MITSUBISHI ELECTRIC

Changes for the Better

for a greener tomorrow eco Changes

FACTORY AUTOMATION

ROBOT SYSTEM SOLUTIONS

e-F@ctory

MELFA

iQ Monozukuri

GLOBAL IMPACT OF MITSUBISHI ELECTRIC

Through Mitsubishi Electric's vision, "Changes for the Better" are possible for a brighter future.

Changes for the Better

We bring together the best minds to create the best technologies. At Mitsubishi Electric, we understand that technology is the driving force of change in our lives. By bringing greater comfort to daily life, maximizing the efficiency of businesses and keeping things running across society, we integrate technology and innovation to bring changes for the better.

Mitsubishi Electric is involved in many areas including the following

Energy and Electric Systems
A wide range of power and electrical products from generators to large-scale displays.

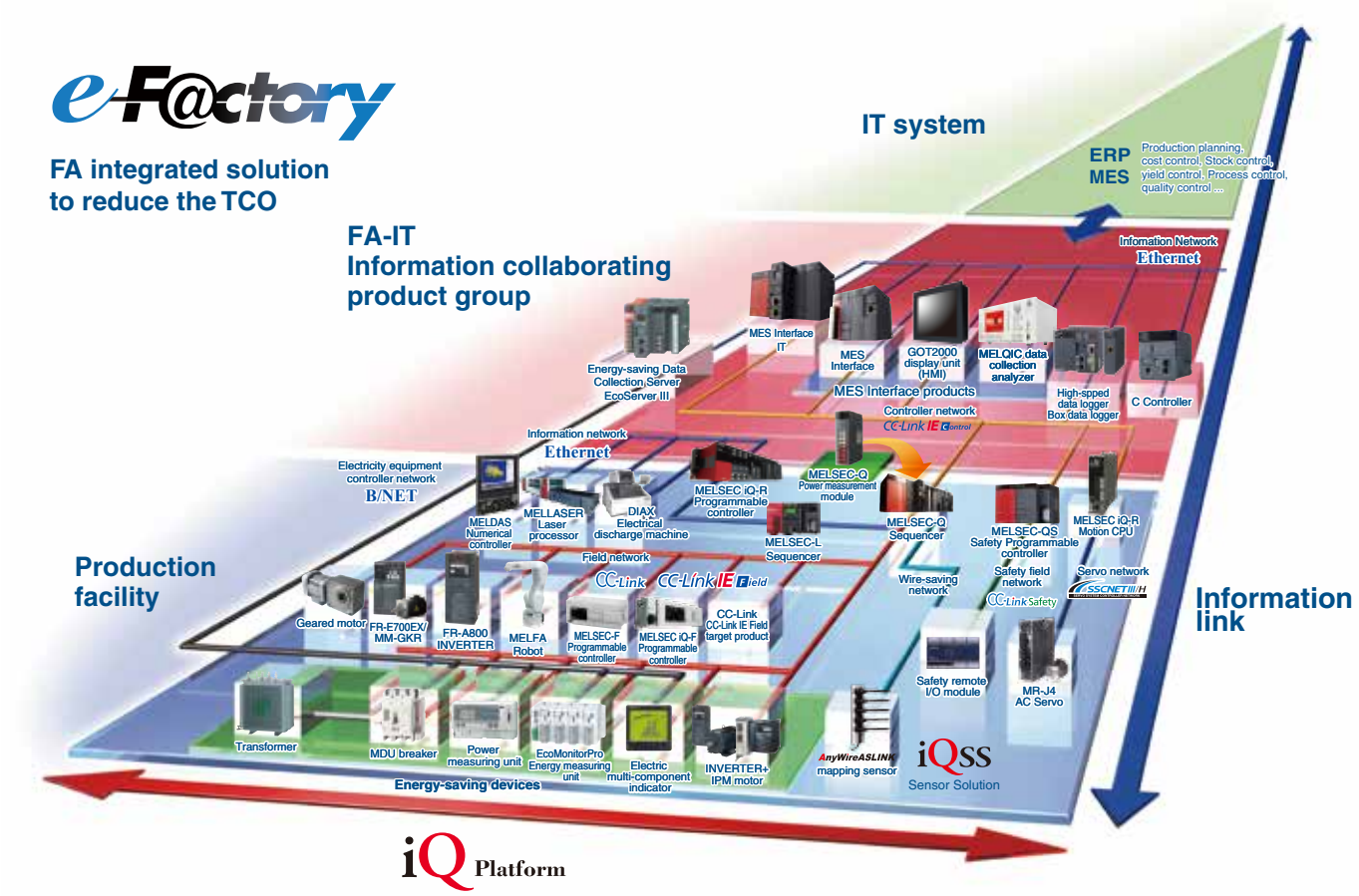
Electronic Devices
A wide portfolio of cutting-edge semiconductor devices for systems and products.

Home Appliance
Dependable consumer products like air conditioners and home entertainment systems.

Information and Communication Systems
Commercial and consumer-centric equipment, products and systems.

Industrial Automation Systems
Maximizing productivity and efficiency with cutting-edge automation technology.

Committed to ever higher customer satisfaction



Mitsubishi Electric is a global leader in the research, manufacturing and marketing of electrical and electronic equipment used in areas such as communications, consumer electronics, industrial technology, energy and transportation. Within this, the industrial automation business has grown significantly since the first induction motor was manufactured over 90 years ago and has closely followed the automation industry in Japan, Asia, and beyond. Mitsubishi Electric industrial automation boasts a wide-range of product areas such as production control, drives, and mechatronics that are used in various industries. In addition, Mitsubishi Electric offers e-F@ctory and iQ Platform, leveraging its total industrial automation solution portfolio. Mitsubishi Electric will keep offering products to customers all over the world as a total supplier of FA.

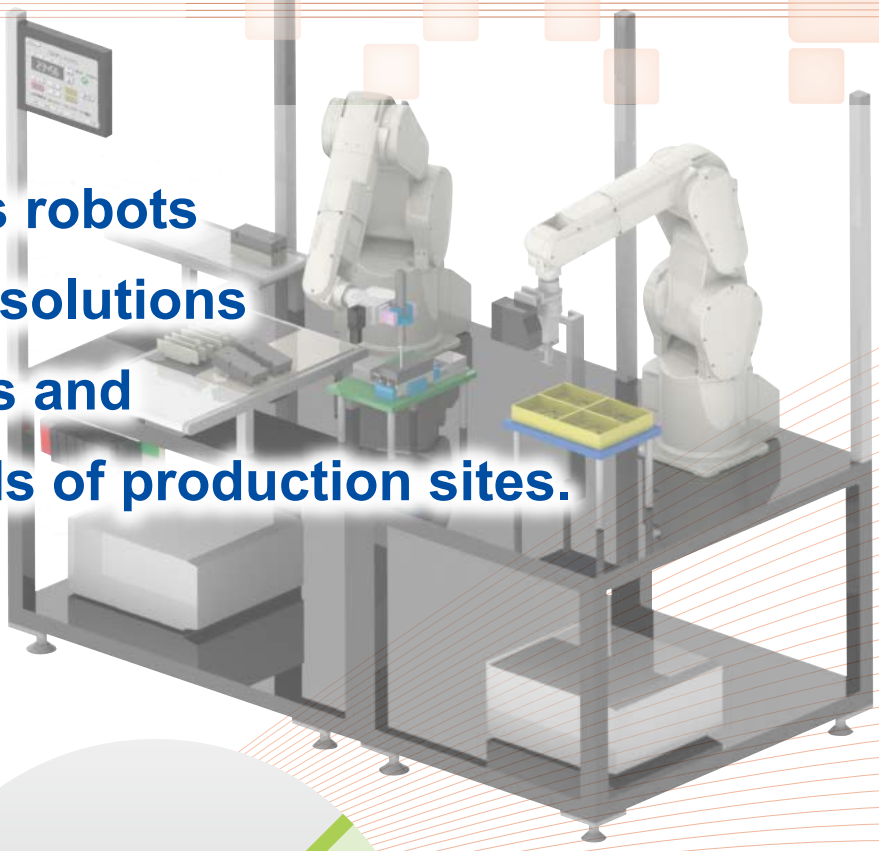
Our robotic solutions allow companies productivity and reducing costs.

