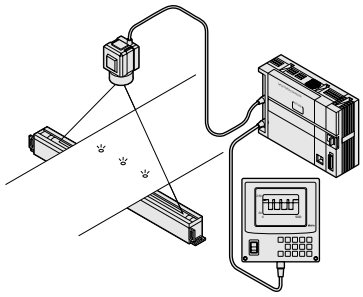
VI SERIES

One-dimensional Image Sensor

Oscilloscope not required! high operability and functionality

No oscilloscope needed

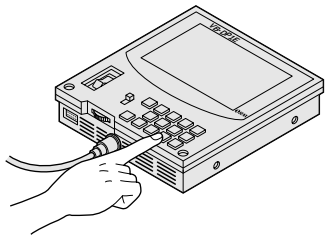
The console is equipped with a large and easy to view backlight LCD screen that displays the video signal sent from the camera.



Easy programming

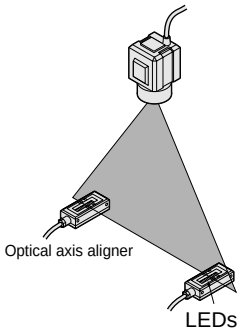
Your original program can be easily developed on the console using menu driven commands. Help menu assists you in program development.

(The console can be mounted on the controller, or away from it, up to 50 m 164.042 ft.)



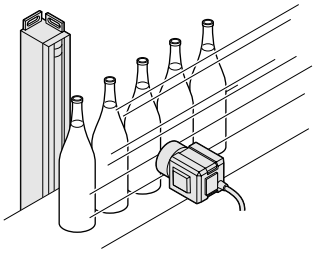
Easy alignment

With optional optical axis aligners, it is easy to determine where the camera is aimed.



Suitable for high speed production lines

The camera operates at 10 MHz frequency and the controller utilizes RISC chip technology. Hence, the **VI** system insures fast and reliable program execution and video processing.



Versatile functions

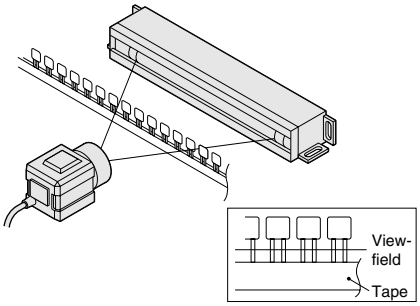
- **Shading correction**
  Because of the non-uniform light distribution due to the lens or the light source, the waveform is obscured at the outer edges. The shading correction rectifies the non-uniform video signal into an ideal symmetrical video signal via unique digital compensation.
- **Video derivative**
  This function extracts only sudden changes from the fluctuating video signal. Thus, minute but steep voltage differences can be detected.
- **Multiple view-fields**
  A total of eight view-fields can be set on the camera view by selecting the first pixels and the last pixels.
- **RS-232C communication**
  By RS-232C communication with PC or PLC, data and / or programs can be easily transferred.
- **Auto-reference**
  This function automatically shifts the slice-level to follow the time variation of light intensity. The system is able to detect the slight signal differences, reliably, all the time.

The **VI** system provides these practical functions and more. Refer to p.998～ for more details.

APPLICATIONS

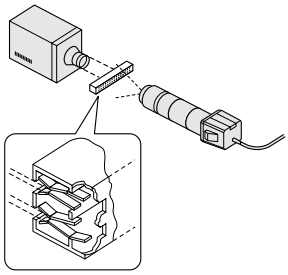
Inspecting pitch between pins of taped components

The pitch between pins of electric components that have been taped can be measured accurately.



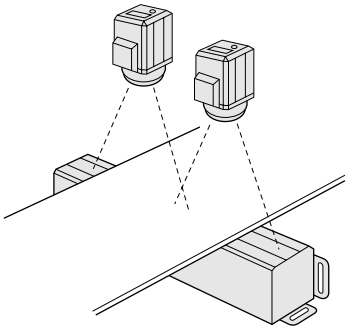
Checking for clearance in connector

The **VI** camera is able to measure a minute gap accurately and at a high speed due to its high resolution of 5,000 pixels.



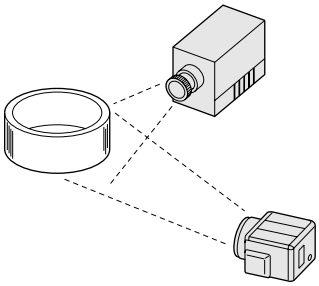
Measuring width of iron steel sheet

A large width steel sheet can be measured accurately by using two image sensors.



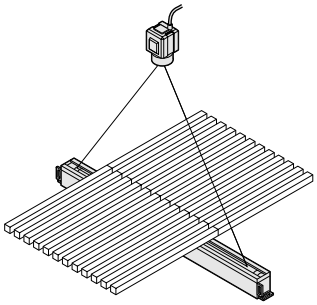
Detecting scratches on a metallic object

Irregular reflection due to scratches can be detected by using the **VI** camera.



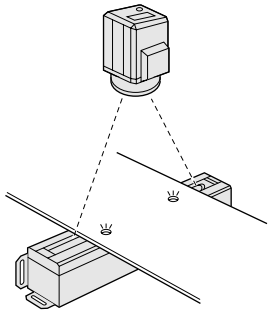
Counting aluminum bars

The number of aluminum bars can be counted accurately.



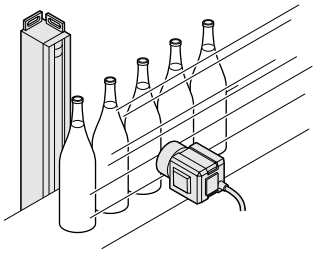
Detecting pin-holes in a sheet

Small pin-holes in a continuously moving sheet are accurately detected.



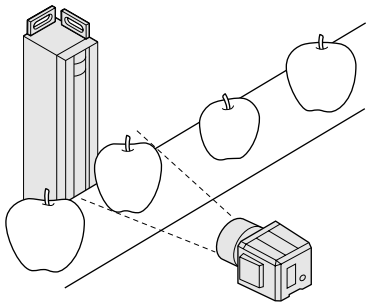
Inspecting liquid level in bottles

Each bottle is inspected to determine if it is filled within the specified level. Fast image updating and program processing allow the sensor to reliably monitor even a fast production line.



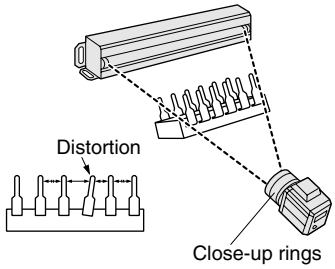
Classifying apples in size

Apples can be classified in size by measuring the outer dimension.



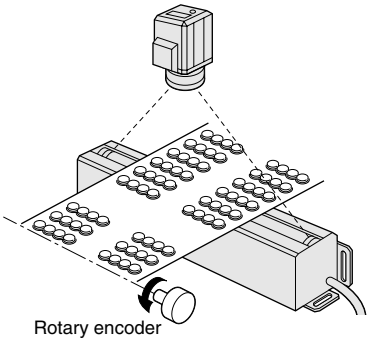
Checking IC pin distortion

Spacing between legs can be measured to determine if the legs are distorted.



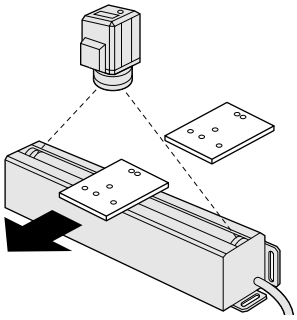
Checking for missing tablets in a tablet pack

Presence of a tablet in each pocket of the tablet pack is examined.



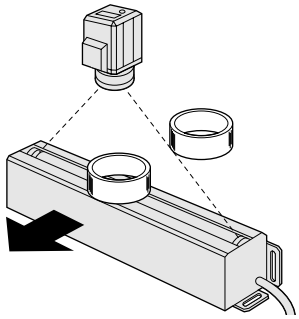
Measuring width of printed circuit board

Width of a perforated printed circuit board can be measured.



Measuring inner and outer diameters of an object

Inner and outer diameters of a moving object can be measured simultaneously.

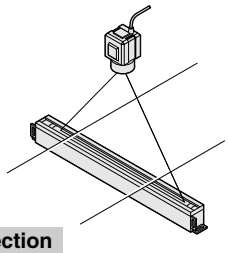


FUNCTIONS

Shading correction

• Because of the non-uniform light distribution due to the lens or the light source, the waveform is obscured at the outer edges. The shading correction rectifies the non-uniform video signal into an ideal symmetrical video signal via unique digital compensation.

Example: Width measurement of translucent film (when using the wide-angle lens)



Before shading correction

The incident light passing through the outer edges of a lens gets distorted. Also, no fluorescent light source is able to produce uniform light intensity along the entire length of the tube. This non-uniform incident light then produces the illustrated video signal, with both sides lower than the center. This makes it difficult to detect a minute signal change.

