ROBOT VISION iVY RCX240

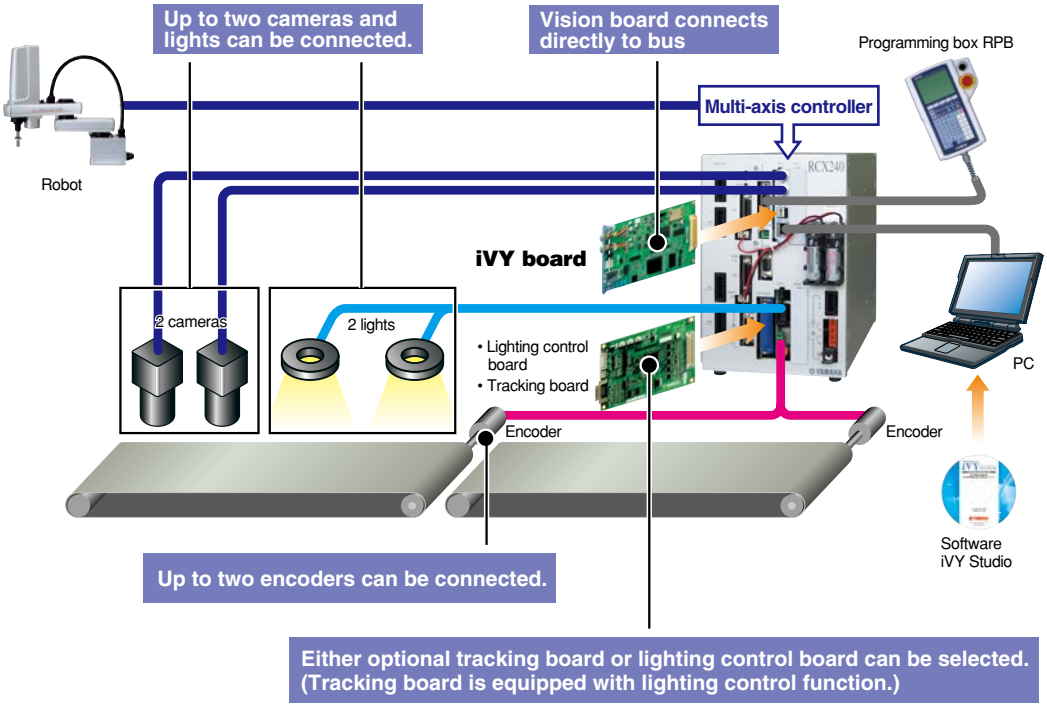
Easy to use and reduction of work steps.

"Finds and Picks up" and "Pursues and Picks up" without teaching.

Many robot users might think, "We tried vision recognition, but it seemed to take a lot of work" or "we tried it before, but making adjustments was a tough job".
But YAMAHA iVY system solves these problems.
Anyone can make the setup easily to contribute to reduction of work steps.

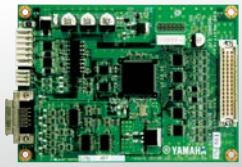
iVY system layout

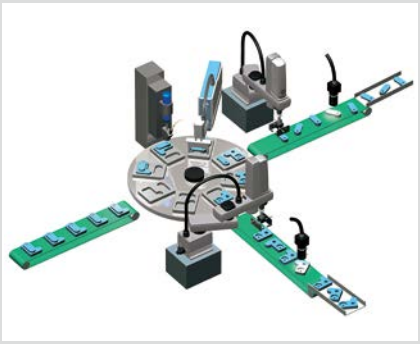
A robot controller with an image processing function is completed only by setting the iVY board in the 4-axis controller RCX240 or RCX240S. As "eye" is put in the robot, the robot finds and takes workpiece, checks deviations in workpiece position, and makes correction if the workpiece deviates largely. This expands the range of applications.



