Smart Sensors with Ultra-High-Speed Color CCD Cameras
ZFV-C

OMRON
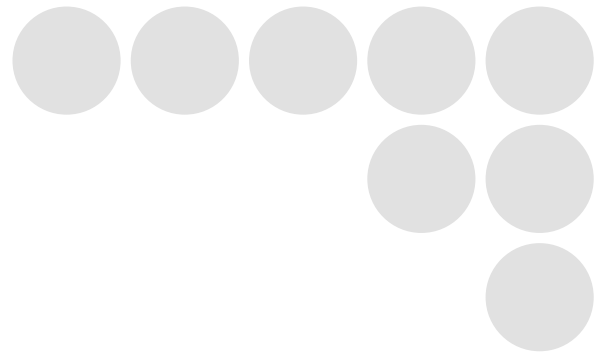
The Next Generation of Advanced Color Sensing.

For Demanding, Color-Critical Applications.

OUTPUT
RUN
ERR
READY

OMRON ZFV-CA40

real**i**zing

Have you heard about some of the sensor problems on your production lines?

If you listen carefully,
you'll probably hear people complaining
about these sensor problems.

With optical sensors...

With image sensors...

It's difficult to make fine settings.

It takes time to make settings and adjustments.

Detection is unstable, leading to quality problems.

They're expensive.

It's difficult to reset the line when products change.

Only people with technical knowledge can operate them.

Optical sensors and image sensors.
The general consensus on the production line is that they both have their advantages and disadvantages.
Many users hesitate to introduce a full-scale image sensor system, but at the same time, find it difficult to install and use an optical sensor system.
Now there is a sensor that answers these problems.
Not an optical sensor and not an image sensor, it's a brand new type of smart sensor.
With the increasing importance that is being placed on quality control today,
you will find this sensor to be a major help in moving your production lines forward.

Introducing the new Smart Sensor from OMRON.

Next Page

Simple to use.
Detection abilities close to human vision.
Smart Sensor provides the best combination of optical and image sensors.

Color or position differences are a good example.
A person can see these with a glance, but it's both costly and labor-intensive to set up a system that will allow a sensor to detect these differences.
If only there were a simpler way, something that resembled human vision...
Now there is, because we have added color capabilities to the Smart Sensor.
In addition to being able to distinguish colors, the new Smart Sensor also offers stable detection for ordinary, conventional workpieces.
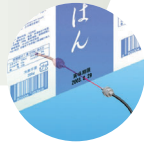It goes a long way toward answering many of the problems that today's production lines are facing.

Stability
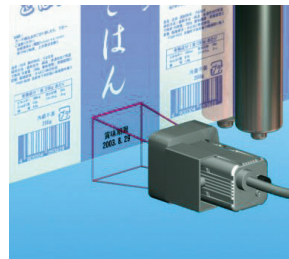
From sensing points to sensing areas

With optical sensors...

There's a chance they will fail to detect due to problems like a shift in the position of printed text.
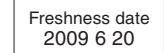
The color ZFV!

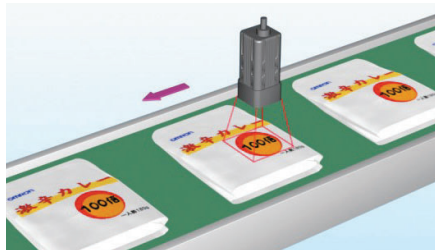It distinguishes shapes, so its measurements maintain stability.

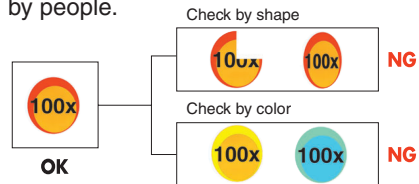The Color Filter function also improves contrast for more stable detection of even faint text.

Freshness date
2009 6 20

▼

Freshness date
2009 6 20

Reliability

Double-check with shape and color

Smart Sensor inspects objects using both shape and color, the two main criteria used by people.

Check by shape

10▢x   100x   **NG**

100x

OK

Check by color

100x   100x   **NG**

Simplicity

Set-up is easy, even for first-time users.

Start setting → TEACH / Menu window → PATTERN / Select inspection item. → Specify area → Finish setting

Simple menu selection using icons.
Just select the icon for the application you want.

One-touch teaching function
The basic settings for inspection items are made by watching the monitor and simply pressing the appropriate button.
This also speeds up resetting operations when products change.

Note: The operational flow varies depending on the selected item.

Ease

Easier than image sensors in a variety of ways.

With image sensors...

You need to worry about the initial cost and the work to build the system.

You don't need advanced functions for simple inspections.

Settings are complicated and maintenance is a chore.

With smart sensors...

Start-up is easy because the sensor and the light source are integrated. Of course, it is also reasonably priced.

Only the functions that your production people truly need are provided. By including the essential functions of the image sensor, we have achieved highly stable measurement.

Even new users can make settings and adjustments easily by selecting the icons while watching the LCD monitor. You don't have to be an expert to use it.

OMRON Color Technology Provides Superior Sensing.

The original Smart Sensor was designed to be easy enough for anybody to use, and our color model shares the same characteristic. The ZFV-C Color Smart Sensor is designed with the same Target, Teach, Go simplicity as the original ZFV.

