Low Noise for Accurately Capturing Small Signals
Light Reception Algorithm
Smart Noise Reduction



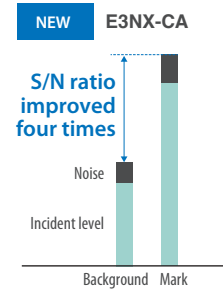
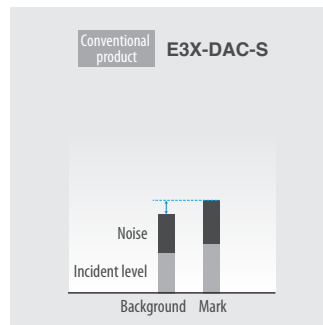
High Power to Achieve Stable Detection
High-luminance Light Emitting Element
High-Luminance Device

High-speed, High-precision Signal Processing
High-speed, High-precision IC
N-Core

Colour Mark Photoelectric Sensor (E3S-DC)



Colour Fiber Amplifier Unit (E3NX-CA)

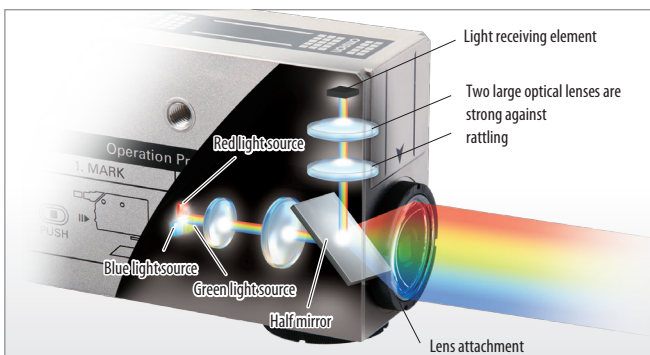


From single wavelengths to colour sensing

The wavelength ranges for red, green, and blue are narrow, and combinations with other colours cannot be detected with RGB single-colour light source sensors (Fig. 2). For the new Colour Mark Sensors, the Photoelectric Sensor uses RGB three-colour LEDs as the light source, and the Fibre Sensor uses a white LED that has a broad wavelength range. Colour sensing makes stable detection possible—even for those colour combinations that would be difficult using single wavelengths.

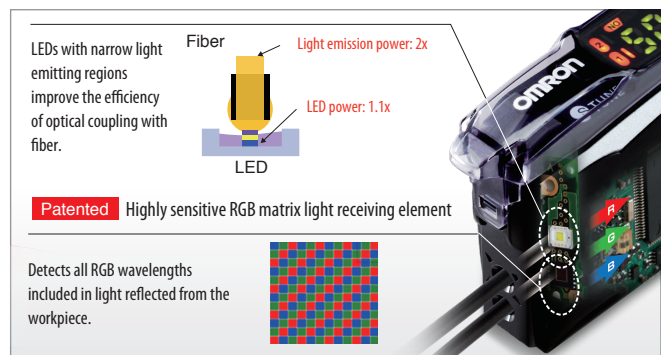
Colour Mark Photoelectric Sensor (E3S-DC)

Three light sources (R, G, and B) in a single device



Colour Fiber Amplifier Unit (E3NX-CA)