■ Options

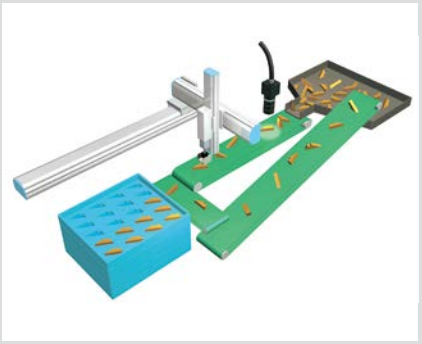
- Lighting control board
- Tracking board
- CCD camera
- LAN cable (Shielded cross-cable)
- Camera cable
- Lens
- Close-up ring





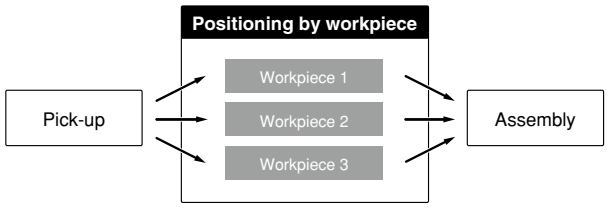
■ Positioning by searching for workpiece

■ Automatic correction even if the camera moves



■ Applicable to conveyor tracking

Conventional system without robot vision



When the workpiece is changed, the positioning jig replacement work is needed.
In particular, when using a small lot of workpieces, the setup costs or jig manufacture and management costs are needed.

System with robot vision

Even when the workpiece is changed, it is flexibly supported only by changing the part type data.
Since no mechanical positioning is needed, cost reductions, such as equipment down-sizing or jig cost reduction become possible.

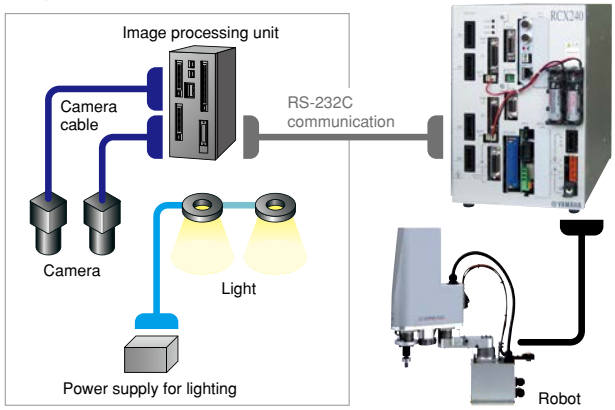
POINT 1

Easy for anyone to use, applicable to a wide variety of applications

When the system was upgraded by combining the robot with a generally available image processing unit, it took a long time conventionally to adjust the robot controller and image processing unit, and perform the correction calculation. In YAMAHA "iVY system", the vision board is integrated into the robot controller and the functions are limited to the positioning and position correction so as to greatly simplify the operability. This makes the system incredibly easy to use when compared to conventional vision systems. YAMAHA aimed at "a vision system that anyone can easily use". Please try to use YAMAHA's new robot vision.

Conventional robot vision

① Alignment with robot coordinates is difficult.
② Correction calculation is needed when the camera moves.
③ Operation deviation between the camera and robot due to comunication time.
④ Adjustment of communication format is needed.



✕
- Difficult to handle.
- Hard to actually operate.
- Installation and setup costs are high.
- Difficult to know emergency contact address.

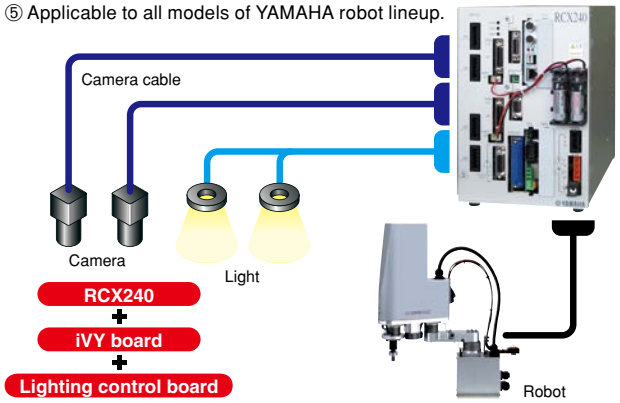
Special skills are required and many work steps are needed.

Connecting an external camera to the robot controller requires tasks such as coordinate alignment (calibration), and correction programs are needed, so the startup work is difficult. When using for simple applications, many work steps are needed. So, possible applications are limited.

iVY system

① Simple calibration function is incorporated.
② Coordinates are corrected automatically even when the camera moves.
③ High-speed connections through dedicated bus line.
④ Controller is incorporated to provide the central operation.
⑤ Applicable to all models of YAMAHA robot lineup.