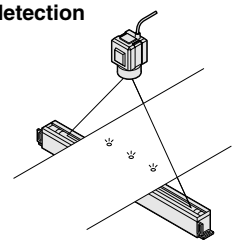
After shading correction

A symmetrical video signal is generated over the entire view-field. The slice-level can be set easily on this clear waveform.

Video derivative

• This function extracts only sudden changes from the fluctuating video signal. Thus, minute but steep voltage differences can be detected.

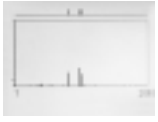
Example: Pin-hole detection



Without video derivative

A tiny pin-hole gives insufficient light intensity. It cannot be detected in a normal waveform.

Video derivative engaged

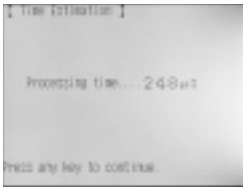


The sharp voltage changes are amplified but the slope is neutralized by the video derivative.

Time estimation

• This function calculates the approximate processing time of the program written by you. The result is used to set the camera scan time.

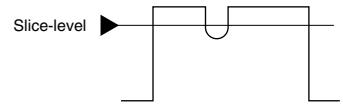
Window on the console



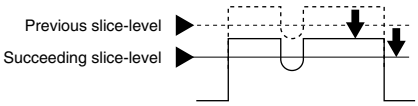
Auto-reference

• This function automatically shifts the slice-level to follow the time variation of light intensity. The system is able to detect the slight signal differences, reliably, all the time.

Regular condition



Light source deteriorating condition

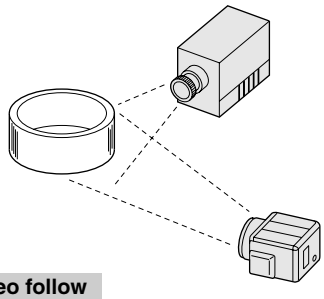


• As the light intensity level decreases, the slice-level automatically changes.
The system maintains its sensitivity even as conditions change.

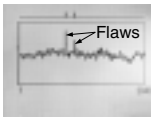
Video follow

• This function enables detection of the signal from a noisy view-field.

Example: Flaw detection on a rough surface

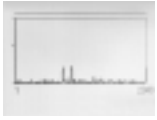


Without video follow



Flaws are not detectable due to random saw-tooth noise over the view-field.

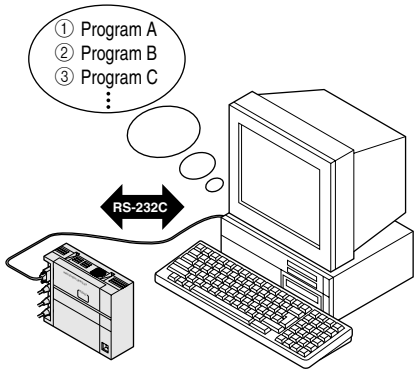
Video follow engaged



Since only large changes are detected, stable sensing is possible.

RS-232C communication

• By RS-232C communication with PC or PLC, data and/or programs can easily be transferred.

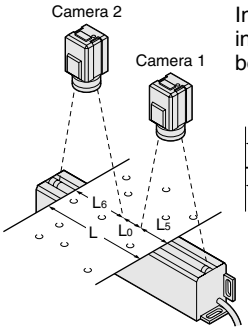


FUNCTIONS

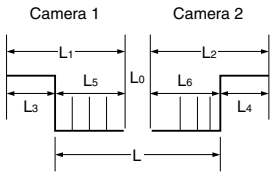
Scan direction

• This function changes the direction of the camera scan to either forward or reverse. The camera can be installed in either orientation.

Example: Width measurement of a perforated sheet using two cameras.



In case Camera 1, 2 can be mounted only in the same direction, the video signal will be as given below.



$L = L_5 + L_6 + L_0$

Since L_5, L_6 cannot be measured, due to the number of Light patterns being uncertain, L_3 and L_4 are measured and subtracted from the entire view-field to give L_5 and L_6.

$L_5 = L_1 - L_3$, $L_6 = L_2 - L_4$

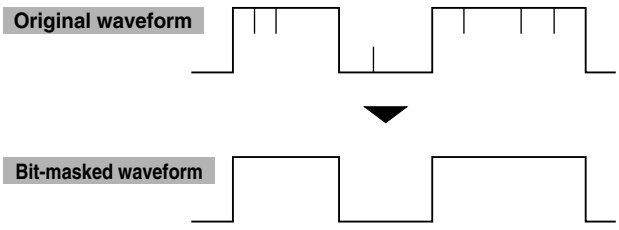
Accordingly,

$L = (L_1 - L_3) + (L_2 - L_4) + L_0$

Here, although L_3 can be measured straight away, L_4 cannot be measured since the number of light patterns are undetermined. In such a case, if the scanning direction is reversed, the waveform becomes similar to that of Camera 1 and L_4 can be measured.

Bit mask

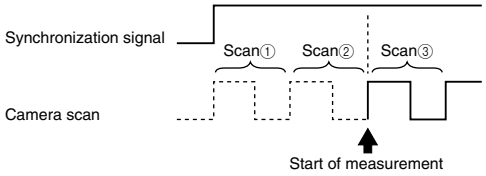
• This function masks sharp point signals under 15 pixels wide.



Bit-masked waveform is not displayed on the console.

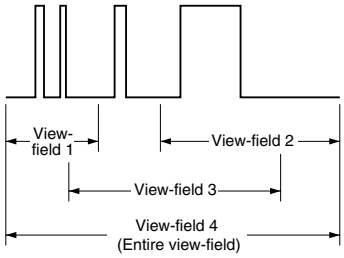
Scan mask

• The system starts measurement after the specified number of scans initiated by the synchronization.
When it is difficult to match the synchronization timing to the point where the measurement starts, this function is useful to adjust the synchronizing point.



Multiple view-fields

• A total of eight view-fields can be set on the camera view by selecting the first pixels and the last pixels. The view-fields can overlap each other and the respective slice-levels can be set independently.



Program save

• A total of 31 programs can be stored in the controller. This allows for easy program changes that enable quick product change-over.

Data display

• The selected data is displayed on the console during RUN mode. This information is updated once per cycle of program execution. When any specified BRKP (Break point) condition becomes true during normal operation, or warning occurs, the display update is halted. This function can be used for finding out program errors, or troubleshooting actual situations in your application.

Light monitor set-up

• The controller monitors the received light intensity level. If the light intensity level is lower than the alarm level, the alarm output is activated.
The system continuously monitors aging of the light source, or deterioration of the camera lens or the system environment.

Two active programs

• The controller can control two independent cameras installed at different locations. The **VI** system is able to run two active programs in parallel, associated with the respective cameras.