The Color Filter function is completely automatic, and colors can be easily extracted while watching the monitor. This sensor is smart enough to handle even advanced applications.

The Automatic Color Filter function adds stability to your images.

This function increases the image contrast to make measurements more stable. There are a total of seven color filters in all. The one that obtains the most suitable contrast is automatically selected, so there's no need to worry about color setting parameters.

Color image

5 L 3 Q J 0 6

The optimal filter is automatically selected.

Cyan · Blue · Gray · Magenta · Red · Yellow · Green

After filtering
Monochrome image

5 L 3 Q J 0 6

Crisp and clear!

Without filtering
Monochrome image

5 L 3

Low contrast

Simply choose the candidate color to complete color extraction.

For items that use color extraction, you simply specify the area you want.
The color components in that area are then analyzed and the extraction color candidates are automatically displayed. All you have to do is select the color to be measured.
The extraction conditions for the candidate colors can also be fine-tuned if necessary.
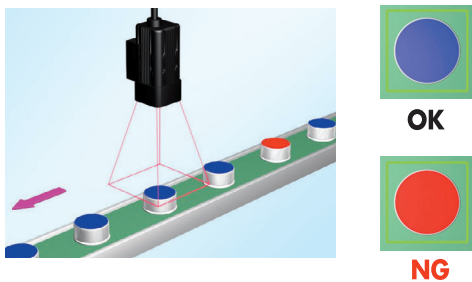This is OMRON's unique human-machine interface for color extraction.

ABC

Extraction color candidates
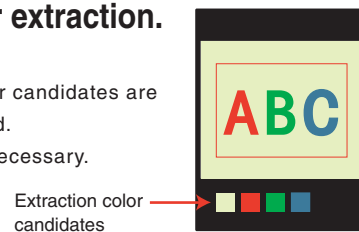
Actual color measurement

HUE

▶ **Inspecting for the intermixture of different-colored packages**

Actual colors can be measured, and those differing from the reference color can be easily distinguished.

OK

NG

Simultaneous, one-touch checking of multiple colors

AREA2

▶ **Inspecting for the intermixture of different cap types**

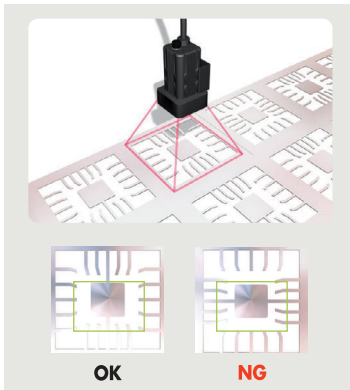Multiple colors can be extracted, so that the surface area of each color can be distinguished.

OK **NG** **NG**

Tea *Tea* *Tea*

(Reference)

Color												
Area												

The area of this color is different.

The area of this color is different.

Seven High-level Matching Capabilities for a Wide Range of Applications

Pattern

OK **NG**
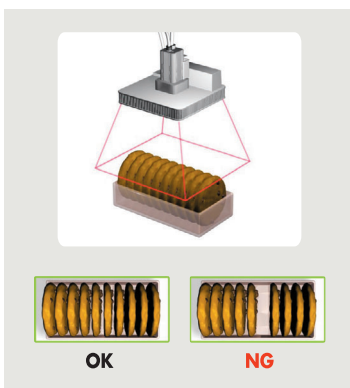
▶ Measure difference or presence of patterns to match shape of object.

Position

OK **NG** **NG**
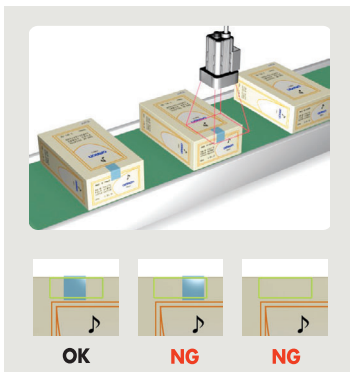
▶ Measure the edge position of labels or sheets.

Number

OK **NG**

▶ Count the number of cookies.

Area

OK **NG**
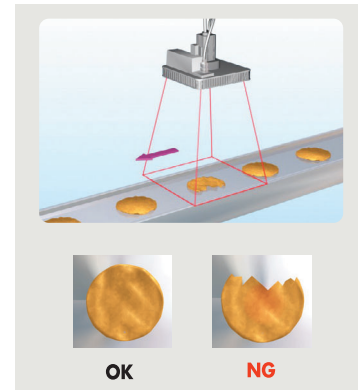
▶ Measure the area of shapes and compare against model to detect broken cookies.

Width

OK **NG**
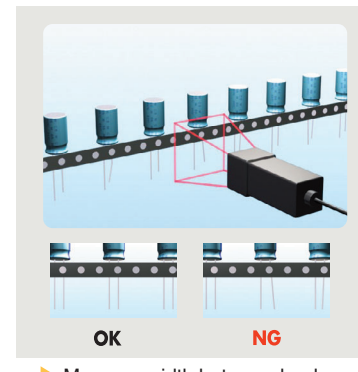
▶ Measure width between leads.