Point



○
- Easy to use
- Various applications are supported using easy operation.
- Cost reduction by reducing work steps.
- YAMAHA gives you total support.

Easy operation extends applications

YAMAHA iVY system can be calibrated very simply
Furthermore, the coordinates are corrected automatically when a camera is installed on the robot. As iVY system can be used, it can be applied to various applications.

POINT 2

Easy workpiece registration only with 3 steps

YAMAHA aimed at "a vision system that anyone can easily use". But, image recognition itself has been around for a long time. However, conventional image recognition required complex tasks such as coordinate matching (calibration) or coordinate correction during camera movement, and it never became very popular. YAMAHA vision iVY System can be operated by anyone including machine designers or actual machine operators.

STEP. 1

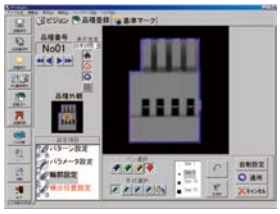
Capture images.

Put the workpiece within the camera field-of-view and specify an image capturing range.

STEP. 2

Set the contour.

Contour is automatically extracted. Paint the necessary contour with a pen tool.



STEP. 3

Register the detection position.

Specify the detection position with the mouse. Desired positions can be set.

Search results

POINT 3

Dedicated software "iVY Studio" included

The iVY system includes dedicated software "iVY Studio". All operations related to the vision, such as registration of fiducial marks used for the calibration or workpieces (edge setting, various parameter setting, and image capturing range setting, etc.), backup, restore, and operation monitor can be performed only with this software.

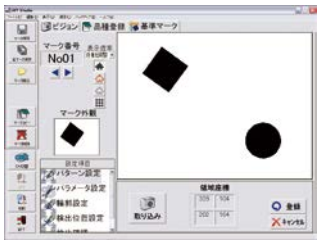
Support software iVY Studio

- Search trial-run, part type registration
- Reference mark registration (for calibration)
- Up to 40 workpiece types can be registered.
- Workpiece can also be added easily.
- Up to 40 workpieces can be detected at once.
- Data backup
- This software functions as a monitor during program operation.

POINT 4

Simple calibration function (coordinate matching alignment work) incorporated

Conventional equipment combining "image processing unit + robot" requires many steps in "calibration" that aligns the camera coordinates with the robot coordinates. In the iVY system, the operation is completed easily in a short time only by following interactive instructions using the programming box. Additionally, the coordinate values are corrected automatically even when the robot installation position is changed, such as upward clamping, downward clamping, robot Z-axis clamping, or SCARA robot Y-arm clamping.



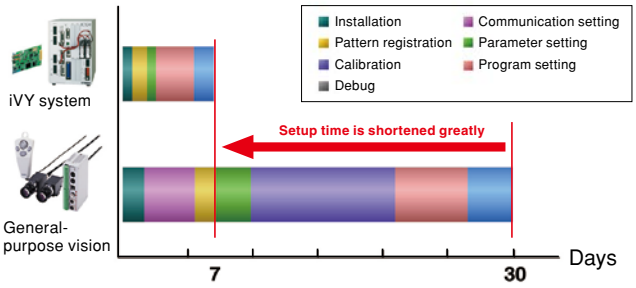
Just follow instructions on Wizards

POINT 5

Setup time reduced greatly

When using a general vision, a coordinate conversion program needs to be created in the robot controller since the robot coordinate data differs from the vision format.
Since the robot controller is integrated into the iVY system, the robot coordinate data can be stored into the robot point data using single process. This ensures very simple operation. Additionally, the unified control of the camera control and light control can be performed using the robot program. The control becomes easy and the number of start-up steps can also be reduced.

Comparison of setup time



POINT 6

Free selection from YAMAHA robot lineup

This robot vision is applicable to all YAMAHA robots that can be operated by the RCX controller.
According to the applications, an appropriate robot can be selected from the single-axis robots FLIP-X series, linear single-axis robots PHASER series, Cartesian robots XY-X, and SCARA robots YK-XG. A low-cost and easy-to-use robot vision system can be constructed with an optimal model suitable for applications.