MITSUBISHI ROBOT SYSTEM SOLUTION

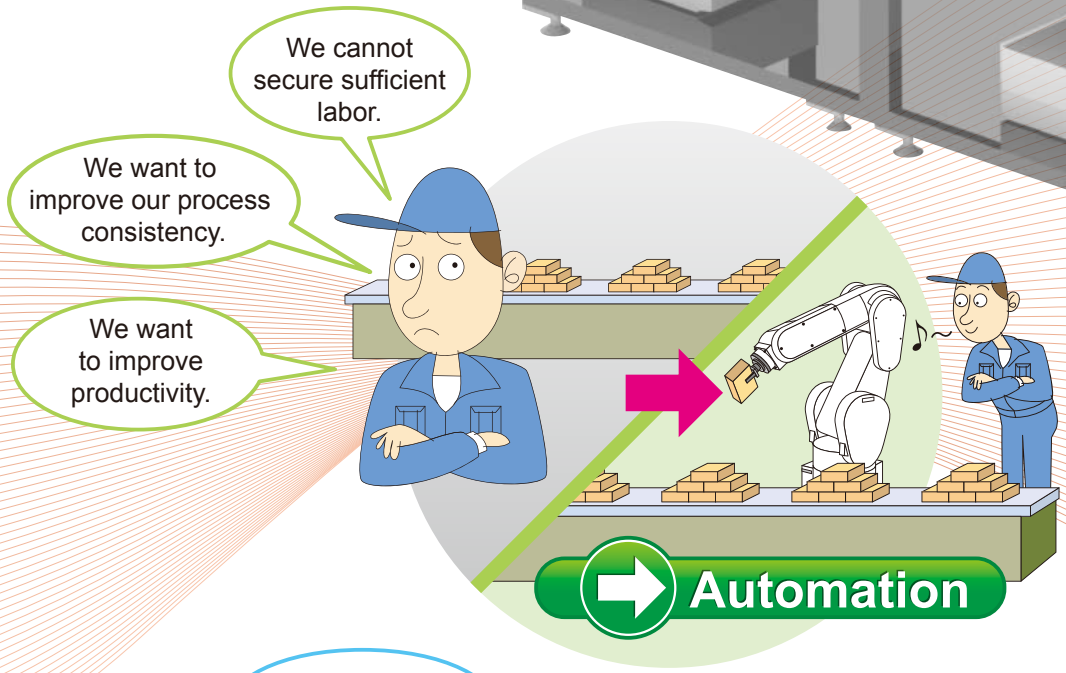
Mitsubishi Electric Corporation is a leading maker of factory automation systems, and has abundant experience in various areas including automobile parts, electronic and electric components, liquid crystal displays, semiconductors, food products, medicines, cosmetic products, potteries, education and research.

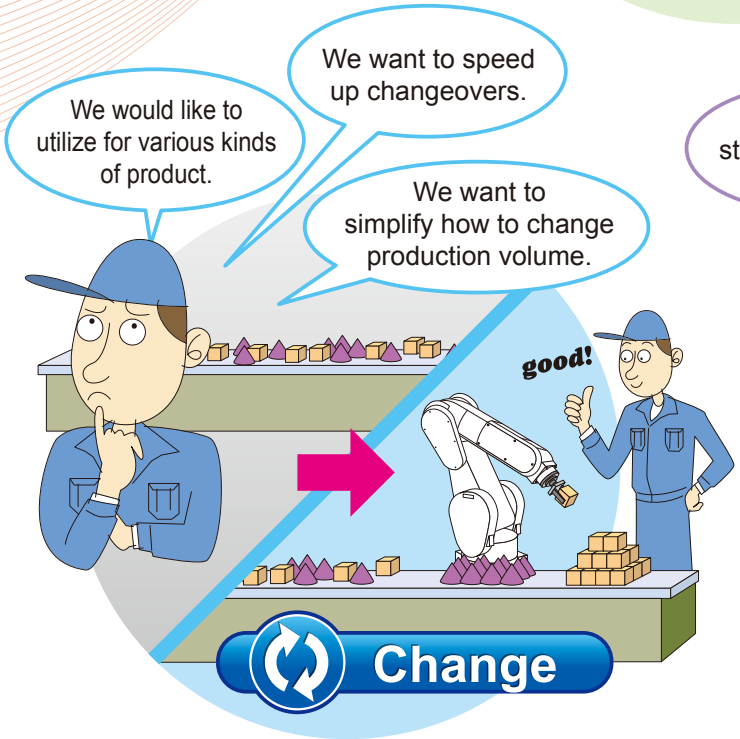
The company proudly offers the best of its kind intelligent solution with highly rigid arms which enable high-speed and high-precision operations, to support factories, to arrange optimization and to be one step ahead of other manufactures.

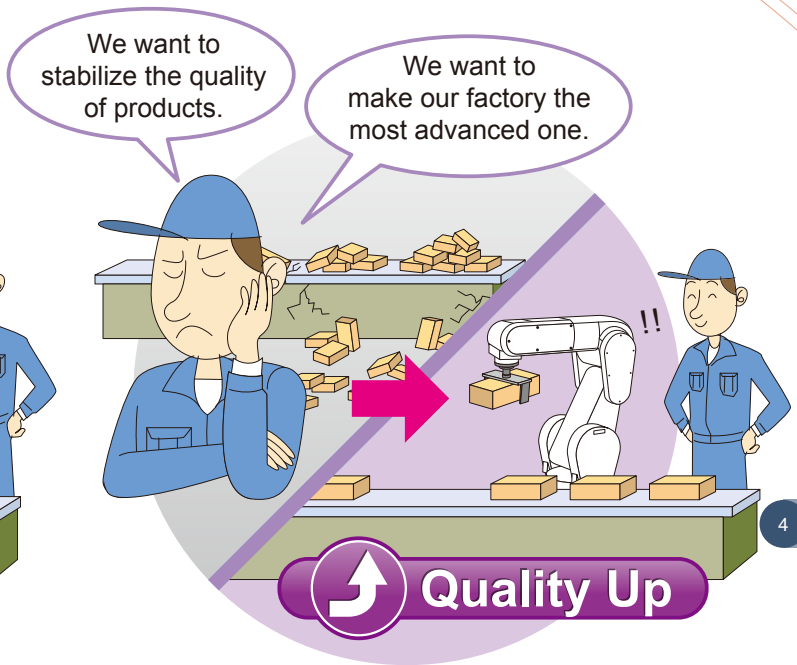
to upgrade their production lines thereby improving



Mitsubishi Electric's robots and robotic system solutions solve various issues and satisfy diverse needs of production sites.



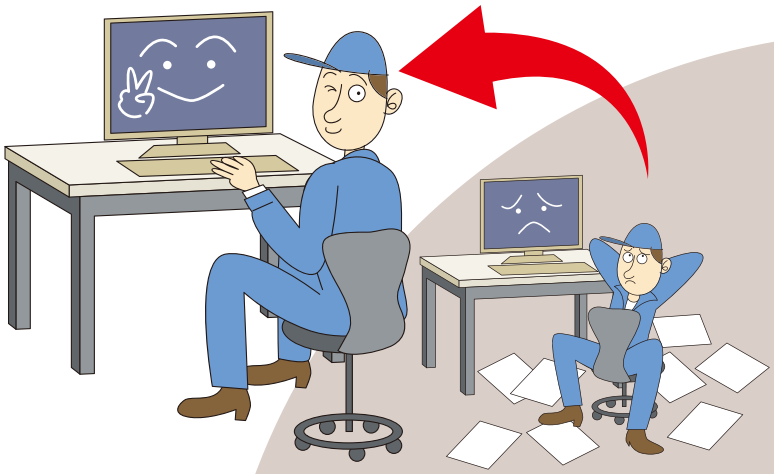




We will immediately answer to your

Smooth system configuration!!

- We propose the most appropriate automation system out of our ample FA products.
- There are various ways to learn how to operate a robot in advance, such as e-learning and Robot School. Note 1)
- Call center is available for consultation for operating method and programming, including sudden needs such as a startup at a production site.
- In partnership with experienced system integrators (SI), we will provide proposals which satisfy your requests.