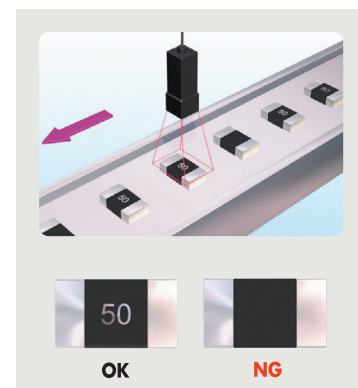## Brightness

OK **NG**
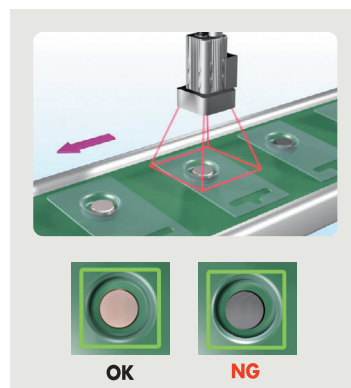
▶ Detecting dirt on battery surfaces.
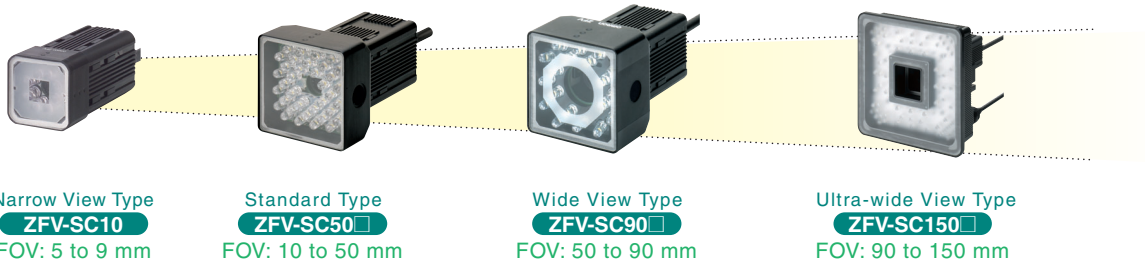
Character

OK **NG**

▶ Match entire character string or detect one missing character.

6

Additional Special Features

1

Wider Field of View of 150 mm

With an FOV from 5 to 150 mm, you can inspect even large workpieces that could not be previously handled.

Narrow View Type	Standard Type	Wide View Type	Ultra-wide View Type
ZFV-SC10	**ZFV-SC50□**	**ZFV-SC90□**	**ZFV-SC150□**
FOV: 5 to 9 mm	FOV: 10 to 50 mm	FOV: 50 to 90 mm	FOV: 90 to 150 mm

Adjustable View
Simple Focus Adjustment

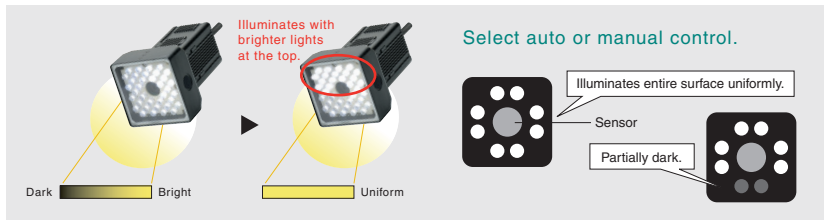An easy to use, manual focus adjustment on the camera eliminates the need to change the head or modify programming for different workpiece sizes.

Adjustment control
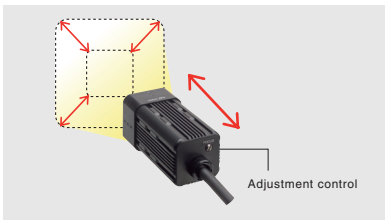
Optimize Lighting Pattern
Intelligent Lighting ZFV-SC10/-SC50□/-SC90□

The lighting pattern can be varied to ensure a uniformly bright display even when the Sensor Head is mounted at an angle. Also, the light turns in sync with the shutter operation, for excellent stability and a long service life.

Illuminates with brighter lights at the top.

Dark — Bright Uniform

Select auto or manual control.

Illuminates entire surface uniformly.
Sensor
Partially dark.

### Fast Mounting
Multi-mount Bracket ZFV-SC10/-SC50□/-SC90□

Mounts to either of the four Sensor Head surfaces, allowing highly flexible mounting and removal.

Ultra Fast for High-speed Production Lines
High-speed Random Shutter CCD

Captures images without any blur, even on high-speed lines. Even at high shutter speeds, the LED power is automatically controlled to provide crisp, clear images.

Tea

No blurring
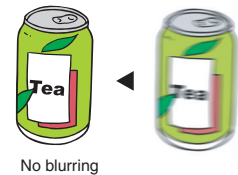
IP67-compliant Design ZFV-SC90W/-SC150W
Washable Head

Featuring an IP67-equivalent design, these models can be completely immersed in water for washing. The entire structure, including the light source, is water resistant.

High-quality Data Transmission
Digital Interface Capability

The image captured by the Sensor Head is quickly transmitted in digital format, making it immune to noise.

Digital transmission

2

Optional Lighting with Easy, One-touch Mounting ZFV-SC50□/-SC90□

A wide variety of optional Lighting Units are available for when the light intensity of the integrated lighting is not sufficient, or when through-beam lighting or some other lighting method is required. Simply plug in the connector to add on.

There is also no need for a special power supply for lighting. Plus, the optional Units feature strobe lighting in sync with the Sensor Head shutter, to provide stable lighting for an extended period of time and a long service life.