■ Cartesian robots XY-X

■ SCARA robots YK-XG

■ Linear motor single-axis robots PHASER

■ Single-axis robots FLIP-X

POINT 7

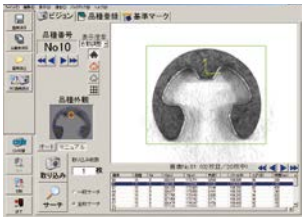
Workpiece handling without teaching

When the robot handles a workpiece, the teaching work to the correct position is absolutely required. If the workpiece position deviates, the correct handling cannot be performed.
Use of iVY system makes it possible to detect the correct position through the image recognition after coarse positioning. The workpiece can be transferred without teaching, so the start-up steps are reduced and workpiece can be changed or added flexibly.

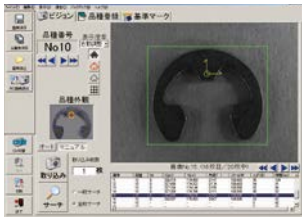
POINT 8

Edge search engine with excellent stability

The gray search (normalized correlation search) that was frequently used for conventional visions is vulnerable to adverse effects, such as lighting conditions, or workpiece chipping or contamination. The environments and applications are restricted.
The iVY system incorporates an "edge search engine" that performs the search process using information on contour shape. This contour search is resistant to effects on external environment and the range of applications is extended.



Search is made with good lighting.

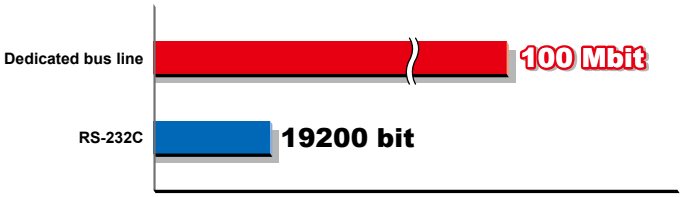


Search is correct even with insufficient lightning.

POINT 9

High-speed connections through dedicated bus line

By directly connecting the robot controller and CPU board through the bus, a data communication speed approximately 5,000 times higher than that of the serial communication speed with general vision is achieved.
Programming also becomes easy since the time lag due to communication does not need to be considered. Additionally, this robot vision supports the conveyor tracking that requires high-speed processing.

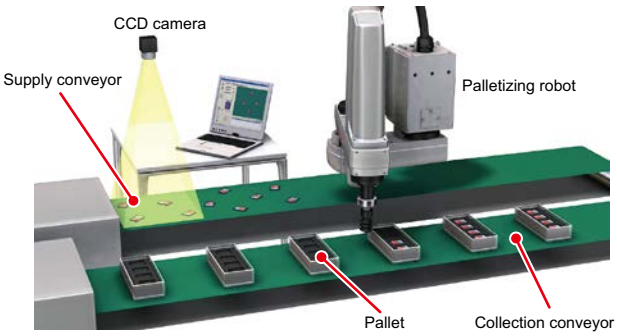


Data transmission volume per second

POINT 10

Applicable to conveyor tracking

The iVY system is applicable to the conveyor tracking only by adding the tracking board. As the pulses (AB-phase) are taken from the encoder installed on the conveyor, the workpiece that is flowing can be picked up without stopping the conveyor.
As up to two encoders for the camera, lighting, and conveyor can be connected, the iVY system is applicable to movement between the conveyors.



POINT 11

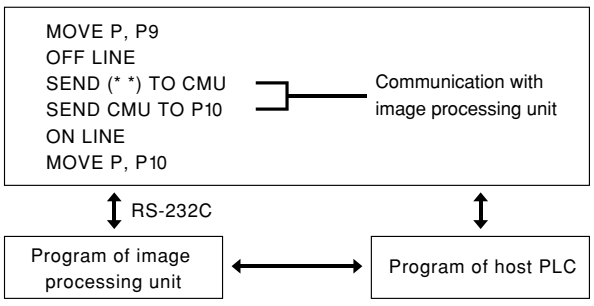
Vision is also controlled easily with robot programs.