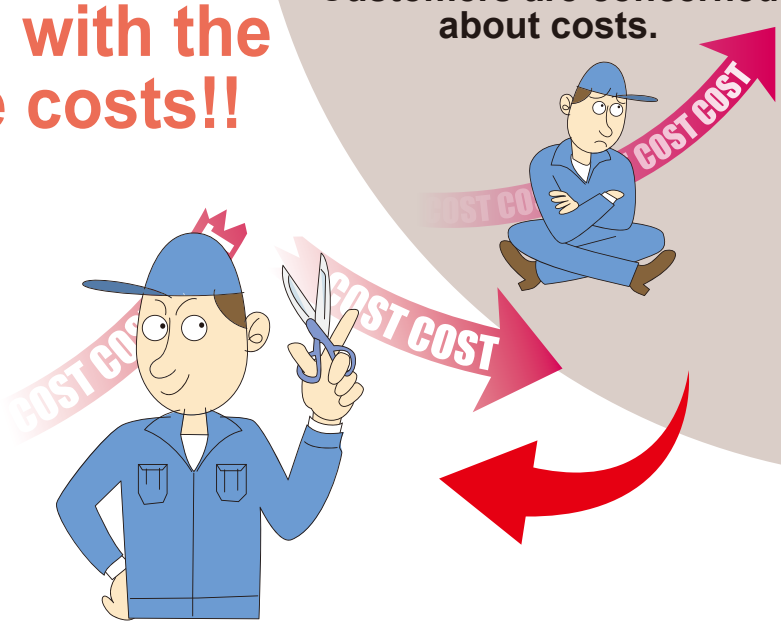
One of customers' concern is how to build a system.

To automate a plant, you will face various issues
Mitsubishi Electric will provide customers with reliable

Plant automation with the most appropriate costs!!

- By utilizing a wide range of functions, interface and components of robots, we will realize automation with the minimum peripherals.
- Customers can select the best robots for their layouts from an abundant lineup of robots.
- We will support our customers to implement the most appropriate system introduction in partnership with experienced system integrator partners.

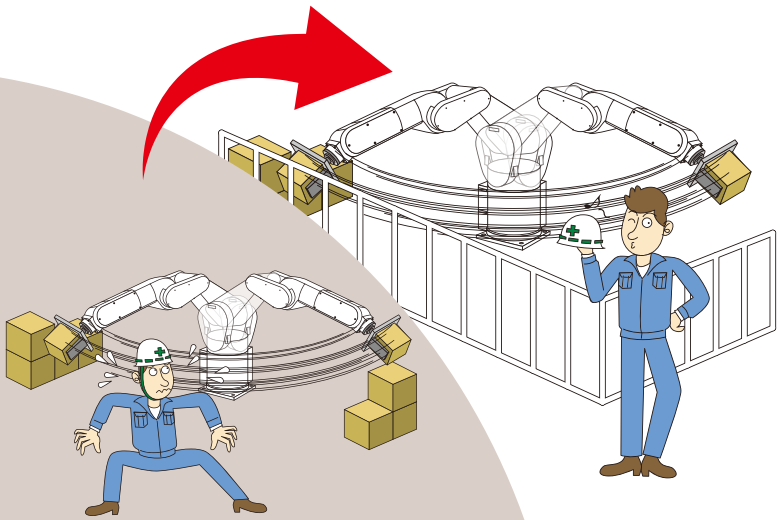
Customers are concerned about costs.



Note 1) Online information service, "Mitsubishi Electric FA Global Website" http://www.mitsubishielectric.com/fa/
Mitsubishi Electric FA Global Website provides technical information such as product information and case studies as well as the notice on training schools and contacts.
Once you register as a member, you will be ale to download manuals and CAD date etc. and take advantage of various services including e-learning.

questions regarding the introduction of robots.

The best safety measures!!

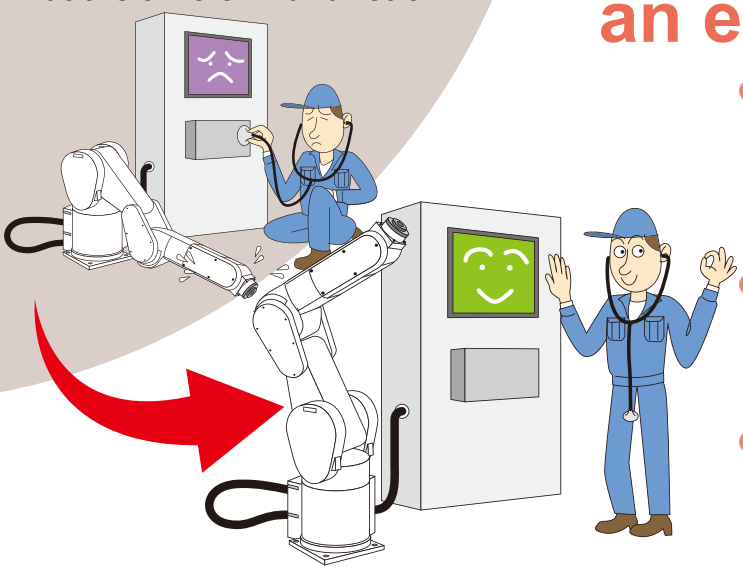


Customers are worried about safety measures.

- At Robot School, customers can learn about matters to be observed regarding the usage of robots such as the installation of a safety fence and a door switch. Note 2)
- Robots are equipped with various safety functions to ensure the safety of operators.
  (They are in compliance with ISO-10218, Safety Requirements for Industrial Robots.)
- We will propose our customers safe and comprehensive solution with our wide range of safety product lineup.

and concern.
support for the introduction of robots in their plants.

Customers want to know if they will be well looked after at the time of malfunction.



Shorter downtime at an emergency case!!

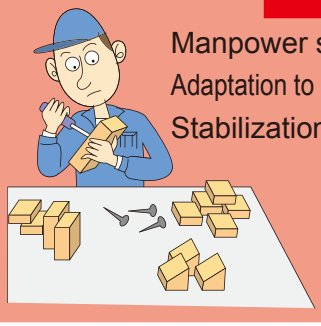
- We globally deploy our after-sales service offices for factory automation equipment and robot which are the key parts of automation systems to establish a reliable support system.
- Utilizing our expertise in factory automation equipment, we will support customers to be equipped with necessary maintenance functions.
- We will provide our support to customers for the design, delivery and maintenance of a robot system through the strong alliance with our partners.

Note 2: With regards to the safety related to robots, it is mandatory to abide by Industrial Safety and Health Law and Ordinance on Industrial Safety and Health in Japan.

Delivering the best automation solution

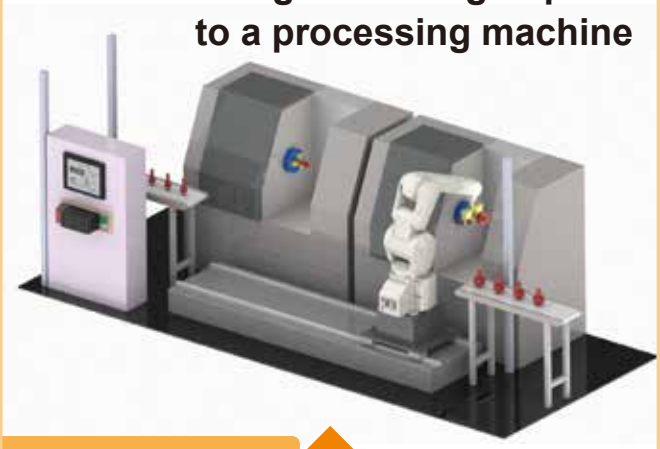
Assembly of electric equipment

Case study: Page 9,10



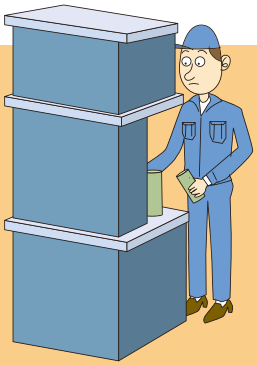
Manpower saving
Adaptation to a wide variety of products
Stabilization of quality

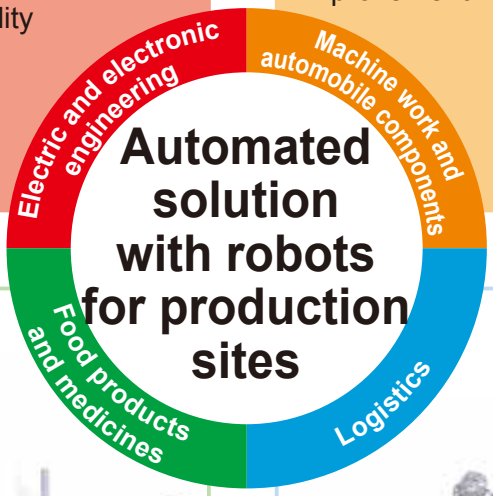
Loading/Unloading of pars to a processing machine