Bar-type low-angle lighting
ZFV-LTL04
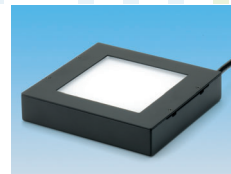
Light source for through-beam lighting
ZFV-LTF01

3

Vision Amplifier with Monitor Features Versatile Functions in a Compact Body

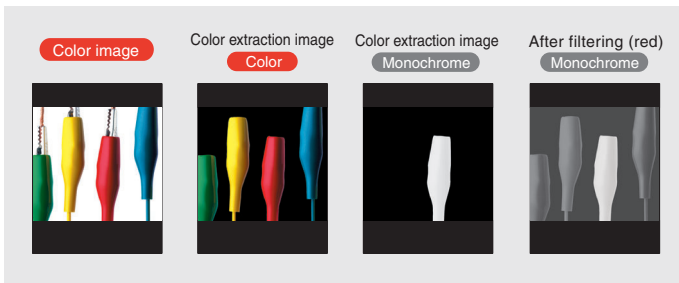Integrated with a 1.8-inch LCD monitor, this Amp is the same compact size as our monochrome models.
It enables operation while viewing the image, so the measurement status can be checked while the line is moving.
It also features USB and RS-232C interfaces for connection to a personal computer.

Selectable Display Patterns
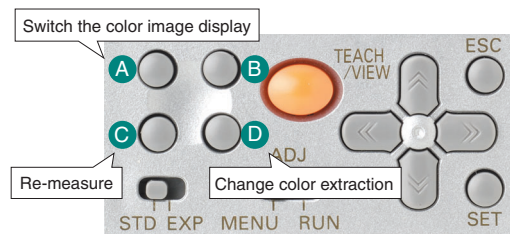One-touch Display Selection

Select the image display that is easiest to see from among color, monochrome, and color extraction display patterns.

Color image

Color extraction image
Color

Color extraction image
Monochrome

After filtering (red)
Monochrome

Japanese-English Selection
Multi Menu

The menu can be switched to Japanese or English to match the application.

Quick and Easy Operation
Function Keys

Fixed keys are allotted with various functions for easy, one-touch operation.

Switch the color image display

A   B   TEACH/VIEW   ESC

C   D   ADJ

Re-measure

Change color extraction

STD EXP MENU RUN   SET

Note: Button B is used for function expansion.

4

High-speed Color Processing

The processing speed is approximately the same as that for monochrome, even when detecting color images with high precision.
OMRON's image processing technologies remove the usual hesitation to use color processing due to its reduced efficiency.

The Industry's Fastest
Real-time Search

An original CCD drive technology and image processing engine enable ultra-fast response by processing data as the image is being captured.
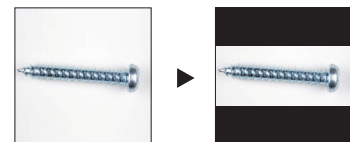The actual image processing time thus becomes zero, making the total processing speed 13 ms maximum.
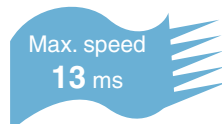
Max. speed
13 ms

Even Faster — 5 ms
Partial Capture Function

The processing speed can be further increased by limiting the image capture to only the part that is required for inspection.
Processing requires 8 ms in FAST mode, and 5 ms (max. speed) in MAX mode.

Max. speed
5 ms

Note: FAST mode

5

Excellent Expandability Meets Even More Applications

With today's rapid pace of new product development, it is essential to select sensors that have future expandability.
The Smart Sensor provides the same level of quality control as larger sensor systems, thanks to its newly enhanced application capabilities and data management and analysis.

Flexible Combinations
High-speed Digital Bus Connection

Controllers can now be directly connected to prevent delays in response. By altering the connection, multiple areas can be simultaneously processed, measurement items can be combined, and the output from two Sensor Heads can be integrated.
This also provides sufficient response to future workpiece changes.

Basic connection   Expanded application connection   Result integration connection   Composite connection
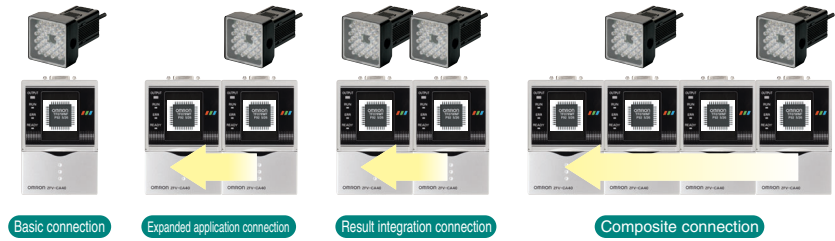
Convenient for Personal Computer Operation and Management
Smart Monitor ZFV Support Software

This software allows settings and image data to be saved and loaded with a personal computer.
For details on the Smart Monitor ZFV Support Software, please contact your OMRON representative.

Smart Monitor ZFV Support Software

USB

6

Easy Operation Achieved by Considering the Operator's Viewpoint

In addition to offering easy basic operation, the ZFV has been designed to provide the best possible operation in a variety of situations.
It helps your quality control system evolve and become smarter by allowing machines to handle the bothersome tasks.