White LED light emitting element & RGB matrix light receiving element



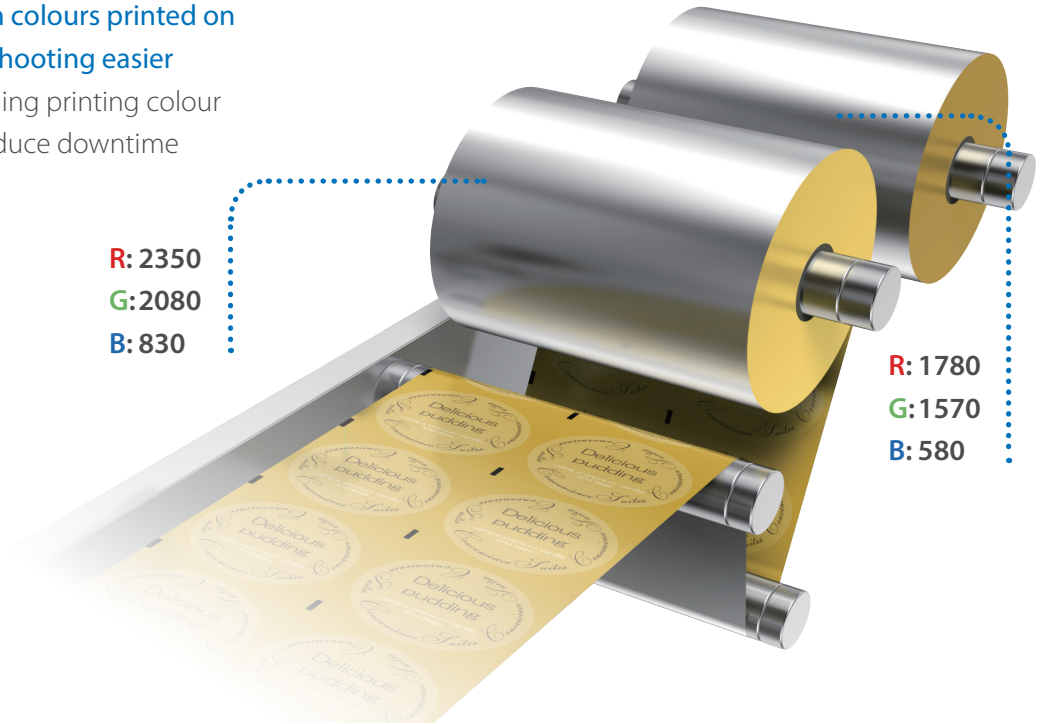
Visualisation of colour variation RGB Data Transmission Function

Visualisation of variation in colours printed on packaging makes troubleshooting easier

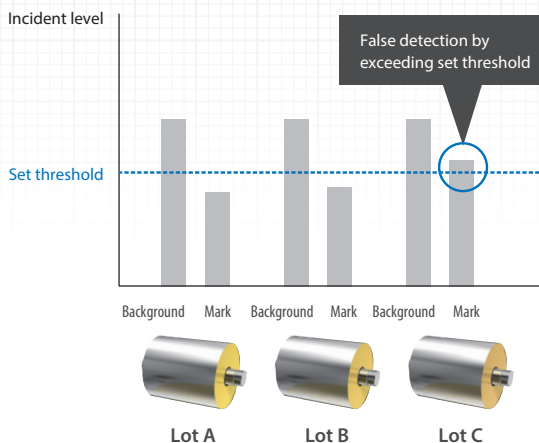
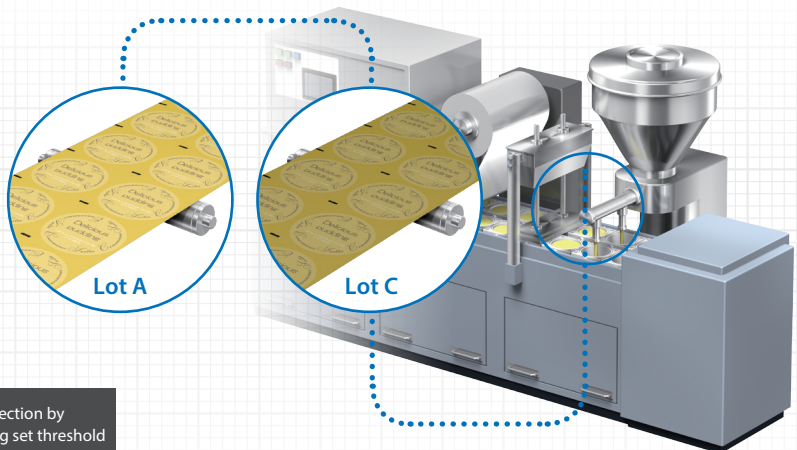
Allowing support of packaging printing colour variation, and helping to reduce downtime

R: 2350
G: 2080
B: 830

R: 1780
G: 1570
B: 580



I want stable detection of packaging even if the lot changes.