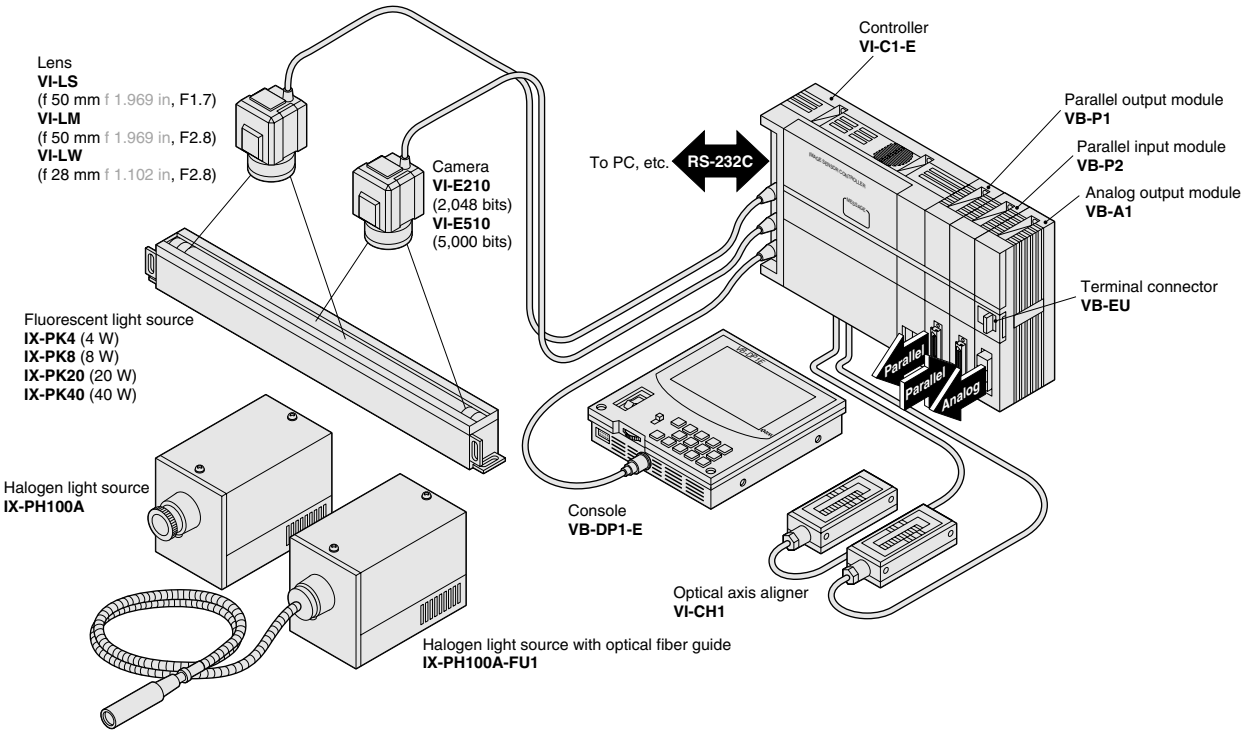
Synchronization

• It is selectable from six types.
① Asynchronous: The program is executed at every scan.
② Single trigger: The program is executed once when the synchronization signal is input.
③ Gate trigger: The program is continuously executed during the synchronization signal input being active.
④ Video trigger: The program execution is triggered by the specified video signal.
⑤ Encoder trigger: The pulses input from the encoder are counted, and for every specified number of pulses the program is executed once.
⑥ Data-out trigger: Serial or parallel data is output after the trigger signal is input.

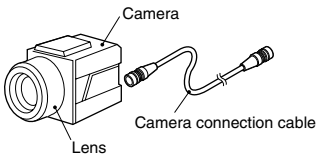
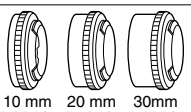
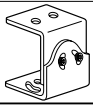
Output timer

• The judgment outputs can be ON or OFF delayed for the specified time.
It enables control of the output signal width for matching it to the input device conditions.

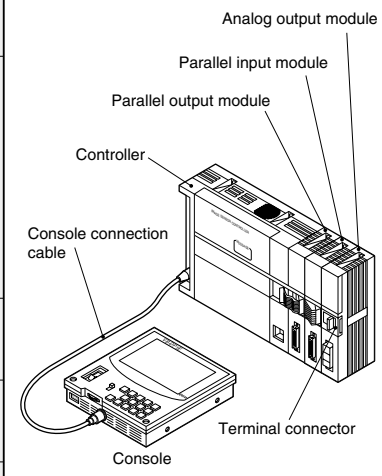
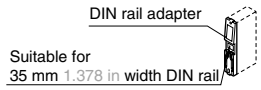
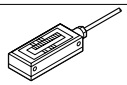
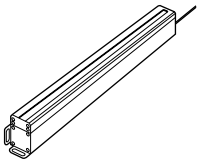
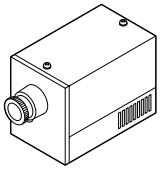
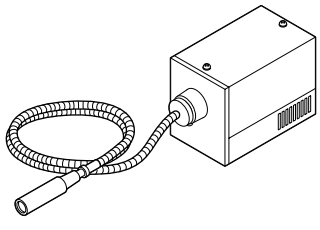
SYSTEM OVERVIEW



ORDER GUIDE

Designation	Appearance	Model No.	Description	
Camera		**VI-E210**	Single dimensional CCD image sensor, 2,048 bits	
		VI-E510	Single dimensional CCD image sensor, 5,000 bits	
Lens		**VI-LS**	Standard lens, f50 mm f1.969 in, F1.7, with focus fixing knob	
		VI-LM	Macro lens, f50 mm f1.969 in, F2.8, with focus fixing knob	
		VI-LW	Wide-angle lens, f28 mm f1.102 in, F2.8, with focus fixing knob	
Camera connection cable		**VI-CCJ5**	Length: 5 m 16.404 ft	This cable connects the camera to the controller. Connectors are attached at both the ends.
		VI-CCJ10	Length: 10 m 32.808 ft	
		VI-CCJ20	Length: 20 m 65.617 ft	
		VI-CCJ30	Length: 30 m 98.425 ft	
Close-up rings		**K set**	The extension rings narrow the field of view and increase accuracy. One set consists of 3 pcs. (10 mm 0.394 in, 20 mm 0.787 in, 30 mm 1.181 in types)	
Camera mounting base		**MS-IX1**	This is a mounting base for horizontal or vertical installation of the camera. Mounting screws are attached.	

ORDER GUIDE

Designation	Appearance	Model No.	Description
Controller		**VI-C1-E** (Note)	Image sensor controller High-end processing with easy programming (The English version with display in English.)
Console		**VB-DP1-E** (Note)	Operator interface Waveform and data display, and programming terminal (It can be mounted on or separated from the controller.) (The English version with display in English.)
Console connection cable		**ID-CC5-2D**	Length: 5 m 16.404 ft Connection cable to allow the console to be mounted away from the controller
		ID-CC10-2D	Length: 10 m 32.808 ft
		ID-CC20-2D	Length: 20 m 65.617 ft
		ID-CC50-2D	Length: 50 m 164.042 ft
Expansion module: Parallel output module		**VB-P1**	Used to increase the output points (16 output points) (The **VI-C1-E** controller can support up to 15 expansion modules.)
Expansion module: Parallel input module		**VB-P2**	Used to increase the input points (16 input points) (The **VI-C1-E** controller can support up to 15 expansion modules.)
Expansion module: Analog output module		**VB-A1**	Selectable either analog voltage output (−5 to +5 V or 0 to +5 V) or analog current output (4 to 20 mA) (The **VI-C1-E** controller can support up to 15 expansion modules.)
Terminal connector		**VB-EU**	Terminal connector on the last expansion module
DIN rail adapter		**MS-DIN-IDC**	Adapter to allow the controller and the expansion module to be mounted on 35 mm 0.378 in width DIN rail. (2 pcs. are needed for the controller.)
Optical axis aligner		**VI-CH1**	Optical axis aligner to position camera view-field
Fluorescent light source		**IX-PK4**	Fluorescent light source 4 W, 70 mm 2.756 in effective illuminating length
		IX-PK8	Fluorescent light source 8 W, 200 mm 7.874 in effective illuminating length
		IX-PK20	Fluorescent light source 20 W, 400 mm 15.748 in effective illuminating length
		IX-PK40	Fluorescent light source 40 W, 1,000 mm 39.370 in effective illuminating length
Halogen light source		**IX-PH100A**	Halogen light source 100 W Uniform illumination, incorporates zoom lens and illumination adjuster
Halogen light source: Spare parts		**IX-LA**	Replacement lamp unit for **IX-PH100A** and **IX-PH100A-FU1** (lamp + socket)
Halogen light source with optical fiber guide		**IX-PH100A-FU1**	Halogen light source with optical fiber guide 100 W Since the fiber guide can be mounted even in a narrow place, setting can be chosen as desired.
		IX-PH100AX	Main body of **IX-PH100A-FU1**
Halogen light source with optical fiber guide: Spare parts		**IX-PHA**	Attachment to mount the **IX-FU1** fiber to the **IX-PH100A** main body
		IX-FU1	Optical fiber

Note: The Japanese version with display in Japanese (controller: **VI-C1**, console: **VB-DP1**) is also available.

VI

SPECIFICATIONS

Controller

Item \ Model No.	VI-C1-E
Supply voltage	24 V DC ± 10 % Ripple P-P 5 % or less
Current consumption	450 mA or less (**VI-C1-E** only)
Input (EXT.1 to EXT.4)	Photocoupler input • Rated input voltage: 24 V DC ± 10 % (Voltage between COM.IN and IN) • Signal condition: ON voltage ... (Voltage between COM.IN and IN − 15 V) or less ON current ... 8 mA or more OFF voltage ... (Voltage between COM.IN and IN − 5 V) or more OFF current ... 1.5 mA or less • Input impedance: 2 kΩ approx.
Output (OUT 1 to OUT 6, ALARM, MODE)	NPN open-collector transistor (Photocoupler isolation) • Maximum sink current: 100 mA • Applied voltage: 30 V DC or less (between output and COM. OUT) • Residual voltage: 1.8 V or less (at 100 mA sink current)
Camera connection	Up to 2 cameras
Expansion modules	Up to 15 modules connectable
Ambient temperature	0 to + 50 °C + 32 to + 122 °F (No dew condensation) Storage: − 10 to + 60 °C + 14 to + 140 °F
Ambient humidity	35 to 85 % RH, Storage: 35 to 85 % RH
Material	Enclosure: Heat-resistant ABS Front cover: Polycarbonate
Weight	900 g approx.
Accessories	RS-232C connector (HDEB-9P manufactured by Hirose Electric Co., LTD.) : 1 pc. Connector housing (HDE-CTH manufactured by Hirose Electric Co., LTD.): 1 pc.