Case study: Page 11,12

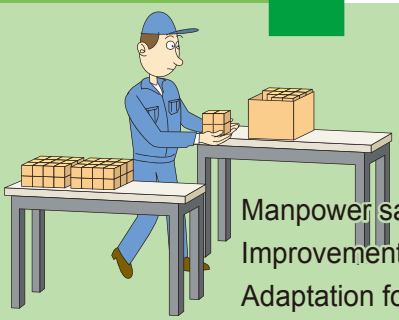
Manpower saving
Higher operating ratio
Improvement in cycle time





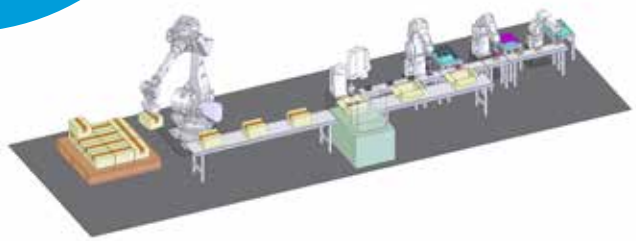
Alignment and packaging

Case study: Page 13,14



Manpower saving
Improvement of traceability
Adaptation for load changes

Handling of packed carton boxes



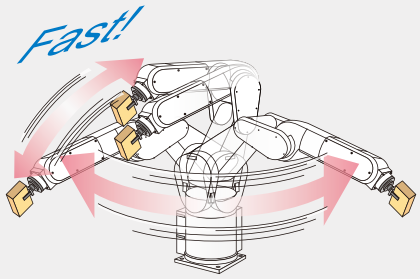
Case study: Page 15

Manpower saving
Improvement in cycle time
Reduction of heavy labor

Merits of robot introduction

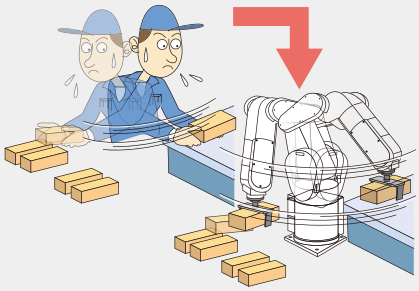
Productivity improvement

Productivity will be improved.



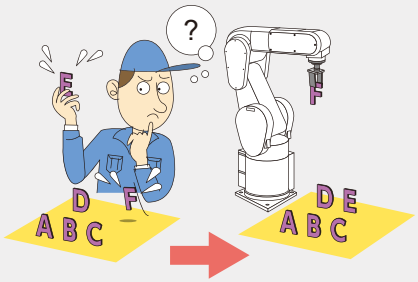
It enables high-speed operation. Continuous operation is possible even at workers' recess time and midnight.

Manpower will be saved.



Robots work taking over the hands and arms of operators. (Robots are able to duplicate complicated movement.)

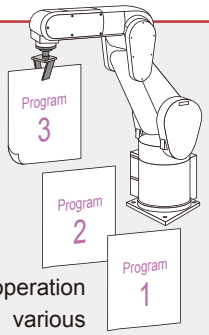
Product quality will be improved.



Since the movement of robots is consistent, there is no mistake such as skipping attachment of a component.

Reduction of total costs

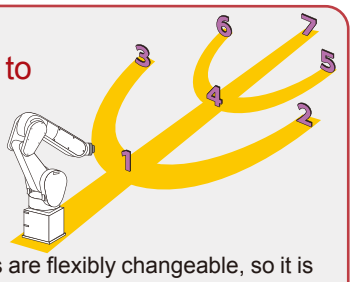
Versatile system can be created. (Adaptation to a wide variety of products.)



Robot Robots enable a quick operation mode change by saving various complicated moves and allowing program and automatic hand change.

Dedicated machine Device tends to have complicated structure which requires changeovers of various parts.

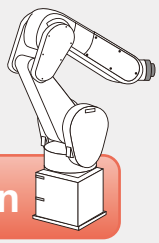
It is easy to change to a new model and to switch to another operation.



Robot Moves of robots are flexibly changeable, so it is easy to add a product type and a process in the future. When a line is stopped, a robot can be easily utilized with another production facility.

Dedicated machine It is necessary to newly design and manufacture a machine for the change and it requires costs.

The start-up time of system will be shortened. There will be fewer troubles at a start-up and adjustment time will become shorter.



Teaching → **Programming** → **Automatic operation**

Robot Since the system is flexible, it is easy to design coordinating with other peripherals. In addition, at the installation, there is no need to adjust a position against those of peripherals, which reduce a start-up time.

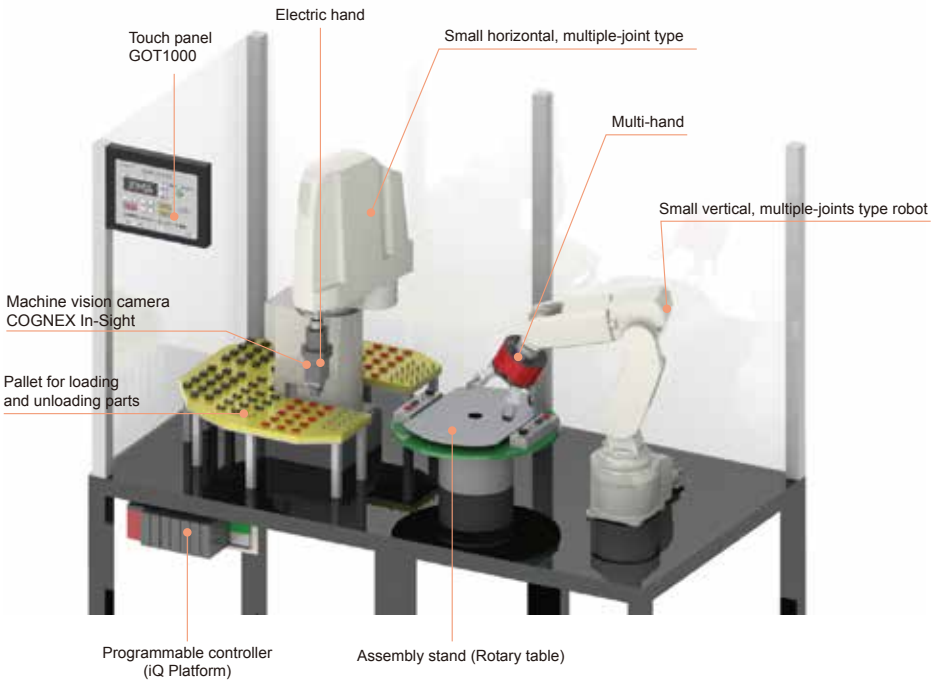
Dedicated machine Since it requires dedicated work, it requires a long time to design and manufacture a machine. In addition, it is not flexible, so it takes a very long time to adjust a position at the installation.

Mitsubishi Electric, one of the leading customers with the most appropriate

Electric and Electronic Engineering

Assembly of electric components (switch)

System configuration diagram



Points for the employment of robots

High-speed parts kitting with a horizontal, multiple-joint type robot, fine assembly with a vertical, multiple-joint type robot, and the ability to handle a variety of workpieces with a high-functioning hand (a multi-hand and an electric hand)

High-speed kitting
It enables high-speed picking from multiple pallets.

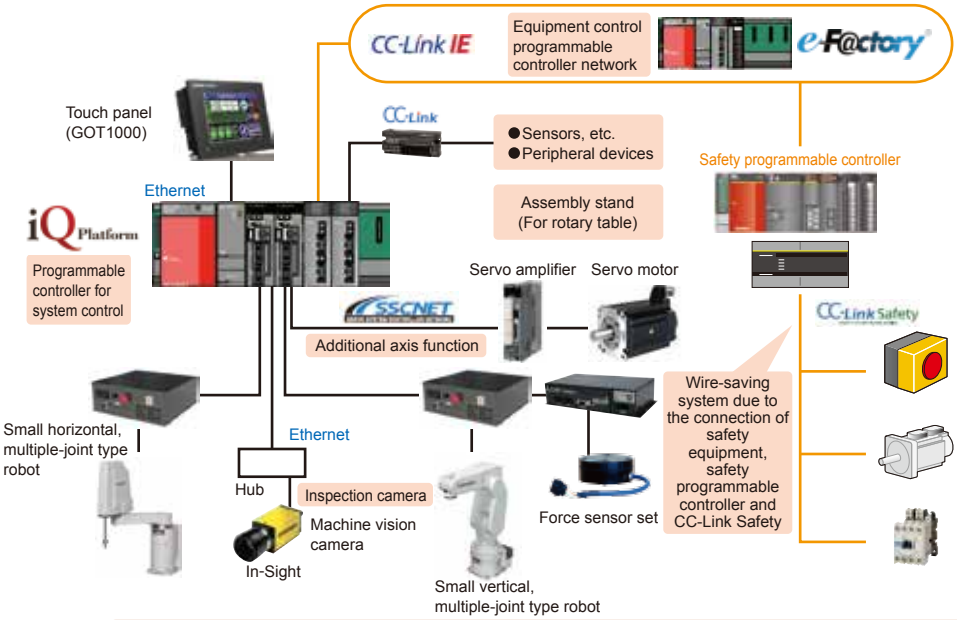
Capable of handling a wide variety of workpieces using only a small space
Utilizing a small horizontal, multiple-joint type robot which has a wide motion range requiring a small installation space, a plant can keep a various kinds of parts as a stock using a smaller space.