There are cases where colours of packaging materials vary from lot to lot. If the sensor's parameters are not changed, this could result in equipment stops caused by false detection. In such a case it can be difficult to determine the cause of the problem—resulting in time lost due to troubleshooting and a notable reduction in productivity.

RGB Data Transmission Function

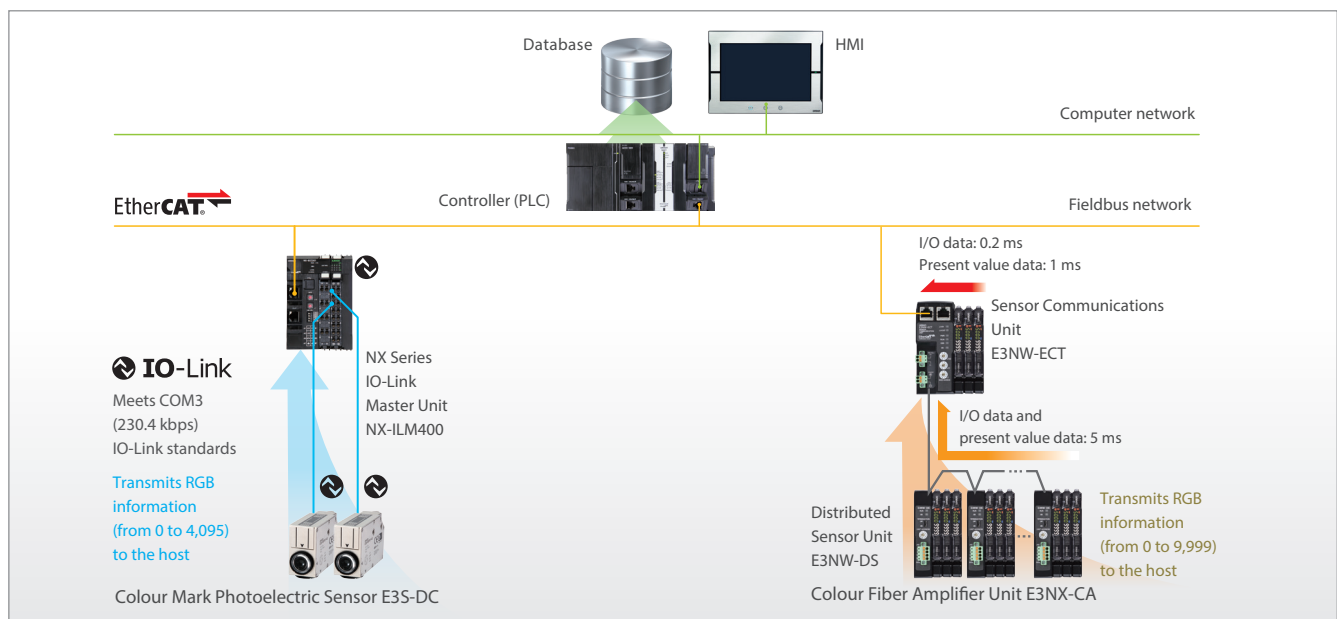
RGB information for colour marks and backgrounds for each lot is transmitted to a host and quantified. This information is then managed in a database, making it possible to set optimal thresholds and identify causes quickly if a problem occurs.

Faster commissioning

Until now, setting the threshold during commissioning required expert knowledge. Now it is possible to get the optimal setting just by registering the RGB ratio of the packaging.

Faster troubleshooting

When the Sensor makes false detection, you can check the values to see if it was caused by a lot to lot colour variation.



Colour Mark Photoelectric Sensor (E3S-DC)

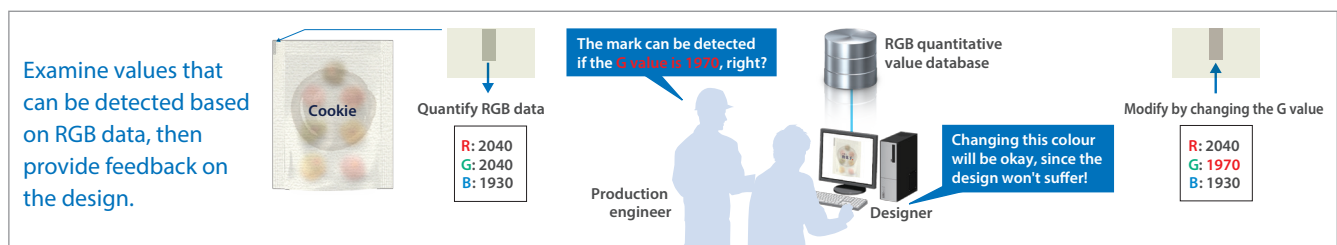
Data transmission via IO-Link

Colour Fiber Amplifier Unit (E3NX-CA)