Cameras

Item \ Type / Model No.	Standard VI-E210	High resolution VI-E510
Supply voltage	24 V DC ± 10 % Ripple P-P 5 % or less (supplied from **VI-C1-E** controller)	
Current consumption	250 mA or less	
Element	CCD	
Number of pixels	2,048	5,000
Scan time	Self-scan: 0.2 to 3.4 ms With controller: 0.25 to 20 ms	Self-scan: 0.5 to 8.1 ms With controller: 0.55 to 20 ms
Drive frequency	10 MHz	
Ambient temperature	0 to + 45 °C + 32 to + 113 °F (No dew condensation) Storage: − 10 to + 60 °C + 14 to + 140 °F	
Ambient humidity	35 to 85 % RH, Storage: 35 to 85 % RH	
Material	Enclosure: Die-cast aluminum	
Weight	380 g approx.	390 g approx.
Accessories	Adjusting screwdriver: 1 pc. Insulating assembly (one plate and two collars): 1 set	

Expansion modules

Item \ Designation / Model No.	Parallel input module VB-P2	Parallel output module VB-P1	Analog output module VB-A1
Supply voltage	24 V DC ± 10 % (supplied from **VI-C1-E** controller)		
Current consumption	30 mA or less	100 mA or less	
Input	Photocoupler input • Rated input voltage: 24 V DC ± 10 % (Voltage between COM.IN and IN) • Signal condition: ON voltage ... (Voltage between COM.IN and IN − 18 V) or less ON current ... 3 mA or more OFF voltage ... (Voltage between COM.IN and IN − 9 V) or more OFF current ... 0.5 mA or less • Data format: BCD or BINARY • Input impedance: 5.6 kΩ approx.	Photocoupler input • Rated input voltage: 24 V DC ± 10 % (Voltage between COM.IN and IN) • Signal condition: ON voltage ... (Voltage between COM.IN and IN − 15 V) or less ON current ... 8 mA or more OFF voltage ... (Voltage between COM.IN and IN − 5 V) or more OFF current ... 1.5 mA or less • Input impedance: 2 kΩ approx.	————
Output	NPN open-collector transistor (Photocoupler isolation) • Maximum sink current: 100 mA • Applied voltage: 30 V DC or less (between output and COM.OUT) • Residual voltage: 1.8 V or less (at 100 mA sink current)		————
Analog output	————		Selectable from − 5 to + 5 V voltage output, 0 to + 5 V voltage output, or 4 to 20 mA current output
Ambient temperature	0 to + 50 °C + 32 to + 122 °F (No dew condensation), Storage: − 10 to + 60 °C + 14 to + 140 °F		
Ambient humidity	35 to 85 % RH, Storage: 35 to 85 % RH		
Material	Enclosure: Heat-resistant ABS, Front panel: Polycarbonate		
Weight	160 g approx.		180 g approx.
Accessories	Data I/O connector (PCR-E28FS manufactured by Honda Tsushin Kogyo Co., LTD.): 1 pc. Connector housing (PCS-E28LB manufactured by Honda Tsushin Kogyo Co., LTD.): 1 pc.		————

SPECIFICATIONS

Console

Item \ Model No.	VB-DP1-E
Supply voltage	24 V DC ± 10 % (supplied from **VI-C1-E** controller)
Current consumption	300 mA or less
LCD	320 × 240 pixels (40 columns × 15 lines) with CFL backlight
Ambient temperature	0 to + 40 °C + 32 to + 104 °F (No dew condensation), Storage: − 10 to + 40 °C + 14 to + 104 °F
Ambient humidity	35 to 85 % RH, Storage: 35 to 85 % RH
Material	Enclosure: Heat-resistant ABS Front cover: Polycarbonate
Weight	600 g approx.
Accessory	Console mounting screw [M4 (length 55 mm 2.165 in) screw with washer]: 2 pcs.

Halogen light sources

Item \ Model No. \ Type	Halogen light source	
		With optical fiber guide
	IX-PH100A	**IX-PH100A-FU1**
Projected area characteristics	Refer to p.1006	
Supply voltage	100 V AC ± 10 % 50 / 60 Hz	
Power consumption	120 VA or less	
Light source	100 W halogen lamp Average lifetime: 1,000 hours at supply voltage 100 V AC	
Illumination control	Adjustable from approx. 60 % to 100 % by adjuster	
Illumination variation	Within ± 2 %/V with respect to supply voltage change Within ± 10 % with respect to ambient temperature change (within ambient temperature range)	
Ambient temperature	0 to + 40 °C + 32 to + 104 °F (No dew condensation), Storage: − 20 to + 80 °C − 4 to + 176 °F	
Ambient humidity	35 to 85 % RH, Storage: 35 to 85 % RH	
Material	Enclosure: Cold rolled carbon steel (SPCC)	Enclosure: Cold rolled carbon steel (SPCC) (Refer to optical fiber guide specifications for fiber)
Connection	Metal connector	
Recommended cable	Extension up to total 50 m 164.042 ft is possible with 0.75 mm² 2-core cabtyre cable (outer dia: φ6 to φ7 mm φ0.236 to φ0.276 in).	
Weight	1.8 kg approx.	1.95 kg approx. (including optical fiber guide)
Accessories	2P metal connector for power: 1 pc.	2P metal connector for power: 1 pc. Hexagon wrench: 1 pc. Precision screwdriver: 1 pc.

Fluorescent light sources

Item \ Model No. \ Type	High frequency			
	IX-PK4	**IX-PK8**	**IX-PK20**	**IX-PK40**
Effective illuminating length	70 mm 2.756 in	200 mm 7.874 in	400 mm 15.748 in	1,000 mm 39.370 in
Supply voltage	100 V AC ± 10 %			
Power consumption	30 VA or less	35 VA or less	60 VA or less	100 VA or less
Illumination frequency	35 kHz approx.		30 kHz approx.	
Light bulb average lifetime	1,500 hours approx.		3,700 hours approx.	5,000 hours approx.
Bulb type	4 W (FL4W) (Note1)	8 W (FL8W) (Note2)	20 W (FL20SS) (Note3)	40 W (FL40SS) (Note4)
Ambient temperature	+ 5 to + 50 °C + 41 to + 122 °F (No dew condensation), Storage: + 5 to + 50 °C + 41 to + 122 °F			
Ambient humidity	35 to 85 % RH, Storage: 35 to 85 % RH			
Material	Enclosure: Aluminum			
Power cable	Cabtyre cable 2.9 m 9.514 ft long with AC plug at the end			
Weight	1.2 kg approx.	1.7 kg approx.	2.8 kg approx.	4.8 kg approx.

Notes: 1) Recommended product...FL4W Manufactured by Matsushita Electric Industrial Co., Ltd.
2) Recommended product...FL8W Manufactured by Matsushita Electric Industrial Co., Ltd.
3) Recommended product...FL20SS·EX-N/18 Manufactured by Matsushita Electric Industrial Co., Ltd.
4) Recommended product...FL40SS·ENW/37 Manufactured by Matsushita Electric Industrial Co., Ltd.

※Optical fiber guide specifications

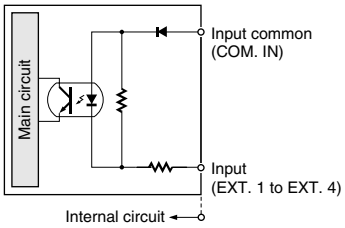
Item \ Model No.	IX-FU1
Fiber cable length	1.2 m 3.937 ft
Allowable bending radius	R25 mm R0.984 in or more
Ambient temperature	− 30 to + 100 °C − 22 to + 212 °F (No dew condensation or icing allowed) Storage: − 30 to + 100 °C − 22 to + 212 °F
Ambient humidity	35 to 90 % RH, Storage: 35 to 90 % RH
Material	Fiber core: Multi-component glass Spiral jacket: Stainless steel Light convergence lens holder: Aluminum
Accessory	Precision screwdriver: 1 pc.