Handy for Maintenance
I/O Monitor Function

The parallel I/O status can be displayed on the monitor to simplify wiring checks, to make maintenance and system start-up faster and easier.

Extend the Service Life
ECO Mode

When not in use, the LCD backlight is automatically turned OFF. This greatly extends the service life compared with having the backlight constantly ON.

Versatile Teaching Modes
Freeze-screen Teaching

This function enables easy one-button teaching, using an image of an instantaneous event that was captured with an external trigger.

Visually Check Judgment Settings
Adjustment Mode

Judgment settings are displayed in bar format, so judgment conditions can be intuitively set.

Workpiece-movement Teaching

The optimum lighting can be automatically selected by using an external trigger to input an image of a moving workpiece.

Flexible Controller Installation

Flexible installation meets the specific needs of each production line. In addition to DIN rail mounting, installation is easy in control panels.

Panel Mounting Adaptor
(Purchase separately)

Ordering Information

■Models

Sensor Heads

Appearance	Type	Setting distance	Sensing area	Model
	Narrow View	34 to 49 mm (variable)	5 × 4.6 mm to 9 × 8.3 mm (variable)	ZFV-SC10
	Standard	31 to 187 mm (variable)	10 × 9.2 mm to 50 × 46 mm (variable)	ZFV-SC50 (IP65) ZFV-SC50W (IP67)
	Wide View	66 to 141 mm (variable)	50 × 46 mm (H × V) to 90 × 83 mm (H × V)	ZFV-SC90 (IP65) ZFV-SC90W (IP67)
	Ultra-wide View	114 to 226 mm (variable)	90 × 83 mm (H × V) to 150 × 138 mm (H × V)	ZFV-SC150 (IP65) ZFV-SC150W (IP67)

Amplifier Units

Appearance	Power supply	Output type	Model
	24 VDC	NPN	ZFV-CA40
		PNP	ZFV-CA45
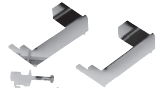
Accessories
Data Storage Units

Appearance	Power supply	Output type	Model
	24 VDC	NPN	ZS-DSU11
		PNP	ZS-DSU41

Controller Link Unit

Appearance	Model
	ZS-XCN

Panel-mounting Adapter

Appearance	Model	
	ZS-XPM1	First Unit
	ZS-XPM2	Additional Units (for expansion)

Sensor Head Extension Cable

Cable length	Model
3 m	ZFV-XC3BV2
3 m	ZFV-XC8BRV2 (Robot cable type)
8 m	ZFV-XC8BV2 (See note 1.)
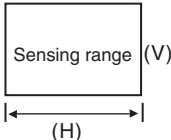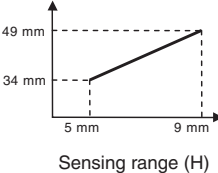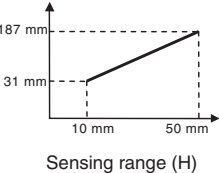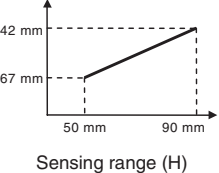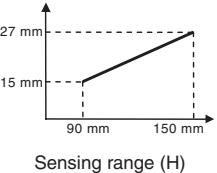
A maximum of two Extension Cables can be connected to extend the cable length of each Sensor Head.
There are no restrictions on the combinations of the two Extension Cables to be used.
Note 1: The ZFV-XC8BV2 Extension Cable can be used only with ZFV-SC10/SC50/SC50W Sensor Heads.

External Lighting

Appearance	Type	Model
	Bar Lighting	ZFV-LTL01
	Bar Double Lighting	ZFV-LTL02
	Bar Low-angle Lighting	ZFV-LTL04
	Light Source for Through-beam Lighting	ZFV-LTF01

Specifications

■Sensor Heads

Item	ZFV-SC10 (Narrow View Type)	ZFV-SC50/SC50W (Standard Type)	ZFV-SC90/SC90W (Wide View Type)	ZFV-SC150/SC150W (Ultra-wide View Type)
Setting distance (L)	34 to 49 mm (variable)	31 to 187 mm (variable)	67 to 142 mm (variable)	115 to 227 mm (variable)
Sensing range (H × V)	5×4.6 mm to 9×8.3 mm (variable)	10×9.2 mm to 50×46 mm (variable)	50×46 mm to 90×83 mm (variable)	90×83 mm to 150×138 mm (variable)
Relation between setting distance and sensing range				
Built-in lens	Focus: f15.65	Focus: f13.47	Focus: f6.1	
Object lighting method	Pulse lighting			
Object light source	Eight white LEDs	Thirty-six white LEDs	Twenty white LEDs	Seventy-two white LEDs
Optional lighting interface	No	Yes		No
Sensing element	1/3-inch CCD			
Shutter	Electronic shutter, shutter time: 1/500 to 1/8,000			
Power supply voltage	15 VDC (Supplied from Amplifier Unit.)	15 VDC, 48 VDC (Supplied from Amplifier Unit.)		
Current consumption	Approx. 200 mA	Approx. 350 mA (15 V: approx. 150 mA, 48 V: approx. 200 mA, including current when external light is connected)		
Dielectric strength	1,000 VAC, 50/60 Hz for 1 min			
Vibration resistance (destruction)	10 to 150 Hz, 0.35-mm single amplitude, 10 times each in X, Y, and Z directions for 8 min			
Shock resistance (destruction)	150 m/s^2, three times each in six directions (up/down, left/right, forward/backward)			
Ambient temperature range	Operating: 0 to 40°C, Storage: −20 to 65°C (with no icing or condensation)			
Ambient humidity range	Operating and storage: 35% to 85% (with no condensation)			
Ambient atmosphere	Must be free of corrosive gas.			
Connection method	Prewired, Standard cable length: 2 m			
Degree of protection (IEC 60529 standard)	IP65	ZFV-SC□□□: IP65 ZFV-SC□□□W: IP67		
Materials	Case: ABS, Mounting bracket: PBT			
Weight	Approx. 200 g (including mounting bracket and cord; packaged condition: approx. 300 g)	Approx. 270 g (including mounting bracket and cord; packaged condition: approx. 350 g)	Approx. 300 g (including mounting bracket and cord; packaged condition: approx. 380 g)	Approx. 600 g (including mounting bracket and cord; packaged condition: approx. 780 g)
Accessories	Mounting bracket (ZFV-XMF) (1), Ferrite core (2), Instruction sheet	Mounting bracket (ZFV-XMF2) (1), Ferrite core (2), Instruction sheet	Mounting bracket (ZFV-XMF2) (1), Ferrite core (2), Instruction sheet	Ferrite core (2), Instruction sheet
LED class (See note.)	Class 1	Class 2	Class 2	Class 1