Data transmission via EtherCAT

See if detection is possible before production starts

The Test Parameter Support Function enables you determine if detection is possible for designs in the prototyping stage. This avoids redesigning unsuitable packaging and helps shorten lead times from design to production line commissioning.





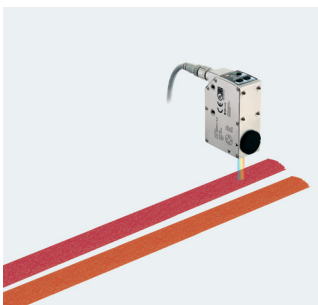
Ordering information

Sensing method	Appearance	Connection method	Sensing distance	Output	Baud rate ^{*1}	Order code
Diffuse-reflective (mark detection)		M12 connector	10±3 mm	Push-pull	COM2	E3S-DCP21-IL2
					COM3	E3S-DCP21-IL3
				NPN	–	E3S-DCN21

^{*1} Refer to Specifications for the baud rate.

Specifications

Item	Sensing method	Diffuse-reflective (mark detection)		
	Output	Push-pull		NPN
	Model	E3S-DCP21-IL2	E3S-DCP21-IL3	E3S-DCN21
Sensing distance		10±3 mm (White paper 10×10 mm)		
Spot size (reference value)		1×4 mm		
Light source (wavelength)		Red LED (635 nm), Green LED (525 nm), Blue LED (465 nm)		
Power supply voltage		10 to 30 VDC±10% (Ripple (p-p) 10% max.)		
Protection circuits		Power supply reverse polarity protection, output short-circuit protection and output incorrect connection protection		
Response time		Operate or reset: 50 µs max. for each (2-point teaching mode) Operate or reset: 150 µs max. for each (1-point teaching mode)		
Ambient temperature range		Operating: –10 to 55°C; Storage: –25 to 70°C (with no icing or condensation)		
Degree of protection		IEC 60529 IP67		
Materials	Case	Diecast zinc (nickel-plated brass)		
	Lens	Methacrylic resin (PMMA)		
	Indicators	ABS		
	Buttons	Elastomers		
	Connector	Diecast zinc (nickel-plated brass)		
Main IO-Link functions		<ul style="list-style-type: none"> Operation mode switching between NO and NC Timer function of the control output and timer time selecting function (Select a function from disabled, ON delay, OFF delay, one-shot or ON/OFF delay.) (Select a timer time of 1-5000 ms.) Selecting function of ON delay timer time for instability (0 (disabled)-1000 ms) Monitor output function (PD output indicating a relative detection quantity) Energizing time read-out function (unit: h) Initialize the settings function "Restore the factory settings" 		–
Communication specifications	IO-Link specification	Version 1.1		–
	Baud rate	E3S-DCP21-IL3: COM3 (230.4 kbps), E3S-DCP21-IL2: COM2 (38.4 kbps)		–
	Data length	PD size: 8 bytes, OD size: 1 byte (M-sequence type: TYPE_2_2)		–
	Minimum cycle time	E3S-DCP21-IL3 (COM3): 1.5 ms, E3S-DCP21-IL2 (COM2): 4.8 ms		–



Stable detection even of similar colors with only minor differences



Three light sources (R, G, B) in a single device



Stable detection of both glossy and colored packaging



Ordering information

Type	Appearance	Connecting method	Inputs/outputs	Order code	
				NPN output	PNP output
Standard models		Pre-wired (2 m)	1 output	E3NX-CA11 2M	E3NX-CA41 2M
		Wire-saving Connector	1 output	E3NX-CA6	E3NX-CA8
Advanced models		Pre-wired (2 m)	2 outputs + 1 input	E3NX-CA21 2M	E3NX-CA51 2M
Model for Sensor Communications Unit ^{*1}		Connector for Sensor Communications Unit	–	E3NX-CA0	

^{*1} A Sensor Communications Unit is required if you want to use the Fiber Amplifier Unit on a network.