VI

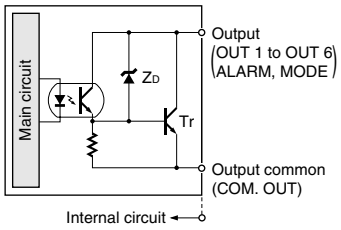
I/O CIRCUIT AND WIRING DIAGRAMS

VI-C1-E

Input circuit diagram

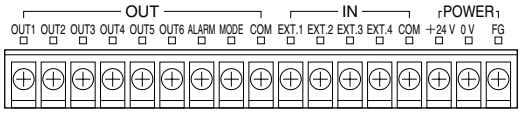


Output circuit diagram

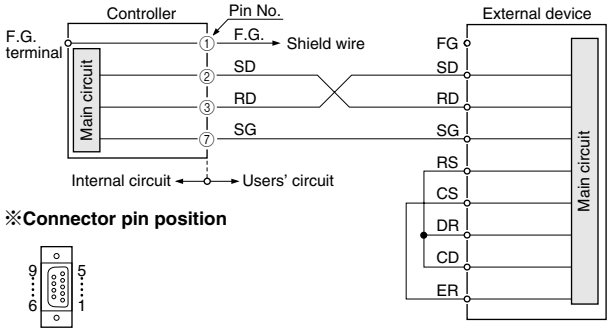


Symbols ... Tr : NPN output transistor
ZD: Surge absorption zener diode

Terminal arrangement



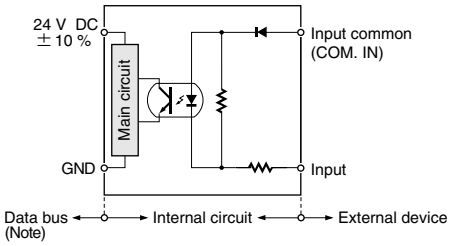
RS-232C wiring diagram



Receptacle on controller: SEDB-9S (Manufactured by Hirose Electric)
Mating connector: HDEB-9P (Manufactured by Hirose Electric Co., LTD.) (accessory) or equivalent
Connector housing: HDE-CTH (Manufactured by Hirose Electric Co., LTD.) (accessory) or equivalent

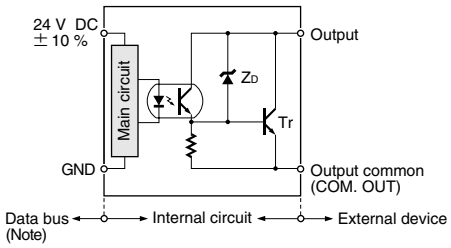
VB-P1
VB-P2

Input circuit diagram



Note: Signals, other than power, have been omitted from the data bus in the above illustration.

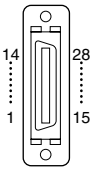
Output circuit diagram



Note: Signals, other than power, have been omitted from the data bus in the above illustration.

Symbols ... Tr : NPN output transistor
ZD: Surge absorption zener diode

Connector pin position



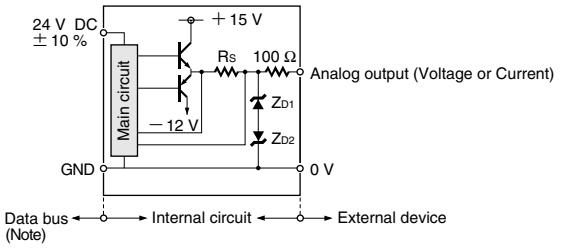
Pin No.	Parallel input module		Parallel output module	
	Signal name	Symbol	Signal name	Symbol
1	Input common	COM.IN	Input common	COM.IN
2	Input 0	IN0	Output 0	OUT0
3	Input 1	IN1	Output 1	OUT1
4	Input 2	IN2	Output 2	OUT2
5	Input 3	IN3	Output 3	OUT3
6	Input 4	IN4	Output 4	OUT4
7	Input 5	IN5	Output 5	OUT5
8	Input 6	IN6	Output 6	OUT6
9	Input 7	IN7	Output 7	OUT7
10	Output common	COM.OUT	Output common	COM.OUT
11	Busy output	$\overline{\text{BUSY}}$	Strobe output	$\overline{\text{STB}}$
12	Sign input	SIGN	Sign output	SIGN
13	Not connected	NC	Not connected	NC
14	Not connected	NC	Not connected	NC
15	Input common	COM.IN	Input common	COM.IN
16	Input 8	IN8	Output 8	OUT8
17	Input 9	IN9	Output 9	OUT9
18	Input 10	IN10	Output 10	OUT10
19	Input 11	IN11	Output 11	OUT11
20	Input 12	IN12	Output 12	OUT12
21	Input 13	IN13	Output 13	OUT13
22	Input 14	IN14	Output 14	OUT14
23	Input 15	IN15	Output 15	OUT15
24	Output common	COM.OUT	Output common	COM.OUT
25	Strobe input	$\overline{\text{STB}}$	Busy input	$\overline{\text{BUSY}}$
26	Error output	ERROR	Error output	ERROR
27	Not connected	NC	Not connected	NC
28	Not connected	NC	Not connected	NC

Receptacle on module: PCR-E28LMDA (Manufactured by Honda Tsushin Kogyo Co., LTD.)
Mating connector: PCR-E28FS (Manufactured by Honda Tsushin Kogyo Co., LTD.) (accessory) or equivalent
Connector housing: PCR-E28LB (Manufactured by Honda Tsushin Kogyo Co., LTD.) (accessory) or equivalent

I/O CIRCUIT AND WIRING DIAGRAMS

VB-A1

Analog output circuit diagram



Note: Signals, other than power, have been omitted from the data bus in the above illustration.

Symbols ... Rs: Current detection resistor
Z_{D1}, Z_{D2}: Surge absorption zener diode

Analog output specifications

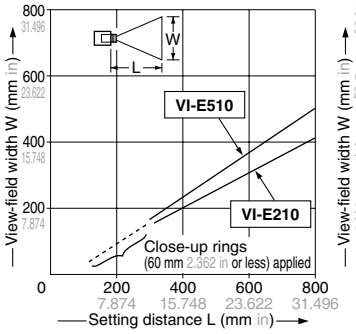
	−5 to +5 V voltage output	0 to +5 V voltage output	4 to 20 mA current output
Output voltage (current) range	−5 to +5 V	0 to +5 V	4 to 20 mA
Resolution	12 bits (2.4 mV approx.)	11 bits (2.4 mV approx.)	12 bits (3.9 μA approx.)
Linearity distortion	±0.25 % F.S. (±25 mV)	±0.5 % F.S. (±25 mV)	±0.5 % F.S. (±80 μA)
Temperature error	±0.02 % F.S./°C		±0.05 % F.S./°C
Load resistance	1 MΩ or more		300 Ω or less
Short-circuit protection	Incorporated		———

CHARACTERISTICS (TYPICAL)

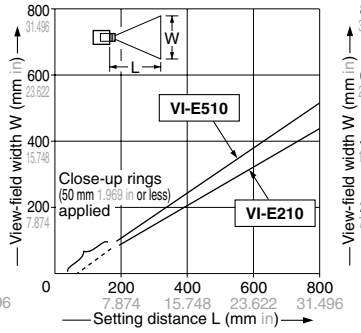
VI-E210 VI-E510 Camera

Correlation between setting distance and view-field width

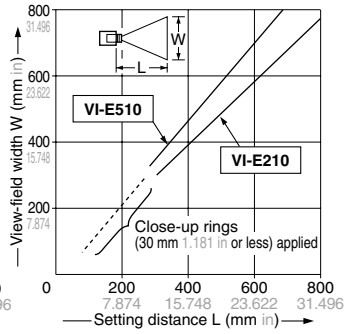
• Standard lens / **VI-LS**



• Macro lens / **VI-LM**



• Wide-angle lens / **VI-LW**



View-field width

Camera	Lens	Min. view-field width (mm in)	Min. setting distance (mm in)
VI-E210	VI-LS	209 8.228	445 17.520
	VI-LM	70 2.756	195 7.677
	VI-LW	240 9.449	275 10.827
VI-E510	VI-LS	221 8.701	390 15.354
	VI-LM	86 3.386	195 7.677
	VI-LW	325 12.795	300 11.811

Note: The above values are typical data for your reference only.

Min. view-field width with close-up rings (VI-E210)

Close-up ring No.	Lens	Min. view-field width (mm in)	Min. setting distance (mm in)
1	VI-LS	80 3.150	220 8.661
	VI-LM	46 1.811	170 6.693
	VI-LW	70 2.756	120 4.724
2	VI-LS	57 2.244	190 7.480
	VI-LM	———	———
	VI-LW	41 1.614	100 3.937
3 (Note 2)	VI-LS	———	———
	VI-LM	30 1.181	160 6.299
	VI-LW	27 1.063	100 3.937
2+3 (Note 2)	VI-LS	———	———
	VI-LM	23 0.906	160 6.299
1+2+3 (Note 2)	VI-LS	23 0.906	100 3.937

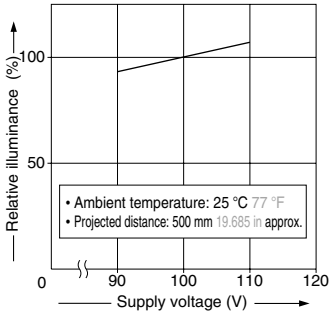
※**Close-up ring length** No.1 = 10 mm 0.394 in
No.2 = 20 mm 0.787 in
No.3 = 30 mm 1.181 in

Notes: 1) The above values are typical data for your reference only.
2) The **VI-LM** macro lens allows close-up rings of 50 mm 1.969 in or less.
The **VI-LW** wide-angle lens allows close-up rings of 30 mm 1.181 in or less.
The **VI-LS** standard lens allows close-up rings of 60 mm 2.362 in or less.
3) The values in the above table are specified for use with **VI-E210** camera, but almost identical values hold for **VI-E510**, too.