The robot program executes all vision controls including camera switching, image capturing, and workpiece search.
Program creation is simple when compared to general vision systems since the operations from the robot movement to the camera control are performed consistently.
Furthermore, the debug work can be performed efficiently to greatly reduce the total number of work steps.

■ Example of robot vision language

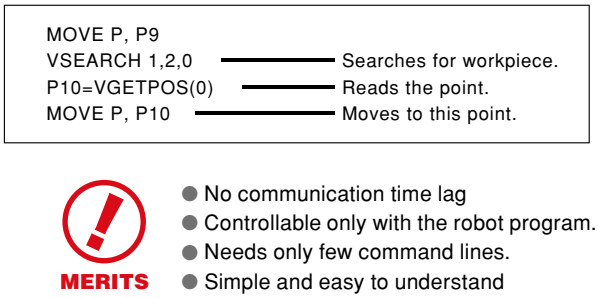
Command name	Function
VCAPTURE	Captures images from the camera.
VSEARCH	Searches for the specified part type.
VMONITOR	Switches the monitor mode between on and off.
VGETCNT	Acquires the number of parts that were found.
VGETPOS	Acquires the position data.
VGETTIME	Acquires a period of time used for the search command that was executed.
VGETSCR	Acquires judgment values for the detected workpiece.
VSAVEIMG	Saves images in BMP format.

Conventional robot vision



Controls using different programs

iVY system



MERITS

- No communication time lag
- Controllable only with the robot program.
- Needs only few command lines.
- Simple and easy to understand

Centralized controls using robot programs

So, the iVY system can solve such problems.

Number of teaching steps needs to be reduced.

Robot teaching work requires a lot of labor and time. The iVY system acts as "robot eye". The final fine positioning can be automated to greatly reduce the teaching time that was required for the conventional models.

Positioning mechanism needs to be simplified.

In the current trend toward small-lot production of multiple models, a larger number of models means that positioning and other aspects of setup will require more time and trouble. Use of the iVY system makes it possible to greatly reduce costs necessary for manufacture, management, and replacement of positioning jigs.

Random workpieces need to be handled.

Use of a position detection function of the iVY system makes it possible to simply construct operations, such as "workpiece is directly placed from the parts feeder" and "workpiece in the pallet is gripped and transferred".

Workpiece flowing on the conveyor is picked up.

The iVY system is applicable to conveyor tracking. The position of the flowing workpiece is continuously recognized according to the signals from the encoder. The workpiece can be picked up without stopping the conveyor.

Consultation destination is not found if a trouble occurs.

When a generally available image processing unit is combined with the robot, various problems such as being unable to capture images, unable to write data, or position deviation occur. YAMAHA iVY system will solve such troubles. The iVY system delivers total support for tasks ranging from capturing of images from the camera to operating the robot.

iVY System

Applicable controllers ▶ RCX240/RCX240S

Robot with image processing functions

"SEARCH and TAKE" "CHECK POSITION and ASSEMBLE"
YAMAHA offers a whole new production line concept that eliminates time-consuming teaching and positioning tasks with "iVY-system".

Main functions ▶ P.74

Ordering method

RCX240 – [Controller] – [Usable for CE] – [Regenerative unit] – [Option I/O] – [Network Option] – [iVY System Option board] – [Light/Tracking] – [Gripper] – [Battery]

iVY System Option board
No entry: None
VY: iVY (VISION)

Light/Tracking
No entry: None
TR: Light+Tracking
LC: Light

Note. For details on the various selection items, refer to P.535

Basic specifications

iVY board

Item		iVY board
Basic specifications	Applicable controllers	RCX240 / RCX240S
	Pixels	640 (H) × 480 (V) (300,000 pixels, VGA)
	Settable part types	40 part types
	Connectable cameras	Maximum 2 units Note. Note. If connecting 2 units, then must be the same model
	Camera types	Double speed compatible analog camera
	Memory	128MB SDRAM, 256MB miniSD card
	External I/F	Ethernet (100BASE-TX)
Search method		Edge search (Correlative edge filter, Sobel filter)
Image input	Trigger	S/W trigger, H/W trigger, Camera internal synch
	External trigger input	2 points
Functions	Search function	Position offset, Auto registry of point data
	ID recognition (usage planned)	QR-Code [Model2], DataMatrix
Setup support functions		Calibration, image save function, model registration[Note], fiducial mark registration[Note], monitor function[Note]

Note. Requires Windows PC.

