

iVY
System

ROBOT VISION

This is why the iVY is terrific!

1 Easy for anyone to use – supports wide spectrum of applications

Attempting to make system upgrades with robots combined with commercial image processing equipment took a great deal of time and trouble due to tasks such as aligning the conventional robot controller with the image processing equipment, exchanging data and messages, and offset processing, etc. In the YAMAHA “iVY System” however the vision board is integrated into the robot controller, and operation is drastically simplified by limiting the functions to positioning and position correction. This makes the system incredibly easy to use

compared to other vision systems used up until now.

The calibration task in particular where the camera coordinates are aligned with the robot coordinates that was usually complicated and time-consuming is now super-simple on the iVY system! Just follow the instructions from the Wizard to complete calibration with no strain and no fuss.

YAMAHA aimed for “a vision system anyone can easily use right from the start” and this is what they achieved so be sure to check out the YAMAHA robot vision for yourself!

Ordinary robot vision



- Difficult to handle and work with
- Troublesome to actually use
- Expensive to install and startup

Using it takes time and effort – has only limited applications



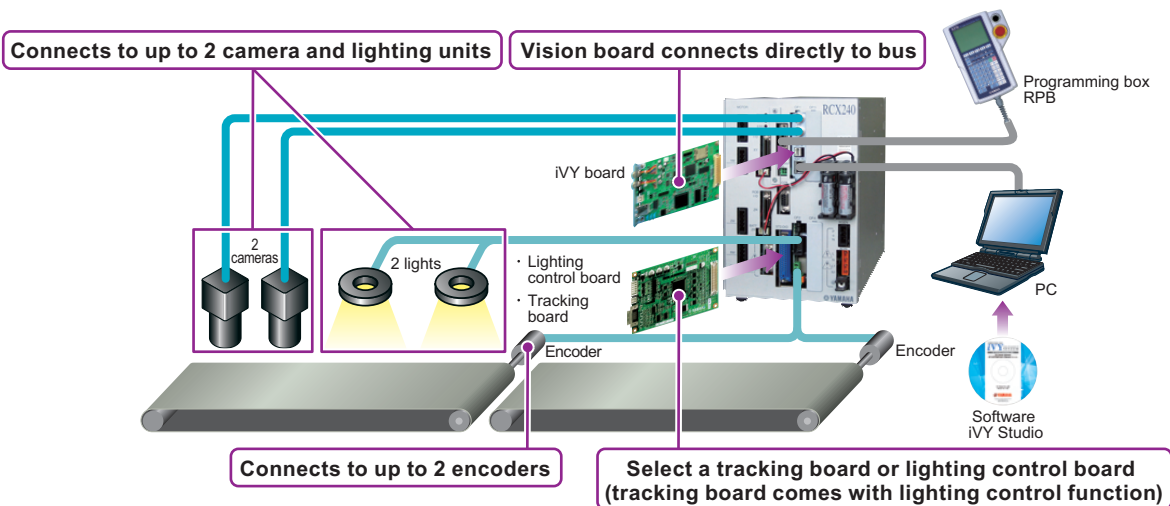
iVY SYSTEM



- Everything is easy and simple!
- Lower cost with fewer man-hours needed
- Simple to use so effective for diverse applications

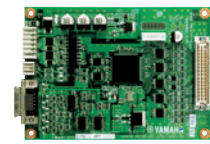
Easy for anyone to use and has an expanding range of applications!

● iVY system layout



Options

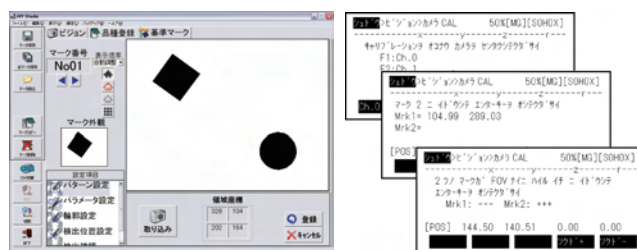
- Lighting control board
- Tracking board
- CCD camera
- LAN cable (Shield crossing)
- Camera cable
- Lens
- Close-up ring



2 Super simple calibration (Coordinate matching alignment tasks)

Conventional equipment combining “image processing equipment + robot” requires an extreme amount of time and trouble due to the task of “calibration” that aligns the camera coordinates with the robot coordinates. On the iVY system however the operator only has to follow conversation-type instructions from the programming box so operation is simple and finishes in a short time.