Specifications

Item	Type	Standard models		Advanced models	Model for Sensor Communications Unit*1
	NPN output	E3NX-CA11	E3NX-CA6	E3NX-CA21	E3NX-CA0
	PNP output	E3NX-CA41	E3NX-CA8	E3NX-CA51	
	Connecting method	Pre-wired	Wire-saving Connector	Pre-wired	Connector for Sensor Communications Unit
I/O	Outputs	1 output		2 outputs	–*2
	External input	–		1 input*3	
Light source (wavelength)		White LED (420 to 700 nm)			
Supply voltage		10 to 30 VDC, including 10% ripple (p-p)			Supplied from the connector through the Sensor Communications Unit.
Power consumption*4		At Power Supply Voltage of 24 VDC Normal mode: 960 mW max. (Current consumption: 65 mA max.) Eco function ON: 720 mW max. (Current consumption: 30 mA max.) Eco function LO: 800 mW max. (Current consumption: 33 mA max.)			
Control output	Load power supply voltage	30 VDC max., open-collector output			–
	Load current	Groups of 1 to 3 Amplifiers: 100 mA max., Groups of 4 to 30 Amplifiers: 20 mA max.			
	Residual voltage	At load current of less than 10 mA: 1 V max. At load current of 10 to 100 mA: 2 V max.			
	OFF current	0.1 mA max.			
Protection circuits		Power supply reverse polarity protection, output short-circuit protection, and output reverse polarity protection			Power supply reverse polarity protection
Sensing method		Contrast Mode: Light intensity discrimination for RGB (initial state/after 2-point tuning) (R+G+B light intensity discrimination for 1-point tuning) Color Mode: RGB ratio discrimination			
Response time	Super-high-speed Mode (SHS)*5	Operate or reset: 50 μs (only in Contrast Mode)			
	High-speed Mode (HS)	Operate or reset: 250 μs			
	Standard Mode (Std)	Operate or reset: 1 ms			
	Giga-power Mode (GIGA)	Operate or reset: 16 ms			
Sensitivity adjustment		Smart Tuning (2-point tuning, full autotuning, or 1-point tuning (1% to 99%)) or manual adjustment			
Maximum connectable units		30 Units			30 Units (When connected to OMRON NJ-series Unit)
Functions	Operation mode	Contrast Mode: NO (Light-ON) or NC (Dark-ON) Color Mode: NO (ON for match: ON for same color as registered color) or NC (ON for mismatch: ON for different color from registered color)			
	Timer	Select from timer disabled, OFF-delay, ON-delay, one-shot, or ON-delay + OFF-delay timer (Counted by 0.1 s in a range of 0.1 to 0.5 ms, by 0.5 ms for 0.5 to 5 ms, and by 1 ms for 5 to 9999 ms. Default: 10 ms, Error: 0.1 ms)			
	Zero reset	Contrast Mode only Negative values can be displayed. (Threshold level is shifted.)			
	Resetting settings*6	Select from initial reset (factory defaults), user reset (saved settings), or bank reset.			
	Eco mode	Select from OFF (digital display lit), Eco ON (digital display not lit), and Eco LO (digital display dimmed).			
	Bank switching	Select from banks 1 to 8.			
	Power tuning level	Set from 100 to 9,999. (The RGB maximum incident level at Smart Tuning is adjusted to the power tuning level.)			
	Output 2	–	Normal, error output, AND output, or OR output		–
	External input	–	Select from input OFF, tuning, full-auto tuning, emission OFF, bank 1 and 2 switching, bank 1 through 8 switching, or zero reset.		–
	Changing the displays	Threshold level and incident level, channel number and incident level, RGB display and incident level, or bank display and incident level			

*1 The E3NW-ECT Sensor Communications Unit can be used, but the E3NW-CRT/CCL, E3X-DRT21-S, and E3X-CRT/ECT Sensor Communications Units cannot be used.