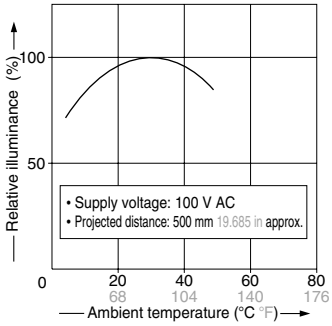
CHARACTERISTICS (TYPICAL)

IX-PK□ Fluorescent light source

Correlation between supply voltage and illuminance

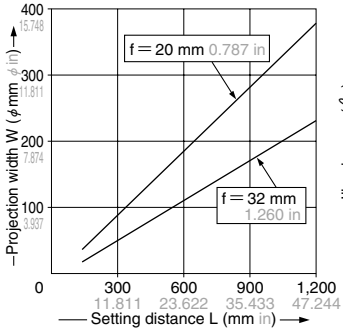


Correlation between ambient temperature and illuminance

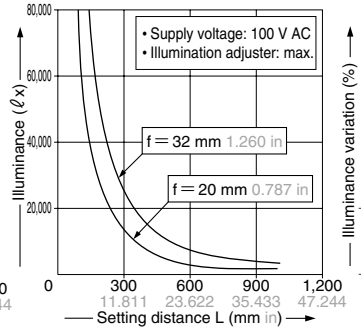


IX-PH100A Halogen light source

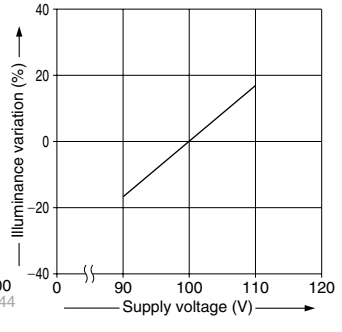
Correlation between setting distance and projection width



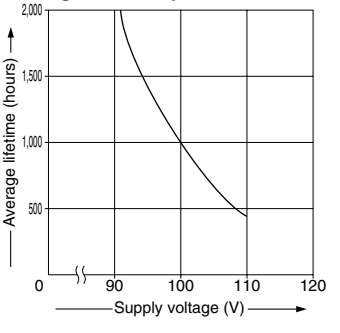
Correlation between setting distance and illuminance



Correlation between supply voltage and illuminance

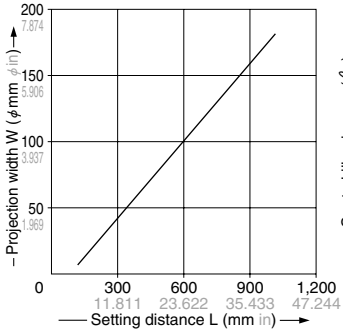


Correlation between supply voltage and lamp lifetime

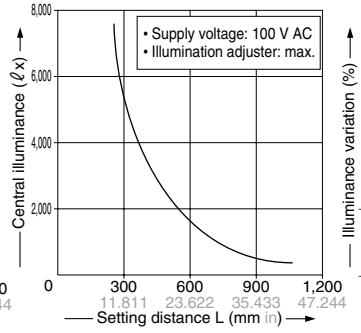


IX-PH100A-FU1 Halogen light source with optical fiber guide

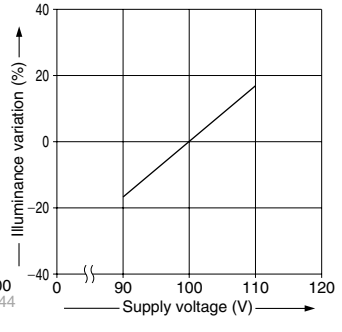
Correlation between setting distance and projection width



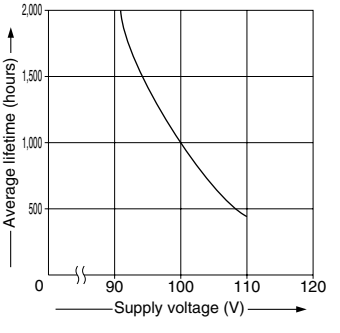
Correlation between setting distance and illuminance



Correlation between supply voltage and illuminance



Correlation between supply voltage and lamp lifetime



PRECAUTIONS FOR PROPER USE

General precautions

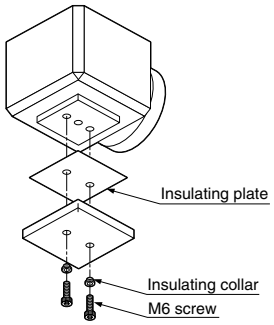
- This product is not a safety sensor. Its use is not intended or designed to protect life, and prevent body injury or property damage from dangerous parts of machinery. It is a normal object detection sensor.
- Place a shield around the halogen light source and the halogen light source with optical fiber guide to protect your hand from a burn as the enclosure heats up to +25 °C +77 °F , or more, above the ambient temperature when power is supplied.
- Before replacing the bulb, or the tube, in the light source, wait till it cools down.
- Do not open the console. High voltage is present inside.

- Avoid dust, dirt, and steam.
- Take care that the product does not come in direct contact with water, oil, grease, or organic solvents, such as, thinner, etc.
- Follow the precautions given for each system device.
- Do not connect any other camera, besides **VI-E**□, to the **VI-C1-E** controller.
- Make sure that the **VI** camera is not subjected to vibrations in order to maintain the detectability.
- Start the operation approximately three minutes after supply of power. However, if your application needs accurate measurement, warm up the system for approximately one hour.
- **VI-C1-E** enables connection of two **VB-DP1-E** consoles. However, even if two consoles are connected, only one console (console connection cable side) can be used.
- The light source takes a few moments to light up after supply of power.

Mounting

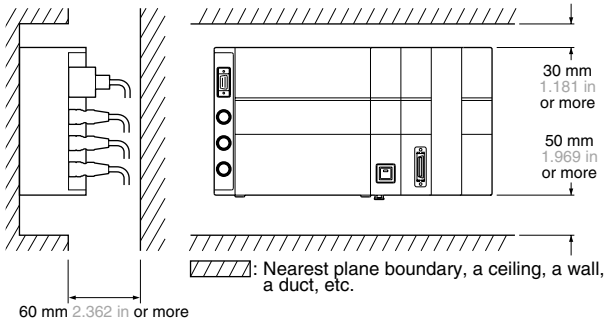
Camera

- Make sure to use the attached insulating assembly (one insulating plate and two insulating collars).
- The tightening torque of the M6 screws should be 2.5 N·m or less.
- Mounting screws are not attached. Refer to the dimensions of the camera and arrange two M6 screws.

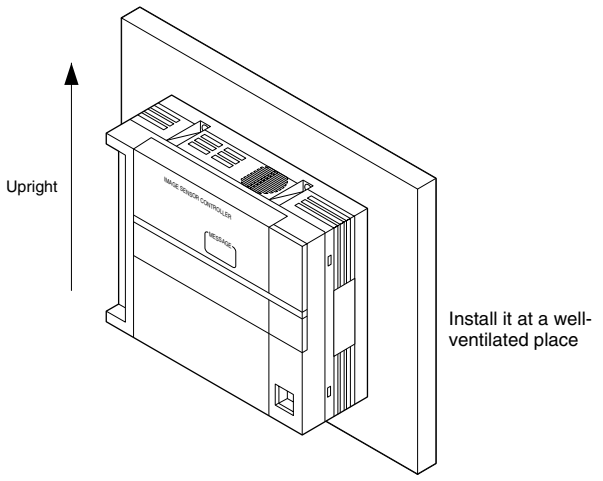


Controller

- Before installing the **VI** controller, consider its operability, the convenience in maintenance, and its environment.
- The tightening torque of the mounting screws should be 1.17 N·m or less.
- The controller must be placed with clearances as shown below. The clearance should be 30 mm 1.181 in, or more, from the ceiling; 50 mm 1.969 in, or more, from the floor for the ventilation and replacement of the fuse; and 60 mm 2.362 in, or more, from the front wall for the bending radius of cables.



- Mounting screws are not attached. Refer to the dimensions of **VI-C1-E** and arrange four M4 screws.
- With two optional DIN rail adapters, **MS-DIN-IDC**, the **VI** controller can be easily mounted on the DIN rail. Fasten two **MS-DIN-IDC** on the back of the controller using the attached screws with a torque of 1.17 N·m or less.
- Install the **VI** controller in a well ventilated place. It must be fixed on a vertical plane in the direction shown in the figure below.