Lighting control board (option)

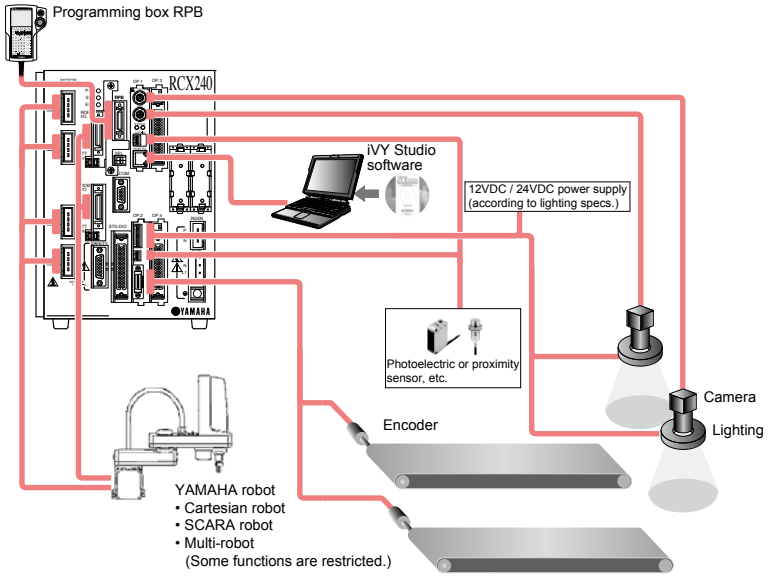
Item		Lighting control board (option)
Basic specifications	Applicable controllers	RCX240 / RCX240S
	Number of lighting connected units	Up to 2 units
	Light adjusting system	PWM control (0 to 100%) (Cycle 60kHz) Stroboscopic light (10 to 33000us)
	Trigger	S/W trigger, H/W trigger
	External trigger input	2 points
	Lighting power input	12VDC or 24VDC (Supplied from outside commonly to 2 channels)
	Lighting output	When DC12V is supplied: Less than 30W with 2 channels totaled When DC24V is supplied: Less than 60W with 2 channels totaled

Tracking board (Options)

Item			Tracking board (option)
Basic specifications	Applicable controllers		RCX240 / RCX240S
	Lighting control section	Light adjusting system	Up to 2 units
		Light adjusting system	PWM control (0 to 100%) (Cycle 60kHz) Stroboscopic light (10 to 33000us)
		Trigger	S/W trigger, H/W trigger
		External trigger input	2 points
		Lighting power input	12VDC or 24VDC (Supplied from outside commonly to 2 channels)
		Lighting output	When DC12V is supplied: Less than 30W with 2 channels totaled When DC24V is supplied: Less than 60W with 2 channels totaled
	Pulse input section	Number of encoder connected units	Up to 2 units
		Encoder power source	DC5V (Less than 500mA with 2 channels totaled) (Supplied from controller)
		Applicable encoder	Line driver equivalent to 26LS31 / 26C31 (Conforming to RS-422)
		Input phase	A, $\overline{A}$, B, $\overline{B}$, Z, $\overline{Z}$
		Maximum response frequency	2MHz
		Counter / Step-up multiplication	0 to 65535 / Double, quadruple
		Other	Provided with broken wire detect function

Note. The tracking board is required when using the tracking function.