No need to change hands to switch a kind of work
Easily attachable electric hand can flexibly handle parts with different sizes and configurations.

Complicated assembly process
A small vertical, multiple-joint type robot, which is versatile and has a wide motion range, processes a complicated assembly process at a low cost.

Reduction of cycle time
Easily attachable four-head multiple hands can process continuous mounting of parts.

Control device configuration diagram



iQ Platform strengthens the link between programmable controller, GOT and a robot. It enables the best system operation and visualization. In addition, it realizes effective production control utilizing various networks and MES interface.

Reduction of cycle time with iQ Platform, which arranges high-speed communication between a robot and a programmable controller.

Unit-saving with the robot's Additional axis function

Easy connectivity with COGNEX machine vision camera

Visualization of data by linking factory automation equipment and wire-saving of various networks

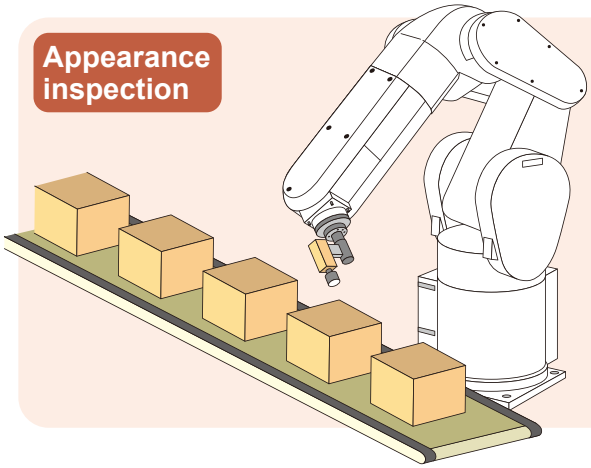
Benefits of introducing

- Manpower-saving with the introduction of facility: It is possible to depreciate the investment cost in about 2 years. (Note: The calculation is based on the conditions that Mitsubishi Electric uses.)
- Introduction merit due to increased production capacity: Production will increase about 2.5 times due to the shorter cycle time and longer operating hours. (Note: The calculation is based on the conditions that Mitsubishi Electric uses.)

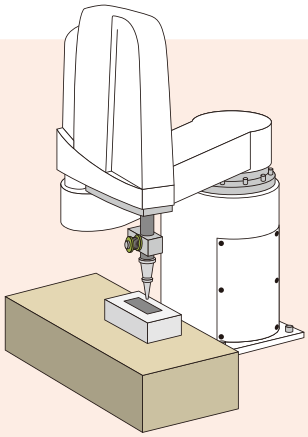
Other merits: Adaptation to the production of a wide variety of products, the simplification of production adjustment, and the stabilization of quality

factory automation system makers, will provide systems through the strong alliance with partners.