*2 Two sensor outputs are allocated in the programmable logic controller (PLC) I/O table. PLC operation via Communications Unit enables reading detected values and changing settings.

*3 The following details apply to the input.

	Contact input (relay or switch)	Non-contact input (transistor)
NPN	ON: Shorted to 0 V (Sourcing current: 2 mA max.). OFF: Open or shorted to Vcc.	ON: 1.5 V max. (Sourcing current: 2 mA max.) OFF: Vcc - 1.5 V to Vcc (Leakage current: 0.1 mA max.)
PNP	ON: Shorted to Vcc (Sinking current: 3 mA max.). OFF: Open or shorted to 0 V.	ON: Vcc - 1.5 V to Vcc (sinking current: 3 mA max.) OFF: 1.5 V max. (Leakage current: 0.1 mA max.)

*4 Power consumption

At Power Supply Voltage of 10 to 30 VDC

Normal mode: 1,080 mW max. (Current consumption: 36 mA max. at 30 VDC, 74 mA max. at 10 VDC)



Eco function ON: 840 mW max. (Current consumption: 28 mA max. at 30 VDC, 50 mA max. at 10 VDC)

Eco function LO: 930 mW max. (Current consumption: 31 mA max. at 30 VDC, 55 mA max. at 10 VDC)



*5 The mutual interference prevention function is disabled if the detection mode is set to Super-high-speed Mode.

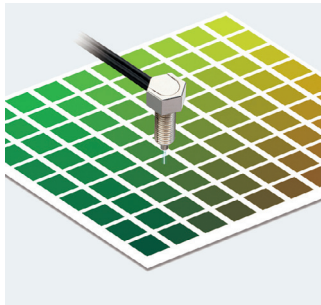
*6 The bank is not reset by the user reset function or saved by the user save function.

Recommended fiber heads

Sensing method	Appearance	Sensing direction	Size	Order code
Reflective		Right-angle	M6	E32-C91N 2M
Through-beam (Grooved type)		Array	10 mm	E32-G16 2M

Fiber amplifier connectors

Type	Appearance	Cable length	No. of conductors	Applicable fiber amplifier units	Order code
Master connector		2 m	3	E3NX-CA6 E3NX-CA8	E3X-CN11
Slave connector			1		E3X-CN12



Stable detection even of similar colors with only minor differences



Stable detection of both glossy and colorful packaging

“To the machine the work of the machine,
to man the thrill of further creation.”

Kazuma Tateisi, founder of Omron

Omron at a glance

Listed in Forbes Top 2000 largest companies of the globe
Omron Corporation NASDAQ: OMRNY
Top ranking in Dow Jones Sustainability Index
Thomson Reuters Top 100 Global Innovators



Dow Jones
Sustainability Indexes
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NASDAQ

200,000 products ranging Input, Logic, Output & Safety

Sensing, Control Systems, Visualisation, Drives, Robots,
Safety, Quality Control & Inspection, Control and
Switching Components

6%

Annual investment in Research & Development

Innovation track record of 80 years

1,200 employees dedicated to R&D
12,500 + issued and pending patents

37,500

Employees worldwide

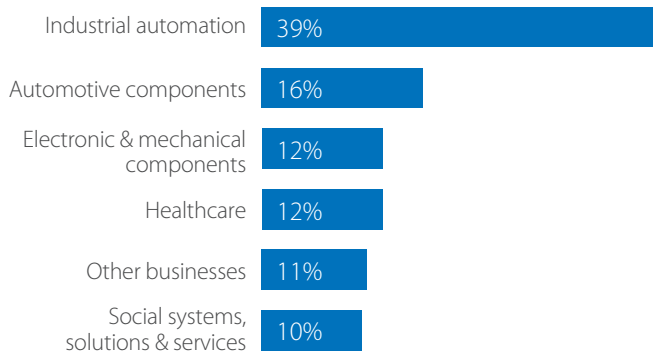
200

Locations worldwide

22

Countries in EMEA

Working for the benefit of society



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