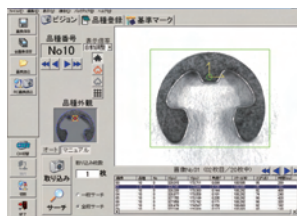
The iVY system also automatically corrects these coordinates even if the robot installation position has changed during tasks such as clamping upward, clamping downward, clamping robot Z axis, and clamping the Scara robot Y arm.



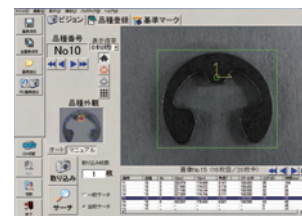
Just follow instructions on the Wizard!

3 Stable edge search for great results

Ordinary machine vision equipment uses gray search (normalized correlative search) which is easily affected by dirt, notches on the workpiece and lighting conditions which limit its usable applications and work environment. The iVY system however contains an edge search engine that makes searches using the contour shape of the part. This contour (edge) search is strongly resistant to outside effects and so instantly opens up a whole range of applications.



● Search made with good lighting



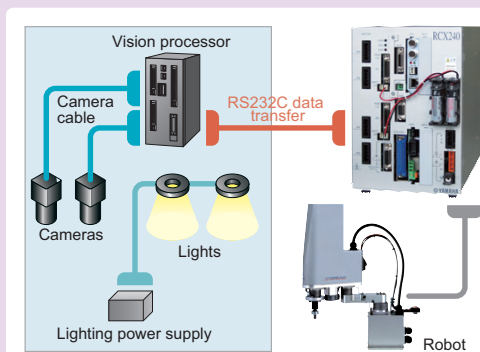
● Search is accurate even with poor lighting

If using ordinary image processing equipment

- ① Aligning with the robot coordinates is a tough job
- ② Offset calculation is needed if the camera is moved
- ③ Operating delays occur between the camera and robot due to the communication time lag
- ④ Communication formats must be made to match each other

Connecting an external camera to the robot controller requires tasks such as coordinate matching (calibration) and running a correction program so equipment startup can be difficult.

Ordinary equipment requires a lot of time and trouble even when using simple applications so the possible applications are limited.

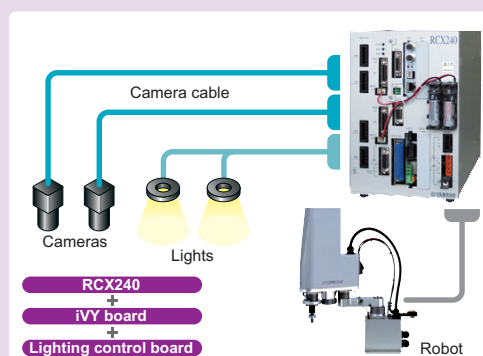


If using the iVY system

- ① Contains a simple calibration function
- ② Coordinates are automatically adjusted even if camera is moved
- ③ High-speed connections over a dedicated bus line
- ④ Integrated operation within controller

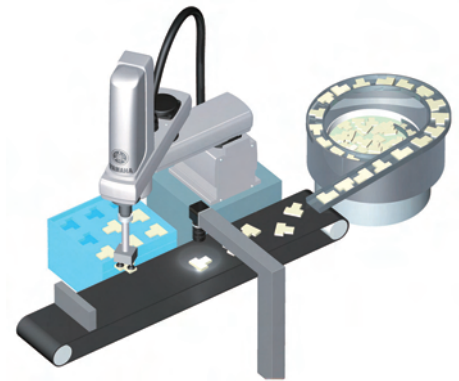
Calibration on the YAMAHA iVY system is simple!

Moreover all coordinates are adjusted automatically when a camera is installed on the robot. Being easy to use also makes it ideal for a diverse range of applications.