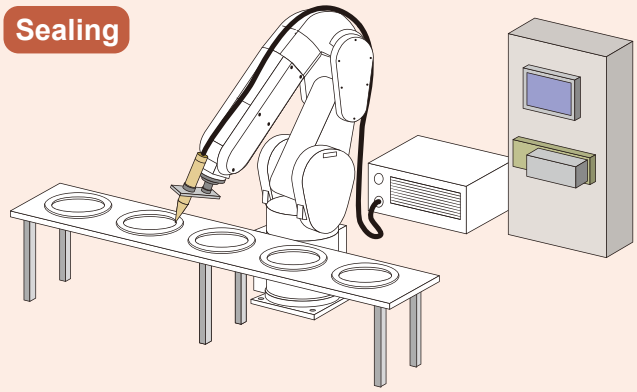
Appearance inspection



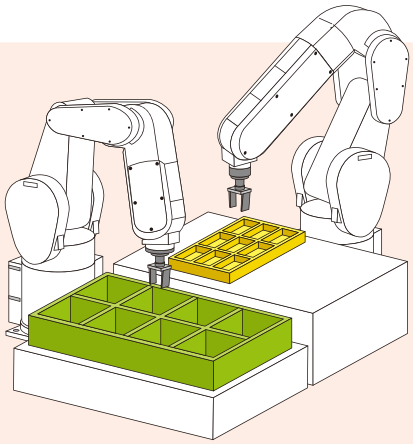
Soldering



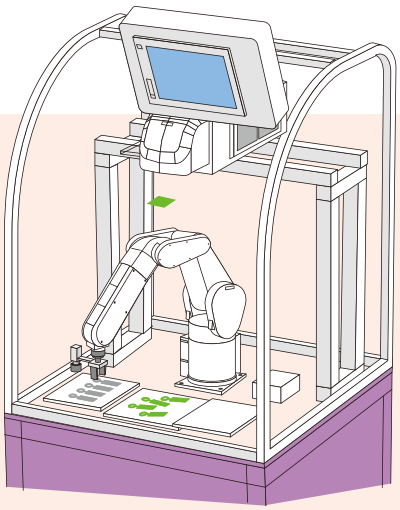
Sealing



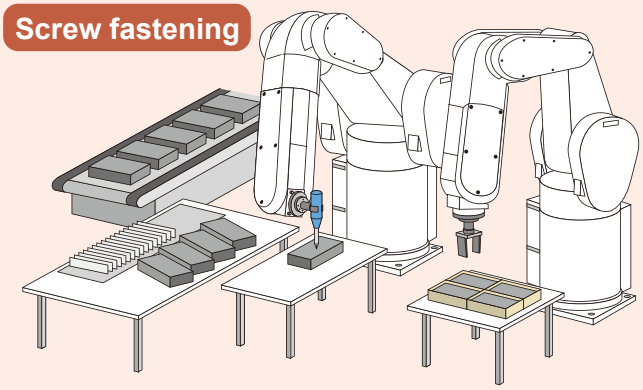
Kitting



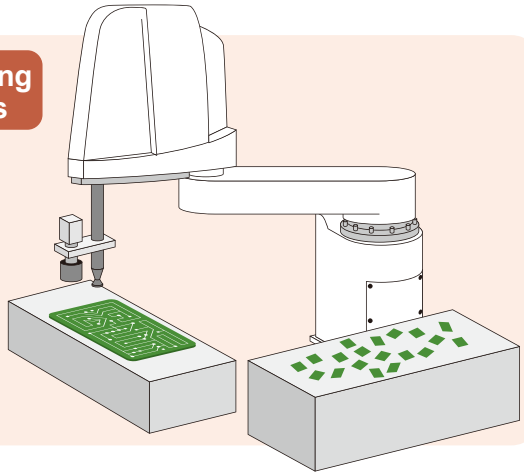
Laser marking



Screw fastening



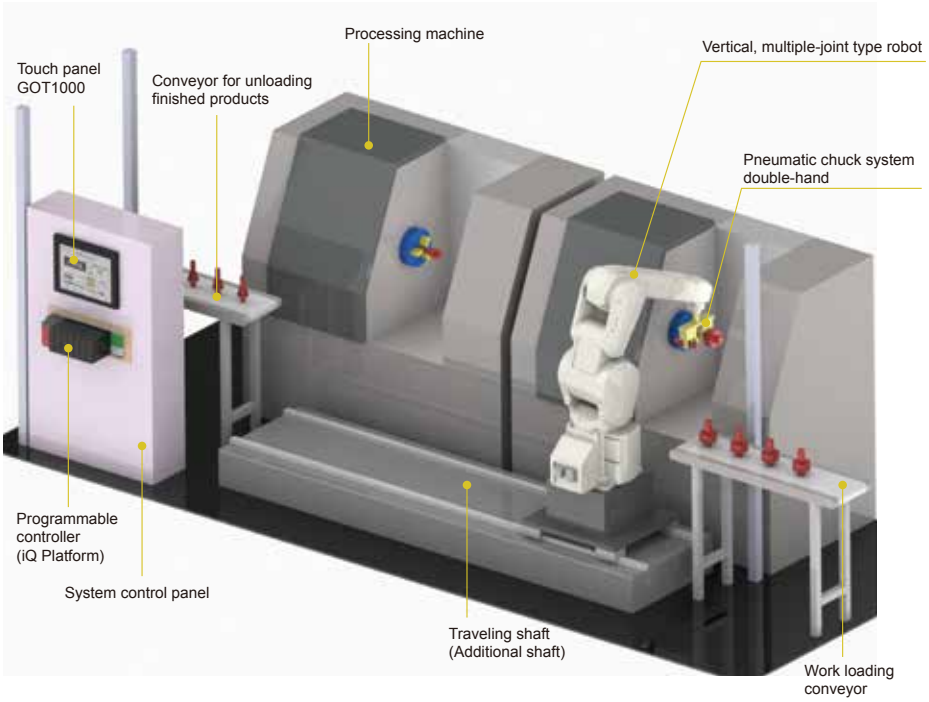
Mounting of parts



Machine work and automobile components

Loading/Unloading of parts to a processing machine (A lathe, a machining center, a press machine, and a make-up machine, etc.)

System configuration diagram



Points for the employment of robots

A vertical, multiple-joint type robot realizes high-speed loading and unloading of parts to a processing machine. (Oil mist proof) Additional traveling shaft improves the operating rate of a robot and efficiently utilizes the facility.

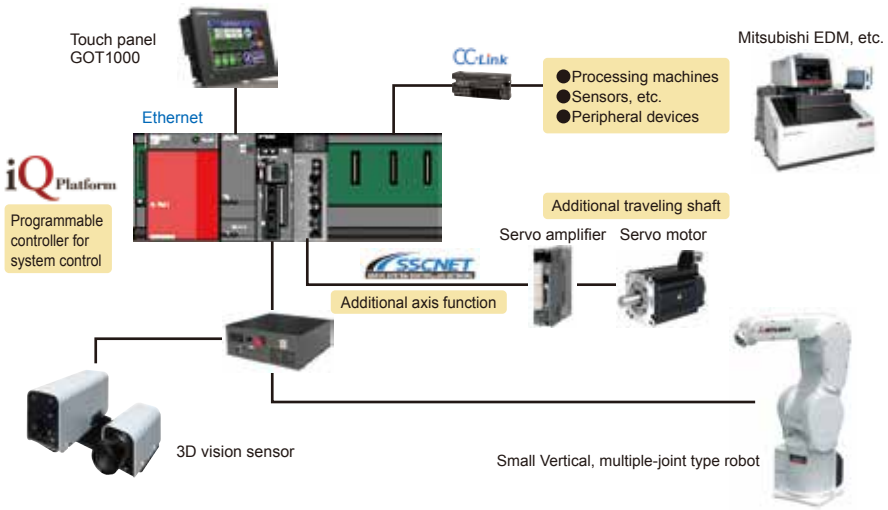
Improvement of environmental resistance
Oil mist proof assures a safe access to a processing machine.

Smooth hand-over of products with various processing machines
It is possible to place a robot in many styles changing the height and the positions of arms, enabling smooth hand-over of products with processing machines.

Higher operating rate of robot
One robot can be slided to access multiple number of processing machines during its operation.

Shorter cycle time
Double-hand operation minimizes the time to replace a workpiece in a processing machine.

Control device configuration diagram



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In addition, it realizes effective production control utilizing various networks and MES interface.

Reduction of cycle time with iQ Platform, which arranges high-speed communication between a robot and a programmable controller.

Unit-saving with robot's Additional axis function

Visualization of data by linking factory automation equipment and wire-saving of various networks

Benefits of introducing

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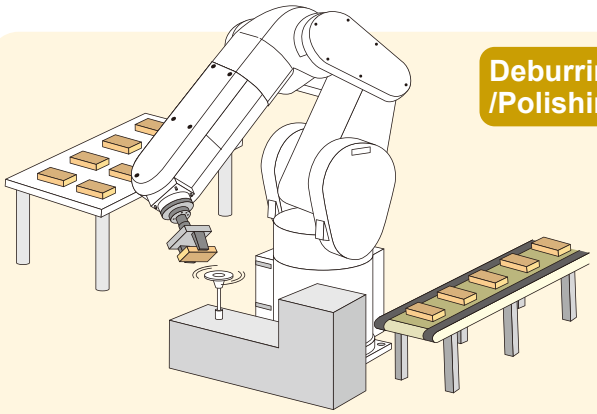
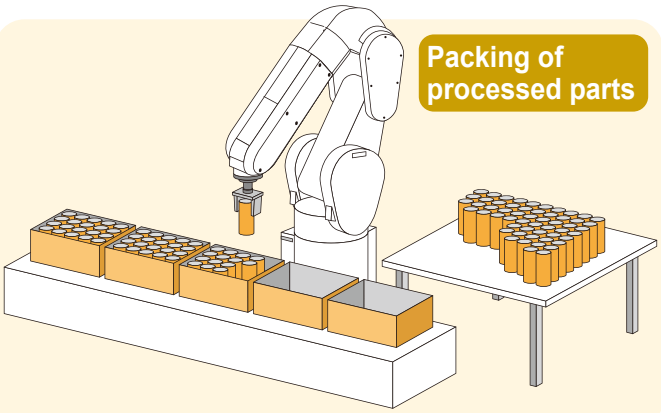
- Introduction merit due to increased production capacity: Production will increase about 1.5 times due to the longer operating hours. (Note: The calculation is based on the conditions that Mitsubishi Electric uses.)

Other merits: Adaptation to the production of a wide variety of products, the simplification of production adjustment, and the reduction of dangerous work