Note :   Applicable standards
IEC 60825-1: 1993, +A1: 1997, +A2: 2001, EN 60825-1: 1994, +A1: 2002, +A2: 2001

■Amplifier Units

Item		ZFV-CA40	ZFV-CA45
Output method		NPN open collector, 30 VDC 50 mA max., residual voltage 1.2 V max.	PNP open collector, 50 mA max., residual voltage 1.2 V max.
Serial I/O	USB2.0	1 port, full-speed (12 Mbps) MINI-B	
	RS-232C	1 port, 115200 bps max.	
Inspection items		Patterns (PATTERN), Brightness (BRIGHT), Area (AREA), Width (WIDTH), Position (POSITION), Count (COUNT), Color inspection (HUE), Character (CHARA)	
Teaching area size		• Patterns (PATTERN), Brightness (BRIGHT): Any rectangular area (256 × 256 max.) • Area (AREA), Width (WIDTH), Position (POSITION), Count (COUNT), Color inspection (HUE), Character (CHARA): Any rectangular area (full screen max.)	
Sensing area		Full screen	
Resolution		468 × 432 (H × V) max.	
Bank selection		Supported for 8 banks.	
Image input cycle		13 ms (Standard), 8 ms (FAST mode), 5 ms (MAX mode)	
Other functions		Control output switching: ON for OK or ON for NG, ON delay/OFF delay, One-shot output, "ECO" mode	
Connecting to ZS-DSU (See note 2.)	Image logging trigger	Stores NG images or all images.	
	Sampling rate	ZFV measurement cycle (See note 1.)	
	Number of logged images	Logs up to 128 images in series	
	Number of connected Units	15 max. (ZFV: 5 Units max.)	
	External bank function	Amplifier Unit setting data can be saved to the memory card as bank data. Reading bank data enables bank switching.	
Output signals		(1) Control output (OUTPUT) (2) Enable output (ENABLE) (3) Error output (ERROR)	
Input signals		(1) Sync measurement input (TRIG)/Continuous measurement input (TRIG); switched from menu (2) Bank selection input (BANK1-3) (3) Object stationary teaching (TEACH)/Object motion teaching (TEACH); switched from menu	
Sensor Head interface		Digital interface	
Image display		TFT 1.8-inch LCD (Display dots: 557 × 234)	
Indicators		• Judgment result indicator (OUTPUT, Color: orange) • Inspection mode indicator (RUN, Color: green) • Error indicator (ERR, Color: red) • Ready status indicator (READY, Color: blue)	
Operation interface		• Cursor keys (up, down, left, right) • Setting key (SET) • Escape key (ESC) • Operating mode switching (slide switch) • Menu switching (slide switch) • Teaching/Display switching key (TEACH/VIEW) • Function keys (A to D, 4 inputs)	
Power supply voltage		20.4 to 26.4 VDC (including ripple)	
Current consumption		800 mA max. (with Sensor Head connected)	
Dielectric strength		1,000 VAC, 50/60 Hz for 1 min between leads and Amplifier Unit case	
Noise immunity		1 kV, Pulse rise: 5 ns, Pulse width: 50 ns, Burst duration: 15 ms, Cycle: 300 ms	
Vibration resistance (destruction)		10 to 150 Hz, 0.1-mm single amplitude, 10 times each in X, Y, and Z directions for 8 min	
Shock resistance (destruction)		150 m/s^2, three times each in six directions (up/down, left/right, forward/backward)	
Ambient temperature range		Operating: 0 to 50°C, Storage: −25 to 65°C (with no icing or condensation)	
Ambient humidity range		Operating and storage: 35% to 85% (with no condensation)	
Ambient atmosphere		Must be free of corrosive gas.	
Degree of protection		IEC 60529, IP20	
Materials		Polycarbonate	
Weight		Approx. 300 g (including cord; packaged condition: 450 g)	
Accessories		Ferrite core (1), Instruction sheet	