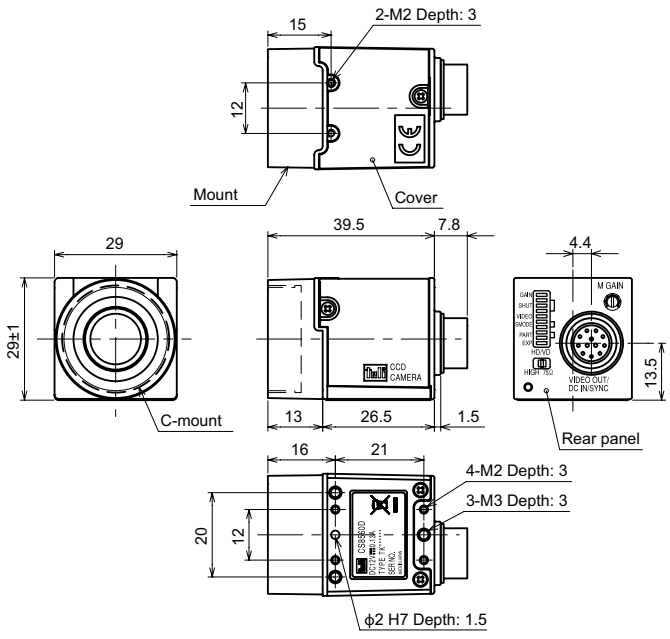
System configuration illustration



* The above configuration example shows a system where the iVY board and tracking board are used.
* Connections to the STD.DIO, ACIN, and SAFETY connectors is not shown in the above illustration.

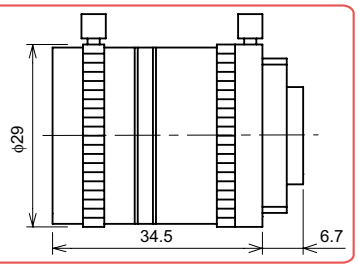
Dimensional outlines CCD camera

●CCD camera dimensions
(Model No. : KX0-M7913-00)

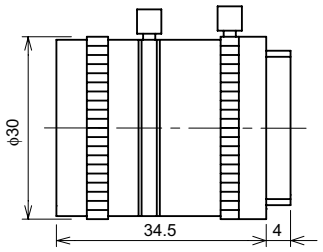


Lenses

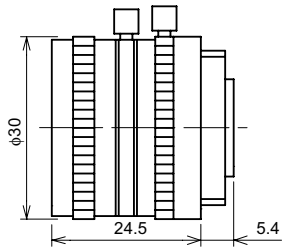
8mm lens [ML-0813]
(Model No. : KM7-M7214-60)



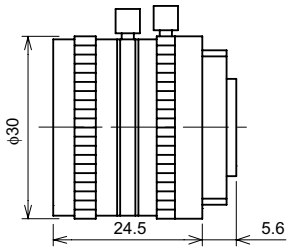
12mm lens [ML-1214]
(Model No. : KM7-M7214-40)



16mm lens [ML-1614]
(Model No. : KM7-M7214-30)



25mm lens [ML-2514]
(Model No. : KM7-M7214-20)



Standard lens angle-of-view table

	Focal length (mm)	Aperture value (F No.)	Angle-of-view (degrees)		Closest approach distance (m)
			Vertical	Horizontal	
8mm lens [ML-0813]	8	F1.3-CLOSE	45.0	57.8	0.2
12mm lens [ML-1214]	12	F1.4-CLOSE	21.9	29.0	0.3
16mm lens [ML-1614]	16	F1.4-CLOSE	23.0	30.4	0.4
25mm lens [ML-2514]	25	F1.4-CLOSE	21.6	28.5	0.5

Note. Field-of-view table for our standard lenses. As the field-of-view widens, distortion on image edges may increase.

Viewing angle, WD, and magnification when using close-up ring

Close-up ring (mm)	8mm lens [ML-0813]				12mm lens [ML-1214]			
	Viewing angle (mm×mm)		WD (mm)	Magnification	Viewing angle (mm×mm)		WD (mm)	Magnification
	Vertical	Horizontal			Vertical	Horizontal		
None	72	96	148	0.05	77	103	248	0.05
0.5	32	43	59	0.11	41	55	125	0.09
	57	77	115	0.06	89	119	289	0.04
1	21	27	34	0.18	28	38	80	0.13
	29	38	52	0.13	45	59	136	0.08
1.5	26	34	22	0.24	21	29	57	0.17
	19	26	31	0.19	30	40	85	0.12
2	–	–	–	–	17	23	42	0.21
	–	–	–	–	22	30	59	0.16
5	–	–	–	–	–	–	–	–
	–	–	–	–	–	–	–	–