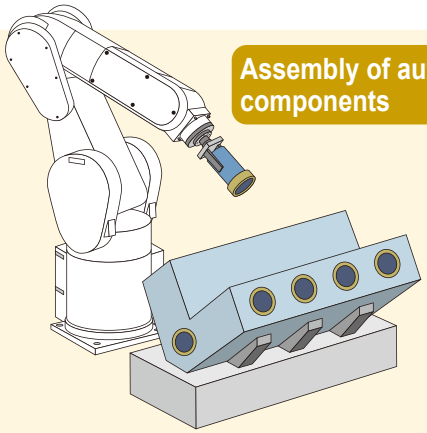
Deburring /Polishing



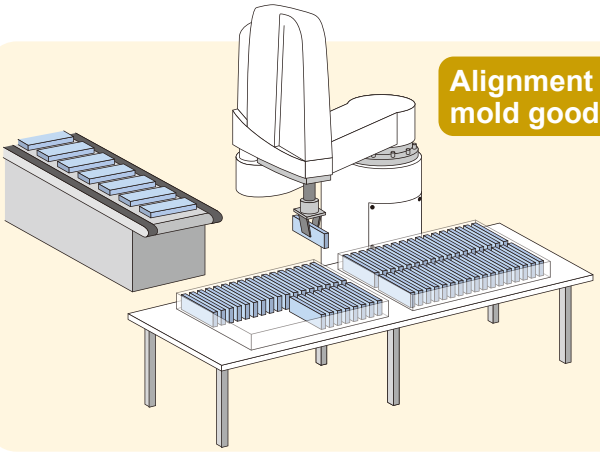
Packing of processed parts



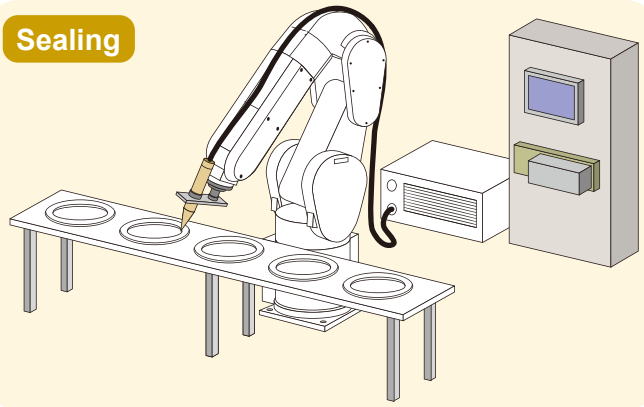
Assembly of automobile components



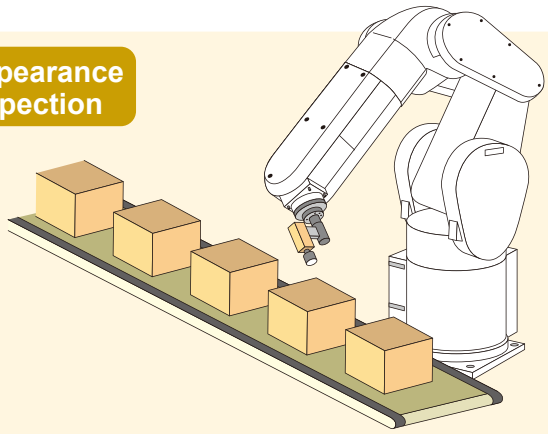
Alignment of mold goods



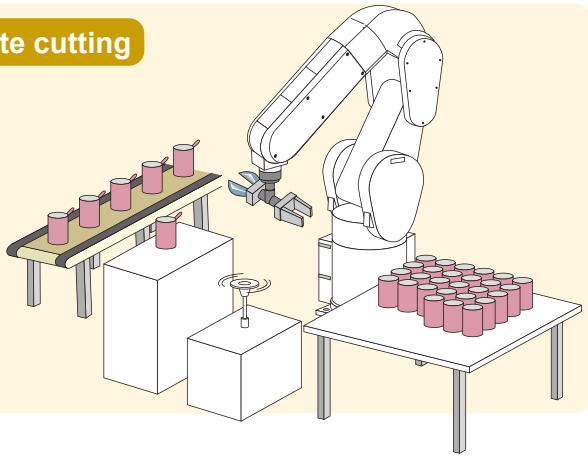
Sealing



Appearance inspection



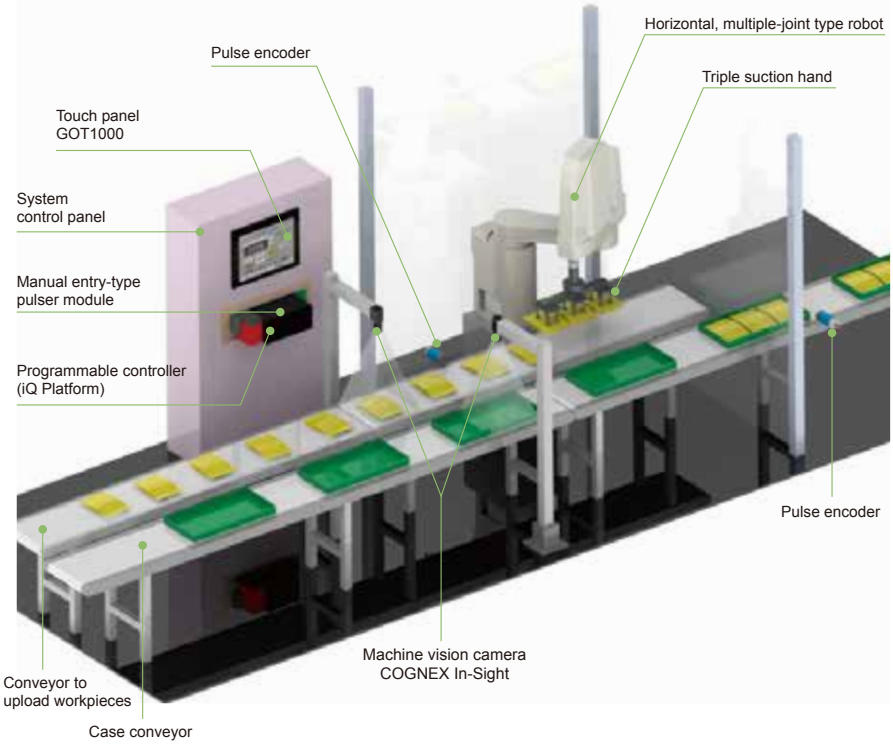
Gate cutting



Food Products and Medicines

Conveyor alignment for packed food products

System configuration diagram



Points for the employment of robots

High-speed vision-tracking of horizontal, multiple-joint type robot realizes non-stopping alignment process. It also processes simultaneous tracking for multiple conveyors.

High-speed tracking

Tracking function of robot allows the line to arrange transfer and alignment processes while easily following the moves of workpieces on a conveyor.

No need of alignment device

No dedicated alignment device is required due to the utilization of machine vision camera, which contributes to the setup of versatile system at a low cost.

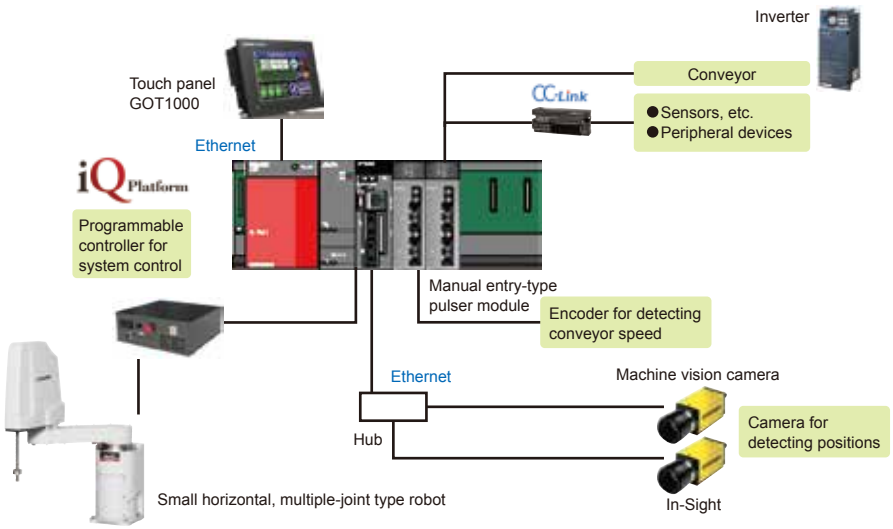
Reduction of cycle time

Synthesis rate of joint of horizontal, multiple-joint type robot realizes the highest speed and highly accurate operation of its kind.

Stable quality due to automated process

Highly accurate repeating movement of robot eliminates the variation in quality due to the quality and operating speed of each operator.

Control device configuration diagram



iQ Platform strengthens the link between GOT and a robot. It enables the best system operation and visualization. In addition, it realizes effective production control utilizing various networks and MES interface.

Reduction of cycle time with iQ Platform, which arranges high-speed communication between a robot and a programmable controller

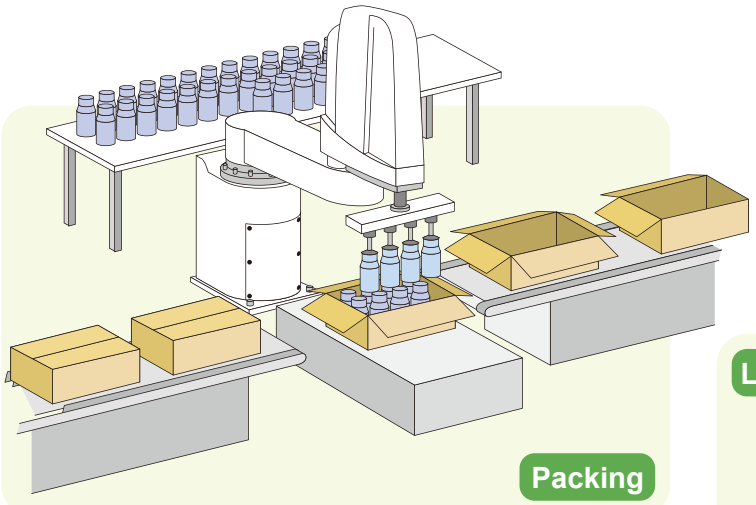
Easy connectivity with COGNEX machine vision camera

Visualization of data by linking factory automation equipment and wire-saving of various networks

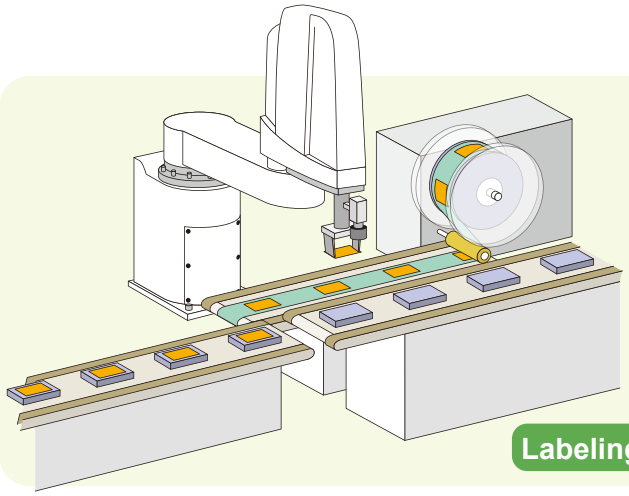
Benefits of introducing

- Manpower-saving from the introduction of facilities: It is possible to depreciate the investment cost in about 1.5 years. (Note: The calculation is based on the conditions that Mitsubishi Electric uses.)
- Introduction merit due to increased production capacity: Production will increase about 1.5 times due to the longer operating hours. (Note: The calculation is based on the conditions that Mitsubishi Electric uses.)