Note 1: This is the sampling rate when logging images. To log measurement data only, use the ZS-DSU settings.
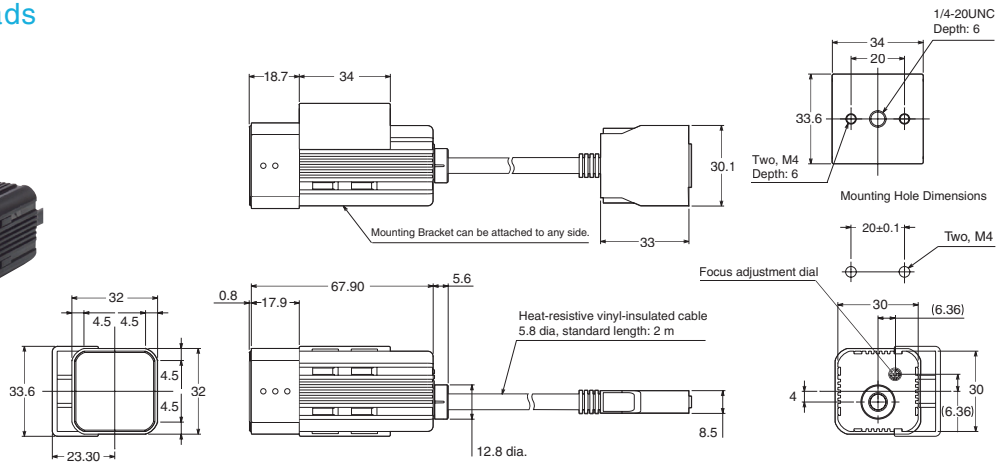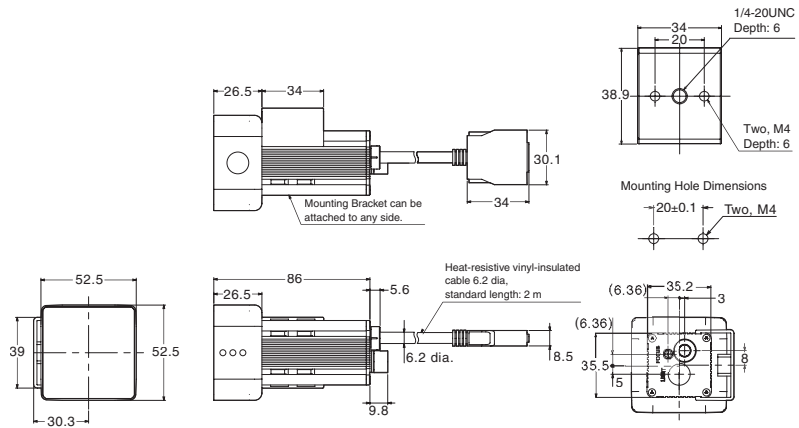2: Connection with the ZS-DSU will be possible with a future upgrade.
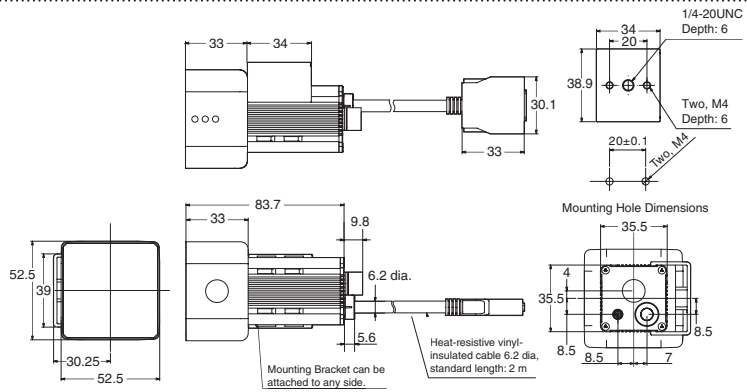
Dimensions

■Sensor Heads

ZFV-SC10

- 18.7
- 34
- 30.1
- 33
- Mounting Bracket can be attached to any side.
- 1/4-20UNC Depth: 6
- 34
- 20
- 33.6
- Two, M4 Depth: 6
- Mounting Hole Dimensions
- 20±0.1
- Two, M4
- Focus adjustment dial
- 32
- 4.5 4.5
- 33.6
- 32
- 4.5
- 4.5
- 23.30
- 0.8
- 17.9
- 67.90
- 5.6
- Heat-resistive vinyl-insulated cable 5.8 dia, standard length: 2 m
- 12.8 dia.
- 8.5
- 30
- (6.36)
- (6.36)
- 30
- 4

ZFV-SC50/SC50W

- 26.5
- 34
- 30.1
- 34
- Mounting Bracket can be attached to any side.
- 1/4-20UNC Depth: 6
- 34
- 20
- 38.9
- Two, M4 Depth: 6
- Mounting Hole Dimensions
- 20±0.1
- Two, M4
- 52.5
- 39
- 52.5
- 30.3
- 26.5
- 86
- 5.6
- Heat-resistive vinyl-insulated cable 6.2 dia, standard length: 2 m
- 6.2 dia.
- 8.5
- 9.8
- (6.36)
- 35.2
- 3
- (6.36)
- 35.5
- 5