4 Handles work without teaching

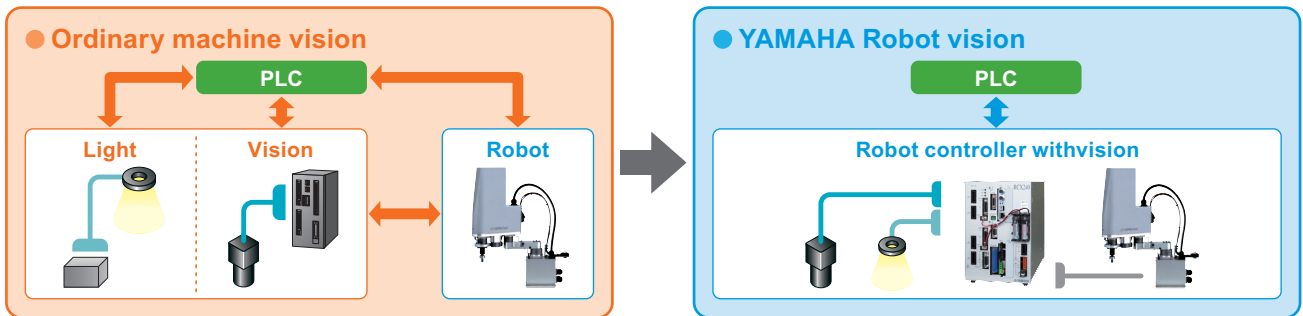
Teaching an accurate position to the robot is essential when attempting to handle work by robot and if an offset or deviation occurs in the work position then correctly handling the work is impossible. In the iVY system however after rough positioning, image recognition is used to make an accurate position adjustment. The work can be moved without teaching so the man-hours needed for startup are reduced and flexible adjustments such as work piece changes or additions can be made.



5 Unified operation with integrated controller

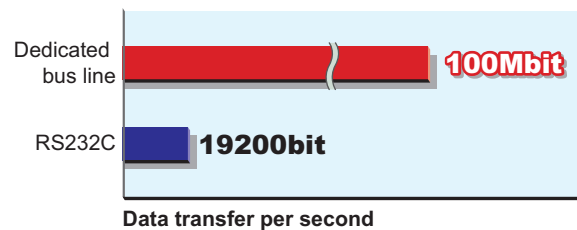
Other machine vision products on the market use different formats so a coordinate conversion program had to be written into the controller.

The iVY system however has an integrated controller so robot point data is stored in one extremely and easy step. Camera control and lighting control are handled by integrated operation within the robot controller in an easy to understand operation that reduces the man-hours needed for equipment startup.

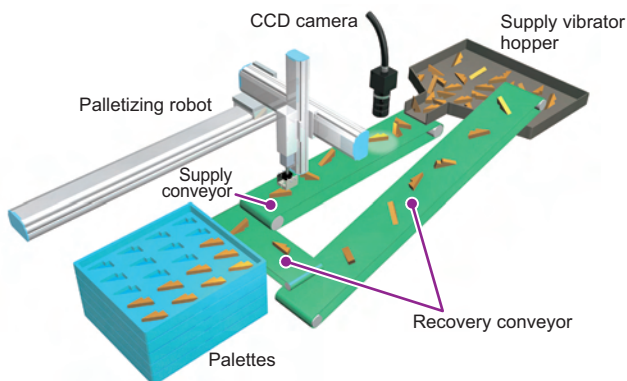


6 High-speed connections over a dedicated bus line

Connecting a bus line directly to the CPU board in the robot controller yields data transfer speeds some 5,000 times higher than serial data transfer on ordinary machine vision equipment! Programming is also easy because the time lag occurring during communications or data transfer does not have to be considered. It also easily handles conveyor tracking tasks that require high-speed processing.



7 Handles conveyor tracking



Just adding a conveyor tracking board allows handling of conveyor tracking tasks.

Pulse (AB phase) signals from an encoder installed on the conveyor are input to a tracking board to continuously recognize work positions and allow pick up of work without having to stop the conveyor.

Up to 2 cameras or lightings or conveyor encoder units can be connected to support movement between conveyors.

8 Select freely from the YAMAHA robot lineup

All YAMAHA robots are controllable on the RCX controller. Select from among the single-axis robot FLIP-X series, the linear single-axis robot PHASER series, the Cartesian robot XY-X, or the SCARA robot YK-XG according to your application needs.

A low-cost and light-weight robot vision system can be easily built up at a low cost with an optimal model selected to match the user's application.