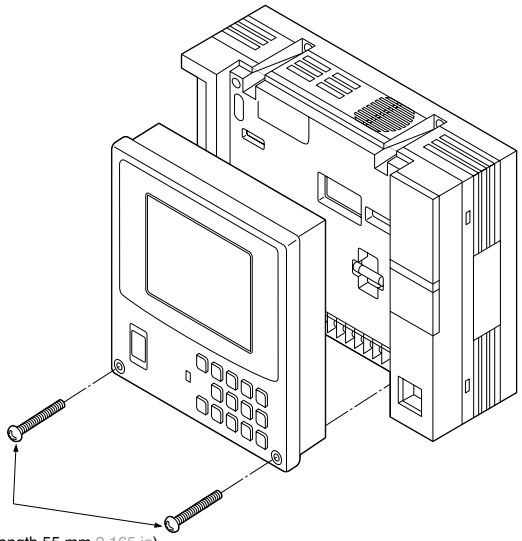


VI

PRECAUTIONS FOR PROPER USE

Console

- To mount the console on the **VI** controller, use the two attached M4 (length 55 mm 2.165 in) screws with washers. The tightening torque should be 0.78 N·m or less.



Two M4 (length 55 mm 2.165 in) screws with washers (Accessory for console)

- Use the console extension cable if you desire to separate the console from the **VI** controller.

Expansion module

- The tightening torque for the M4 screws should be 1.17 N·m or less.
- Mounting screws are not attached. Refer to the dimensions of the expansion module and arrange two M4 screws.
- With the optional DIN rail adapter **MS-DIN-IDC**, the expansion module can be mounted on the DIN rail. Fasten **MS-DIN-IDC** on the back of the expansion module using the attached screws with a torque of 1.17 N·m or less.

Fluorescent light source

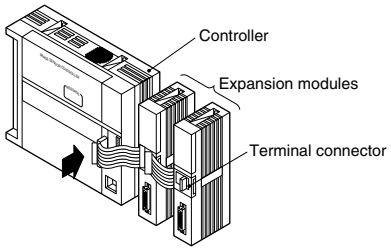
- The tightening torque for the M6 screws should be 2.5 N·m or less.
- Mounting screws are not attached. Refer to the dimensions of **IX-PK**□ and arrange two M6 screws.

Halogen light source, halogen light source with optical fiber guide

- The tightening torque for the M6 screws should be 2.5 N·m or less.
- Mounting screws are not attached. Refer to the dimensions of **IX-PH100A**(**-FU1**) and arrange two M6 screws.
- Place the light source with sufficient clearance on the sides and the rear for ventilation.
  The light source takes a few moments to light up after supply of power.
- The tightening torque should be 0.39 N·m or less to mount the fiber on the light source.
  The tightening torque should be 0.078 N·m or less to fix the convergent lens.

Precautions for wiring

- If power is supplied from a commercial switching regulator, ensure that its from ground (F.G.) terminal is connected to an actual ground.
- Make sure to use an isolation transformer for the DC power supply. If an auto-transformer (single winding transformer) is used, this product or the power supply may get damaged.
- In case a surge is generated in the used power supply, connect a surge absorber to the supply and absorb the surge.
- Do not run the wires together with high-voltage lines or power lines or put them in the same raceway. This can cause malfunction due to induction.
- Make sure that the power supply is off while wiring.
- In case noise generating equipment (switching regulator, inverter motor, etc.) is used in the vicinity of the image sensor system, connect the frame ground (F.G.) terminal of the equipment to an actual ground.
- Use the dedicated camera cable.
  The camera cable should be as short as possible to avoid inductive noise.
- When only one camera is used, always connect it to the Camera 1 port. It will not operate if connected to Camera 2 port.
- RS-232C cable should be 15 m 49.213 ft, or less, long.
- The shield wire of the RS-232C cable should be connected to the F.G. pin either on the controller or on the computer. Do not connect it on both the sides.
- To link the **VI** controller and the expansion modules, the bus connector of the first placed expansion module should be connected to the bus socket on the controller, the bus connector of the second placed expansion module should be connected to the bus socket on the first expansion module, and so forth. The terminal connector should be plugged in the bus socket on the last expansion module. If no expansion module is used, the terminal connector is not necessary.

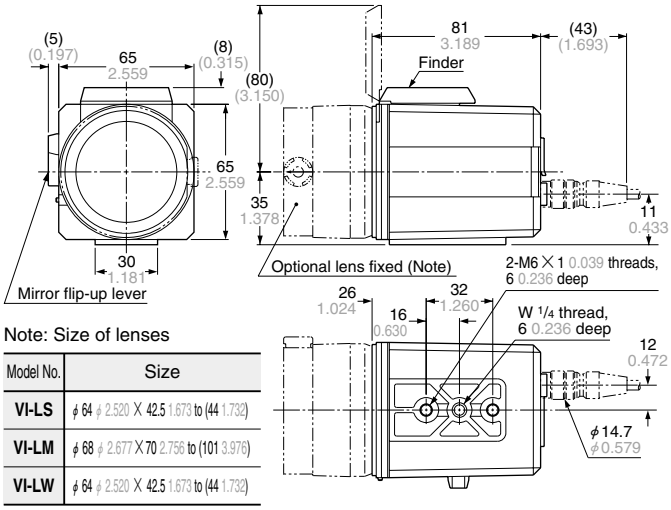


- Ensure that any foreign material does to enter the ventilation opening of the controller or the other devices.
- Ground all F.G. terminals of the system devices that are used.
- Before replacing the fuse, turn off the power and remove the cause of blowout.

DIMENSIONS (Unit: mm in)

The CAD data in the dimensions can be downloaded from the SUNX website: http://www.sunx.co.jp/

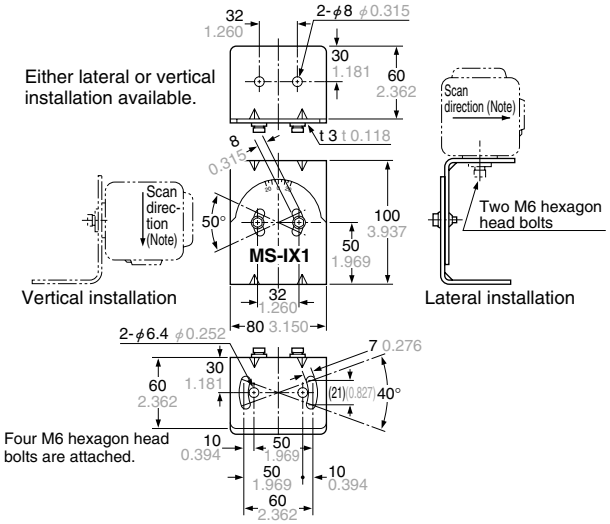
VI-E210 VI-E510 Camera



Note: Size of lenses

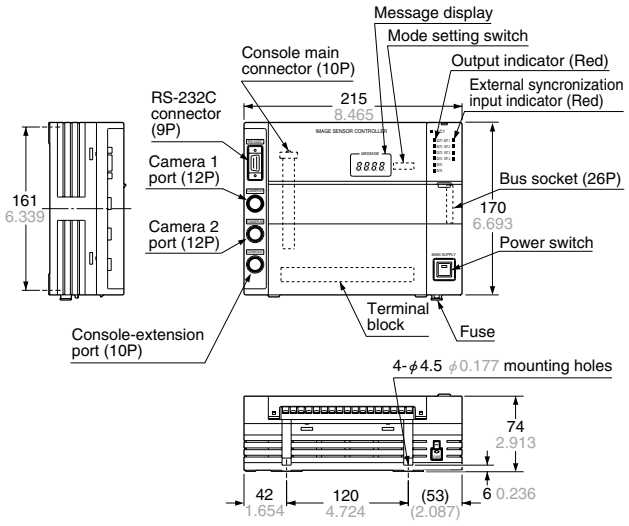
Model No.	Size
VI-LS	φ 64 φ 2.520 X 42.5 1.673 to (44 1.732)
VI-LM	φ 68 φ 2.677 X 70 2.756 to (101 3.976)
VI-LW	φ 64 φ 2.520 X 42.5 1.673 to (44 1.732)

MS-IX1 Camera mounting base

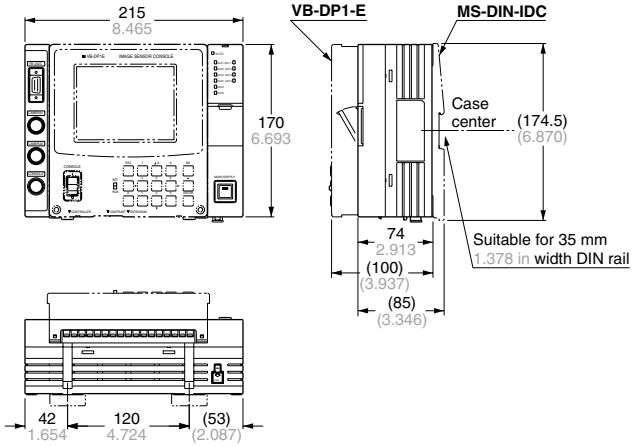


Note: The rear-view of the camera is shown in the above illustrations.
The scan direction reverses with the front-view.