ZFV-SC90/SC90W

- 33
- 34
- 30.1
- 33
- 1/4-20UNC Depth: 6
- 34
- 20
- 38.9
- Two, M4 Depth: 6
- 20±0.1
- Two, M4
- Mounting Hole Dimensions
- 52.5
- 39
- 30.25
- 52.5
- 33
- 83.7
- 9.8
- 6.2 dia.
- 5.6
- Heat-resistive vinyl-insulated cable 6.2 dia, standard length: 2 m
- Mounting Bracket can be attached to any side.
- 35.5
- 4
- 35.5
- 8.5
- 8.5
- 8.5
- 7

ZFV-SC150/SC150W

- 110.2
- 59.5
- 140
- 140
- 73.2
- 5
- 29
- 8.5
- 8.5
- 4
- 8.5
- 12
- 35
- 57
- 98
- Mounting surface
- Heat-resistive vinyl-insulated cable 6.2 dia, standard length: 2 m
- 8.5
- 7
- 33
- Two, M4
- 20±0.1
- Mounting Hole Dimensions

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■Amplifier Units

ZFV-CA4□

■Optional Lighting

ZFV-LTL01

Two sets of three, M3
Depth: 5

Mounting Hole Dimensions

Two, M3
Depth: 5

Mounting Hole Dimensions

ZFV-LTL04

Four, M4
(through-hole)

Mounting Hole Dimensions

ZFV-LTL02

Mounting Hole Dimensions

Four, M4
(through-hole)

ZFV-LTF01

Mounting Hole Dimensions

Four, M3
Depth: 8
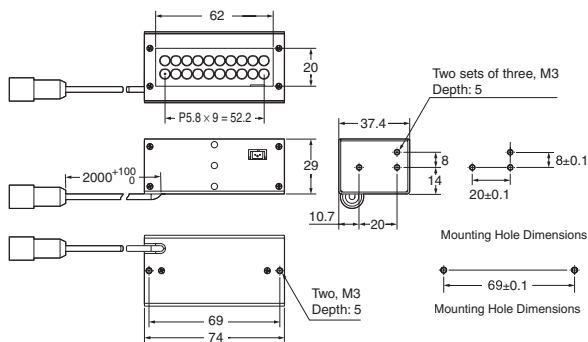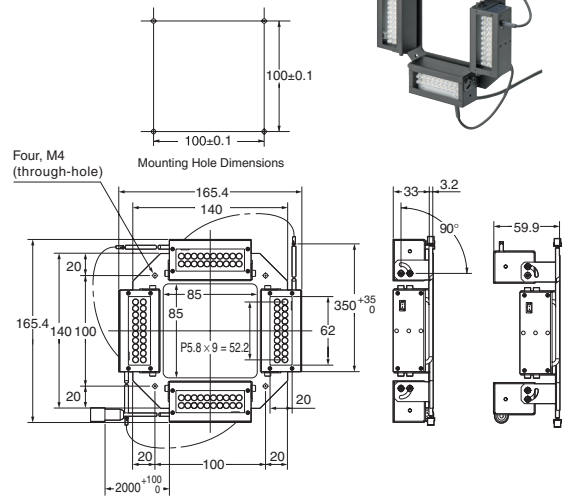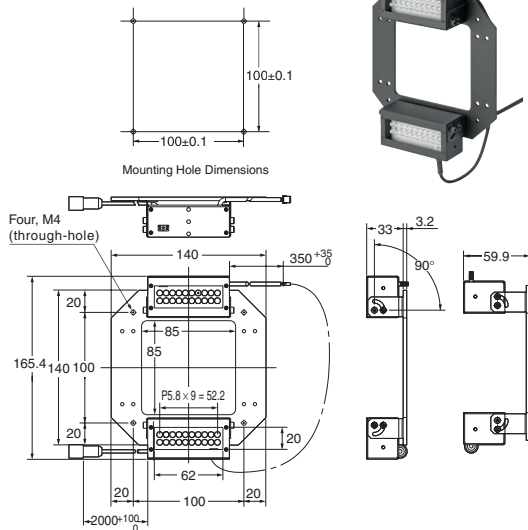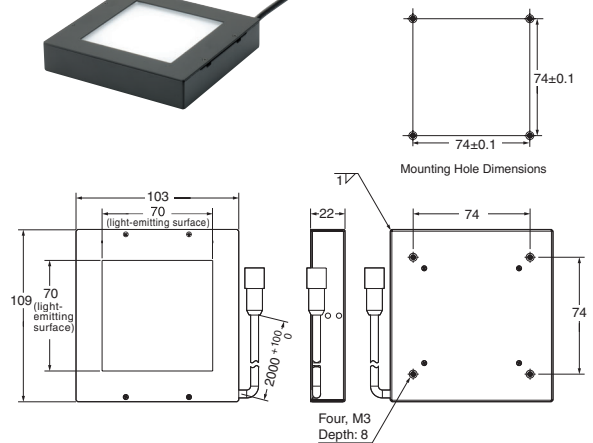
This document provides information mainly for selecting suitable models. Please read the User's Manual (Z240) carefully for information that the user must understand and accept before purchase, including information on warranty, limitations of liability, and precautions.

Note: Do not use this document to operate the Unit.