● Linear motor single-axis robots PHASER



● Cartesian robots XY-X



● SCARA robots YK-XG



● Single-axis robots FLIP-X



9 Vision is also easily controllable on the robot program

When using ordinary machine vision

```

MOVE P, P9
OFF LINE
SEND (* *) TO CMU
SEND CMU TO P10
ON LINE
MOVE P, P10
    
```

Data transfer with
image processing
device

↑↓ RS232C

Program in image
processing device

Program in
host PLC

When using the iVY SYSTEM

```

MOVE P, P9
VSEARCH 1,2,0
P10=VGETPOS(0)
MOVE P, P10
    
```

————— make a work search
————— load the points
————— move to that point



MERITS

- No data communication time lag
- Controllable with just the robot program
- Needs only a few lines of commands
- Simple and easy to understand

The robot program executes all vision control tasks including camera switching, image loading, and work piece search. Writing programs is simple compared to ordinary vision systems because control is all-inclusive from robot movement to camera control. Moreover, debugging is also efficient so the total number of required man-hours can be drastically reduced.

Examples of Robot vision language

Command names	Functions
VCAPTURE	Load image from camera
VSEARCH	Search for the specified part type
VMONITOR	Switch the monitor mode ON or OFF
VGETCNT	Acquire the number of parts that were found
VGETPOS	Acquire the position data
VGETTIME	Acquire the time required by the executed search command
VGETSCR	Acquire judgment values for the detected work
VSAVEIMG	Store images in BMP format

10 Includes dedicated "iVY Studio" software

The iVY system also includes dedicated "iVY Studio" software. This single software registers the work (sets edges, sets all types of parameters, set data loading range) and reference marks used for calibration, and also performs all tasks involving vision including backup and restore, operation monitor control, etc.

Support software iVY Studio

- Makes searches, registers part types,
- Registers reference marks (for calibration)
- Data backup
- Functions as a monitor during program operation

The iVY SYSTEM can eliminate these problems!

Must cut down on teaching man-hours

Robot teaching tasks require a lot of time and effort. The iVY system however acts as the "Eyes of the Robot" to drastically shorten the time usually required for teaching by automating the final fine adjustment step in during positioning.

Must simplify the positioning mechanism

Changing the setup such as for positioning tasks takes a lot of time when there are a large number of parts types and more and more work tends to involve small lot production with different parts. The iVY system can help to drastically lower costs for fabricating positioning jigs, monitoring and replacement tasks, etc.

Need to handle random work tasks

The iVY system can also assist in operations such as "placing the work directly after moving from the parts feeder" or "grip the work on the pallet and transport it". Using the position correction function on the iVY system can make performing these tasks simple.

Need to pickup work flowing on the conveyor

The iVY system also handles conveyor tracking tasks. Signals from an encoder installed on the conveyor are input to allow continuously recognize work positions in the process flow. So that work can be picked up without having to stop the conveyor.

Don't know where to find help when trouble occurs

Problems such as being unable to load images, or unable to write data, position errors tend to occur often in commercial image processing equipment used in combination with the robot. Those are the times when the YAMAHA iVY system will keep working well. The iVY system delivers total support for tasks ranging from loading of images from the camera to operating the robot.

■ iVY board basic specifications

ITEM	iVY board	
Basic specifications	Applicable controller	RCX240
	Pixels	640 (H) × 480 (V) (300,000 pixels, VGA)
	Settable part types	40 part types
	Connectable cameras	Maximum 2 units 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
Setup support functions	Calibration, image storage function ^{Note1} (all images / specified image)	

Note1. Requires Windows PC.