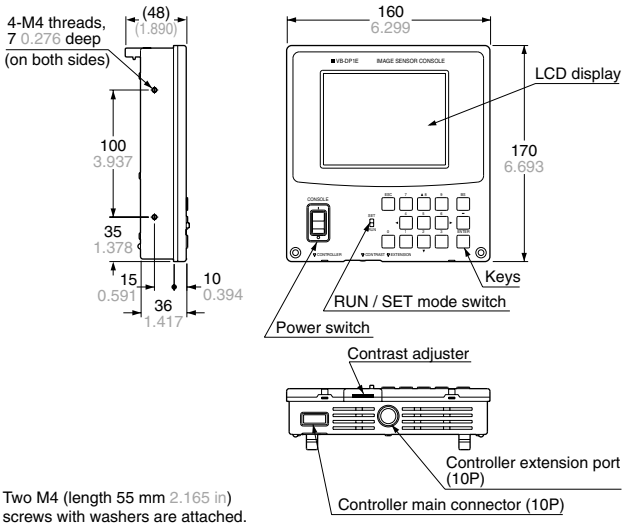
VI-C1-E Controller



Assembly dimensions with VB-DP1-E (Console) and MS-DIN-IDC (DIN rail adapter)

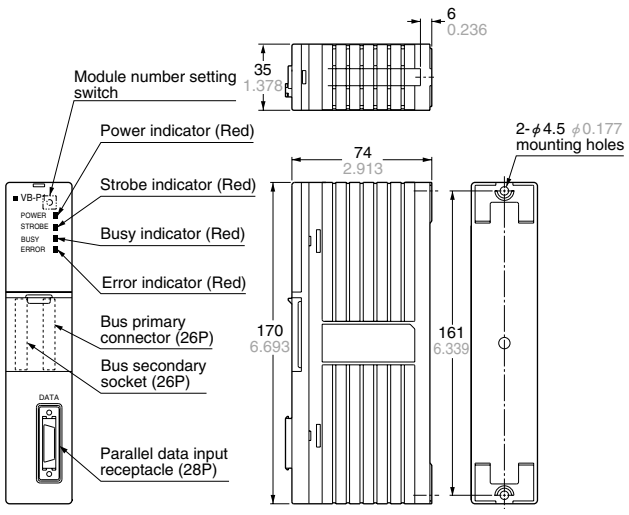


VB-DP1-E Console



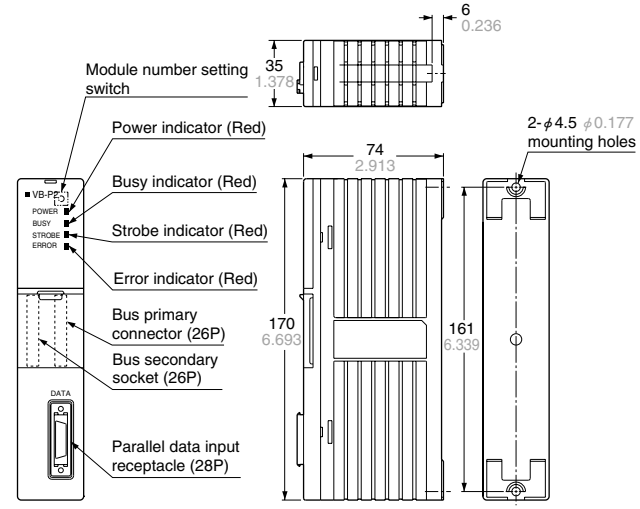
Two M4 (length 55 mm 2.165 in)
screws with washers are attached.

VB-P1 Parallel output module

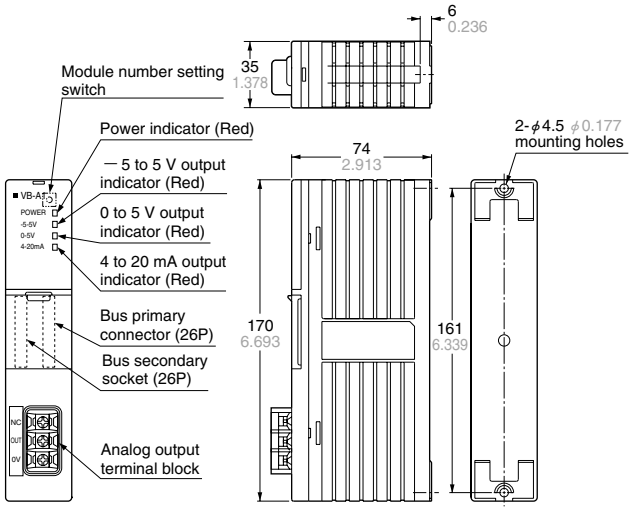


DIMENSIONS (Unit: mm in) The CAD data in the dimensions can be downloaded from the SUNX website: http://www.sunx.co.jp/

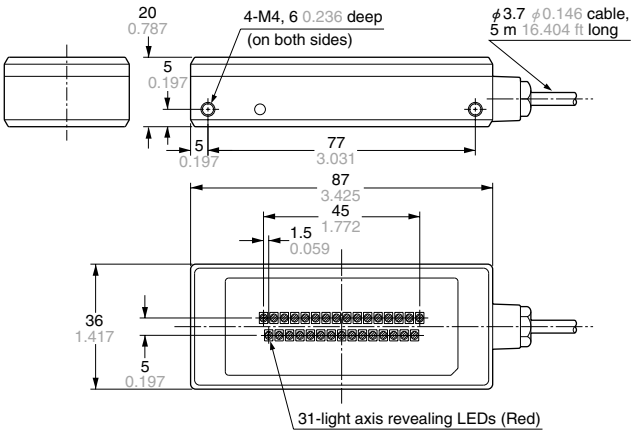
VB-P2 Parallel input module



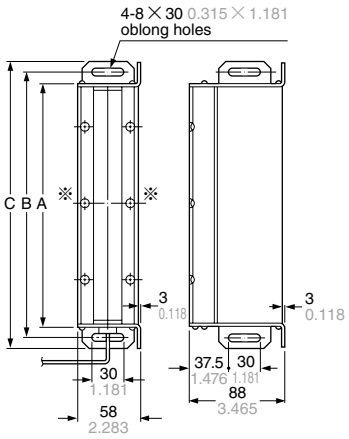
VB-A1 Analog output module



VI-CH1 Optical axis aligner



IX-PK□ Fluorescent light source

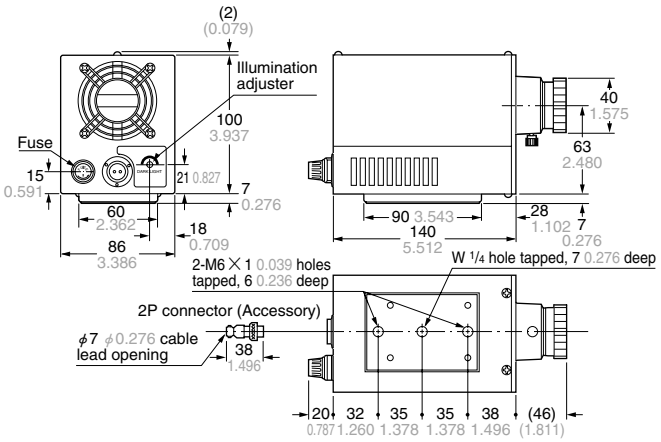


	A	B	C
IX-PK4	160 6.299	180 7.087	200 7.874
IX-PK8	310 12.205	330 12.992	350 13.780
IX-PK20	640 25.197	660 25.984	680 26.772
IX-PK40	1,260 49.606	1,280 50.394	1,300 51.181

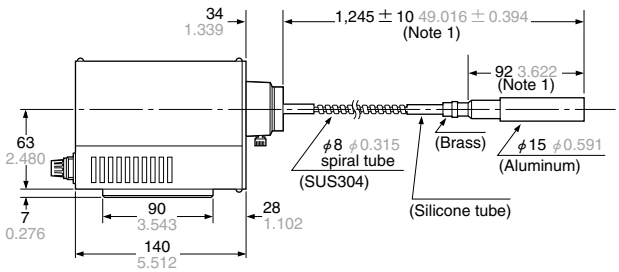
※: The No. of front cover mounting screws is six for **IX-PK40** and four for all others

※: The center of A is the center of the effective illuminating length.

IX-PH100A Halogen light source



IX-PH100A-FU1 Halogen light source with optical fiber guide



Notes: 1) All dimensions are given with the lens head retracted. The lens head can be stretched out 50 mm 1.969 in maximum.
2) The bottom and rear views of **IX-PH100A-FU1** are not shown as they are identical to those of **IX-PH100A**.