Close-up ring (mm)	16mm lens [ML-1614]				25mm lens [ML-2514]			
	Viewing angle (mm×mm)		WD (mm)	Magnification	Viewing angle (mm×mm)		WD (mm)	Magnification
	Vertical	Horizontal			Vertical	Horizontal		
None	82	109	358	0.04	65	87	458	0.06
0.5	48	64	206	0.07	48	64	338	0.08
	117	156	515	0.03	181	242	1270	0.02
1	34	45	143	0.11	38	50	269	0.10
	58	78	252	0.06	91	121	637	0.12
1.5	26	35	108	0.14	31	42	223	0.12
	39	52	164	0.09	60	81	425	0.06
2	22	29	86	0.17	27	36	191	0.13
	29	39	120	0.12	45	60	320	0.08
5	10	14	35	0.35	14	19	103	0.25
	12	16	42	0.31	18	24	130	0.20

Notes
- This table shows viewing angles when using the standard lens and close-up ring. (If no close-up ring this is closest approach.)
- If not using a close-up ring, then a WD smaller than the value in this table cannot be used.
- If using a close-up ring, then only a WD close to this value can be used.
- The values in this table are at most only a reference and do not signify an absolute index.
- To find viewing angle and WD other than for our standard lens, visit our website at: http://www.moritex.co.jp/products/.

Accessories and part options

iVY System

Standard accessories

Model		
	Without power supply harness	KX0-M4402-10
	With power supply harness	KX0-M4402-00

Note. If newly adding an iVY, choose the model with harness.

iVY board

iVY board accessories

Name	Single unit model	Set Model
Camera trigger input cable connector	KX0-M657L-00	KX0-M657K-00
Custom tool	KX0-M657M-00	

Support software for PC iVY Studio

iVY Studio is support software for the iVY system that allows registering part types and reference marks as well as monitoring the work search status during automatic robot operation by connecting to the robot controller.

Environment

Software model	KX0-M4988-00
OS	Microsoft Windows 2000 / XP / Vista Note. The 64 bit version is not subject to the operation warranty.
CPU	Exceeding the environment recommended by the OS being used
Memory	64MB or more (Recommend)
Hard disk	Vacant capacity of more than 40MB in the installation destination drive Note. Besides the above, also requires memory space for storing images and data.
Display	800 × 600 dots or more, 32768 colors (16bit High Color) or more (recommended)
Network	TCP/IP Ethernet port × 1

Options

Lighting control board

Model	KX0-M4400-G0

Required options for the lighting control board

Name	Single unit model	Set Model
Lighting power cable connector	KX0-M657L-10	KX0-M657K-10
Wiring lever	KX0-M657M-10	
Lighting input trigger cable connector	KX0-M657L-00	KX0-M657K-00
Custom tool	KX0-M657M-00	

Tracking board

Model	KX0-M4400-E0

Required options for the tracking board

Name	Single unit model	Set Model
Lighting power cable connector	KX0-M657L-10	KX0-M657K-10
Wiring lever	KX0-M657M-10	
Lighting input trigger cable connector	KX0-M657L-00	KX0-M657K-00
Custom tool	KX0-M657M-00	
AB phase input cable connector	KX0-M657L-20	KX0-M657K-20
AB phase input cable connector case	KX0-M657M-20	

Camera cable

Cable for connecting the camera to the iVY board.

Model	3.5m	KX0-M66F3-00
	6m	KX0-M66F3-10
	9.5m (relay 3.5m+6m)	KX0-M66F0-20
	Relay cable 3.5m	KX0-M66F4-00
	7m (relay 1m+6m)	KX0-M66F0-30
	Relay cable 1m	KX0-M66F4-10

Note. When installing a camera cable in a moving section, use a relay cable so that it can be easily replaced if needed.

CCD camera

Model	KX0-M7913-00

Lens

Model	8mm	KM7-M7214-60 (ML-0813)
	12mm	KM7-M7214-40 (ML-1214)
	16mm	KM7-M7214-30 (ML-1614)
	25mm	KM7-M7214-20 (ML-2514)

Close-up ring

Model	0.5mm	KX0-M7215-00
	1.0mm	KX0-M7215-10
	2.0mm	KX0-M7215-20
	5.0mm	KX0-M7215-30

LAN cable with shield cloth (5m)

Model	KX0-M55G0-00

Tracking encoder cable (10m)

Model	KX0-M66AF-00