■ Lighting control board (option) basic specifications

ITEM	Lighting control board (option)	
Basic specifications	Applicable controller	RCX240
	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 (option) basic specifications

ITEM	Tracking board (option)		
Basic specifications	Applicable controller	RCX240	
	Lighting control section	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
	Pulse input section	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
	Encoder 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 RS422)
Input phase		A, \bar{A} , B, \bar{B} , Z, \bar{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.

iVY System

● Robot with image processing functions

“SEARCH and TAKE” “CHECK POSITION and ASSEMBLE”

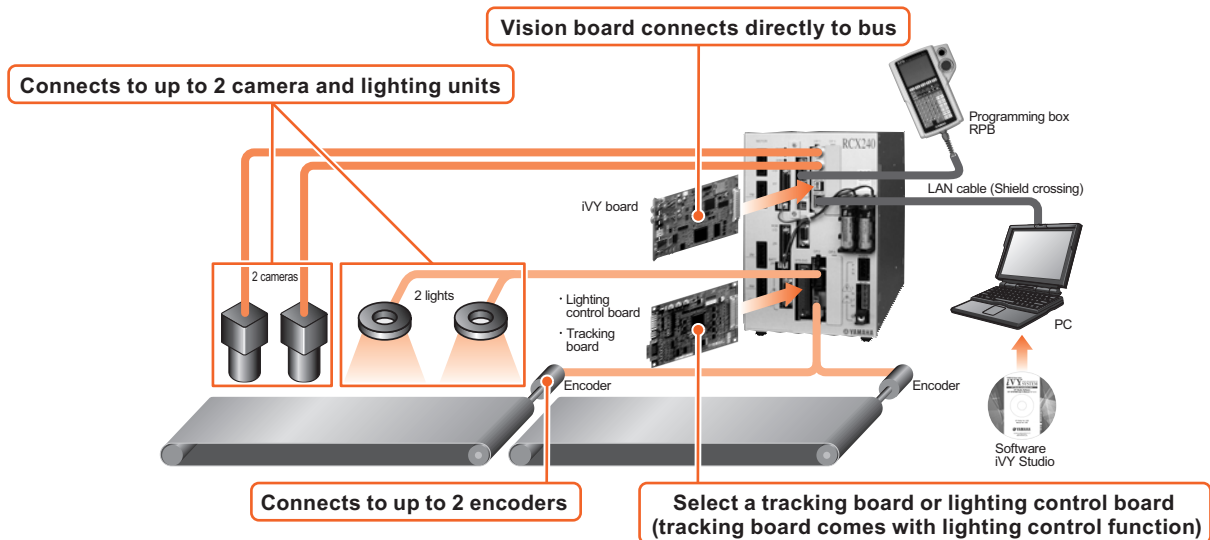
YAMAHA offers a whole new production line concept that eliminates time-consuming teaching and positioning tasks with “iVY-system”!

Main functions ▶ P.040

iVY system layout

Basic system contents

- RCX240 controller
- iVY system (Plug-in Board)
- iVY Studio (Support software)



Features

1 Amazingly easy to use!

Ordinary robot vision requires a great deal of time and trouble due to tasks such as setting up data transfer. However the Yamaha “iVY System” is super easy to operate because it utilizes a unique work positioning function.

2 Super-easy one-step calibration

Calibration (coordinate matching alignment task) is an easy job on the iVY system and finished in a short time because all the operator does is comply with the conversation type commands from the programming box.

3 Uses edge search for great stability

Machine vision on most current equipment uses gray search which is easily affected by the work piece surface state and lighting conditions. The iVY system however includes a “search engine” using edge search that is strongly resistant to outside effects and so opens up a whole new range of machine vision applications.

4 High-speed bus connection is resistant to noise and fast!

Connecting a bus line directly to the CPU board in the robot controller yields data transfer speeds some 5,000 times higher than serial data transfer on commercial vision equipment.

5 Robot program provides easy control of vision tasks

Vision tasks such as camera switching, image capture, and work search can now be easily controlled from the robot program. Tasks ranging from moving the robot to camera control are all carried out in one unified sequence so writing a program is easy.

6 Yamaha delivers total support!

The controller, robot and vision are all manufactured by Yamaha. This means that Yamaha can provide total support for everything from loading images on the camera to robot operation.

APPLICATION
TRANSERVO
Compact
single-axis robots
FLIP-X
Single-axis robots
PHASER
Linear motor
single-axis robots
XY-X
Cartesian
robots
YK-XG
SCARA
robots
YP-X
Pick & place
robots
CLEAN
CONTROLLER
INFORMATION
Robot
positioner
Pulse string
driver
Robot
controller
iVY
Option

iVY System basic specifications

iVY board

- Edge (contour) searches**
 The edge search format of the iVY system is relatively unaffected by missing and soiled workpieces.
- Generous number of registered models**
 Up to 40 models can be registered and used in searches. This permits easy setup changes simply by changing the model number.
- Supports 2 cameras**
 Up to 2 cameras can be connected (both cameras must be the same type).
- iVY Studio permits search conditions to be monitored during automatic robot operation**
 iVY Studio permits monitoring of work search conditions during automatic robot operation, and monitoring of fiducial mark search conditions during calibration setting operations.

Basic specifications

Item		iVY board
Basic specifications	Applicable controllers	RCX141, RCX142, RCX240
	Pixels	640 (H) × 480 (V) (300,000 pixels, VGA)
	Settable part types	40 part types
	Connectable cameras	Maximum 2 units <small>Note. If connecting 2 units, then must be the same model</small>
	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 storage function ^{Note1} (all images / specified image)

Note. 1. Requires Windows PC.

Lighting control board (Options)

- Digitally modulated light format used for PWM**
 A digitally modulated light format is used for pulse width modulation (PWM), resulting in stable light modulation.
- Light emission format (continuous light / strobe light) is selectable according to the application**
 The light emission format can be selected according to the application in question.
 Continuous light : 100-step light modulation (0 to 100%)
 Strobe light : 10μs to 33ms light emission time setting
- Supports 12V and 24V lighting specifications (constant voltage type)**
 Either a 12V or 24V lighting specification can be used to supply power which matches the LED lighting specification in question. LED lighting colors (red, white, green, blue) are also supported.
- 2Ch lighting output, with max. output capacity of 60W**
 2 lighting channels can be used simultaneously, provided that the total power consumption for both channels does not exceed 60W (for 24VDC. For 12VDC, the maximum is 30W). The modulated light and lighting control mode settings can be specified individually.

Basic specifications

Item		Lighting control board (option)
Basic specifications	Applicable controllers	RCX141, RCX142, RCX240
	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)

- Conveyor tracking support**
 The tracking board receives pulse signals (AB phase) from conveyor encoders in order to continuously check the positions of conveyed workpieces. This allows workpieces to be picked up without stopping the conveyor.
- Equipped with 2 pulse counters**
 The tracking board has 2 pulse counters, allowing workpieces to be checked on 2 lines simultaneously. Each of the pulse counters supports pulse inputs of up to 2Mpps.
- Equipped with lighting control function**
 The tracking board is equipped with the lighting control board functions, allowing it to perform all the iVY system functions with only an iVY board and a tracking board.

Basic specifications

Item		Tracking board (option)	
Basic specifications	Applicable controllers	RCX240	
	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 RS422)
		Input phase	A, \bar{A} , B, \bar{B} , Z, \bar{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.

Accessories and part options

Standard accessories

iVY board



Model KX0-M4402-10

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.



iVY board accessories

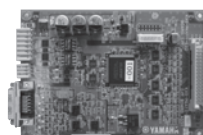
Name	Single unit model	Set Model
Camera trigger input cable connector	KX0-M657L-00	KX0-M657K-00
Custom tool	KX0-M657M-00	

Environment

OS	Microsoft Windows 2000/XP/Windows Vista <small>Note The 64 bit version is not subject to the operation warranty.</small>
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 <small>Note. Besides the above, also requires memory space for storing images and data.</small>
Display	800 × 600 dots or more, 32768 colors (16bit High Color) or more (recommended)
Network	TCP/IP Ethernet port × 1

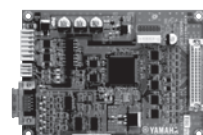
Options

Lighting control board



Model KX0-M4400-G0

Tracking board



Model KX0-M4400-E0

Lighting control board accessories

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 accessories

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 (3.5m+6m)	KX0-M66F0-20

CCD camera



Model KX0-M7913-00

Lens



Model	8mm	KM7-M7214-60
	12mm	KM7-M7214-40
	16mm	KM7-M7214-30
	25mm	KM7-M7214-20

Close-up ring



Model	0.3mm	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

APPLICATION

TRANSERVO
Compact
single-axis robots

FLIP-X
Single-axis robots

PHASER
Linear motor
single-axis robots

XY-X
Cartesian
robots

YK-XG
SCARA
robots

YP-X
Pick & place
robots

CLEAN

CONTROLLER

INFORMATION

Robot
positioner

Pulse string
driver

Robot
controller

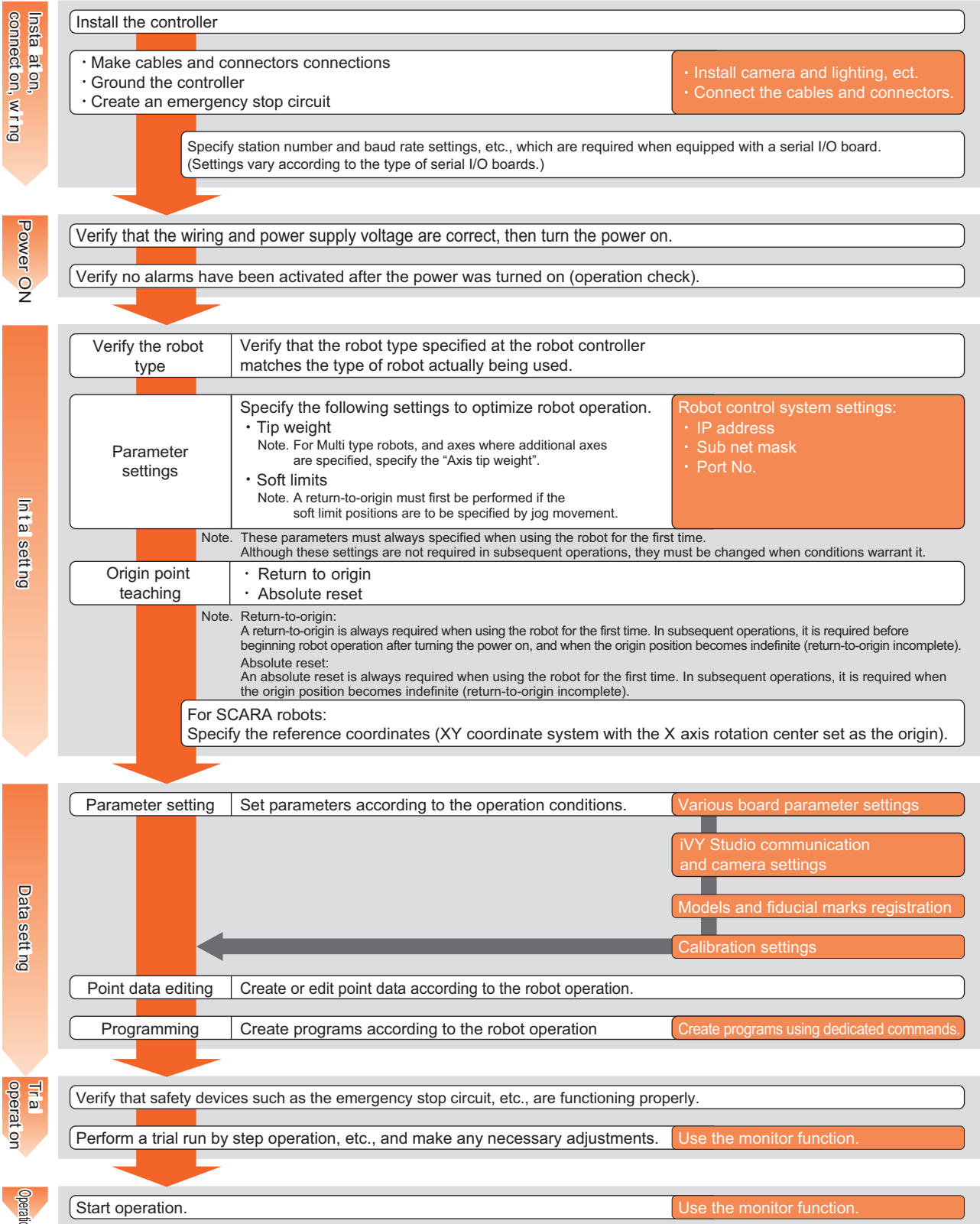
iVY

Option

Usage procedures

Basic procedures for actually operating the iVY system you purchased are described below.

Basic procedures



 Dedicated procedures required when using the iVY system.

 Standard procedures when using the RCX240 controller. (These procedures are required even when using the iVY system.)