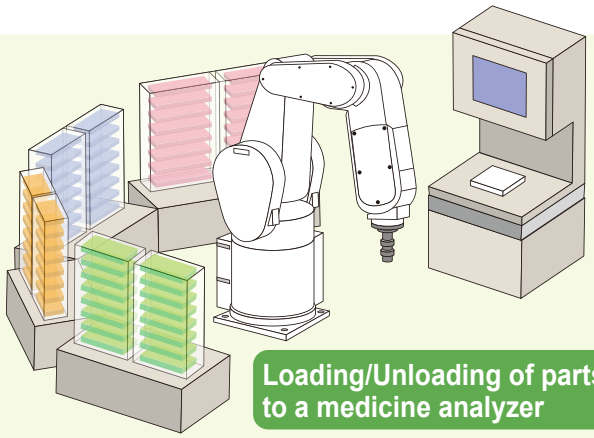
Other merits: Adaptation to the production of a wide variety of products, the simplification of production adjustment, and the stabilization of quality



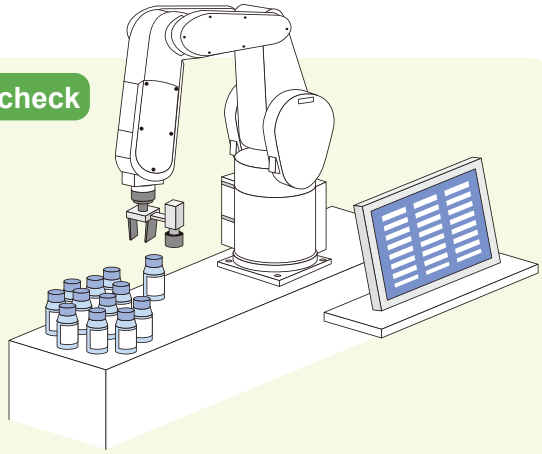
Packing



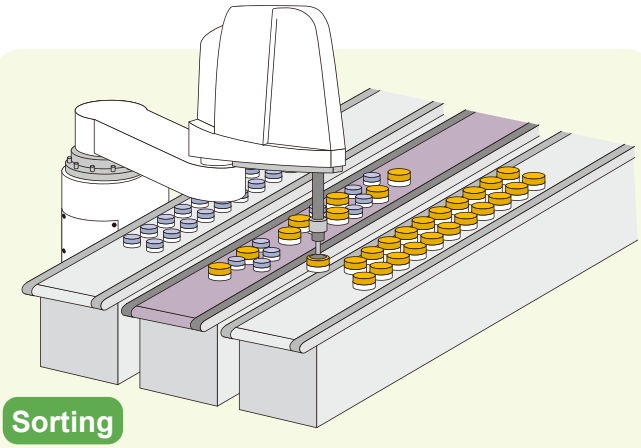
Labeling



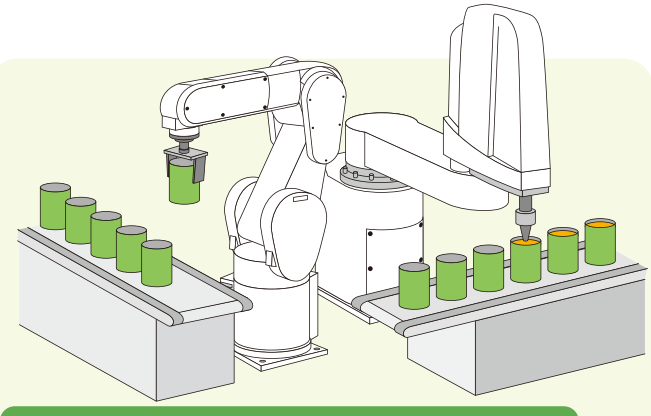
Loading/Unloading of parts to a medicine analyzer



Label check



Sorting

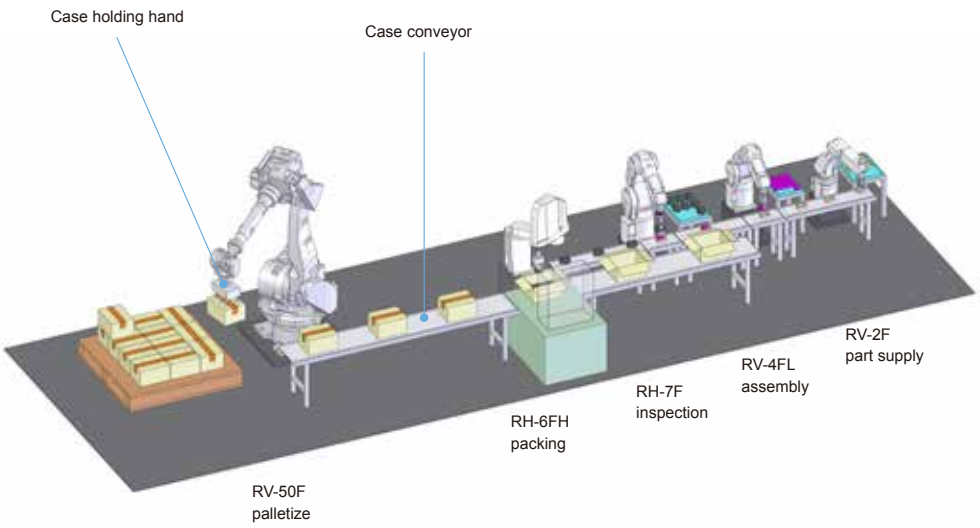


Loading/Unloading processes for a filler

Palletize

Palletize of carton boxes

System configuration diagram



Points for the employment of robots

A robot enables high speed palletizing operation. The length and structure of arms, which have been optimized for palletizing process, improves the flexibility of layout.

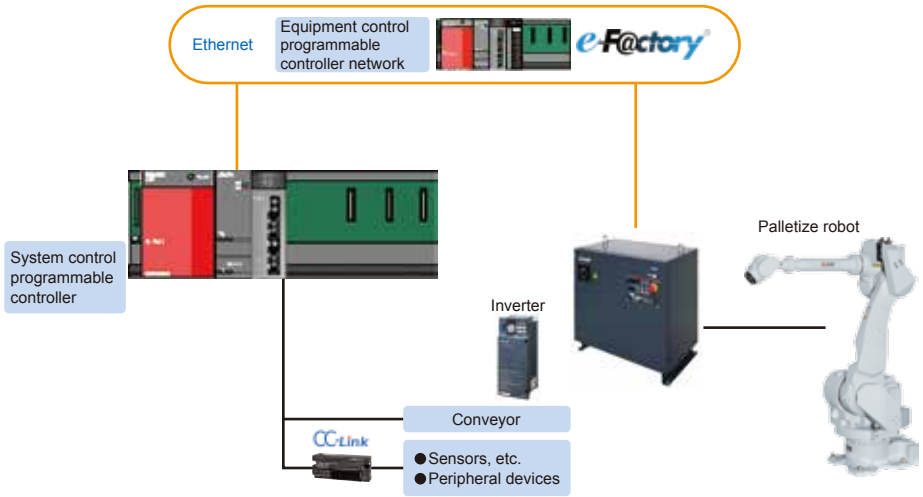
High-speed operation
The use of robot assures the highest speed palletizing of its kind.

Reduction of cycle time
To make the most use of the ability of robot, the most appropriate speed control is adopted depending on the load and the condition of posture of the robot.

Flexible layout
The optimized arm length and structure minimizes an idle space around a robot for the operation using standard pallet sizes.

Stable quality due to automated processes
Highly accurate repeating movement of robot eliminates the variation in quality due to the quality and operating speed of each operator.

Control device configuration diagram



Substantial network function including CC-Link and Ethernet assures the connectivity with upper programmable controllers and computers.

Visualization of data by linking factory automation equipment and wire-saving of various networks

Benefits of introducing

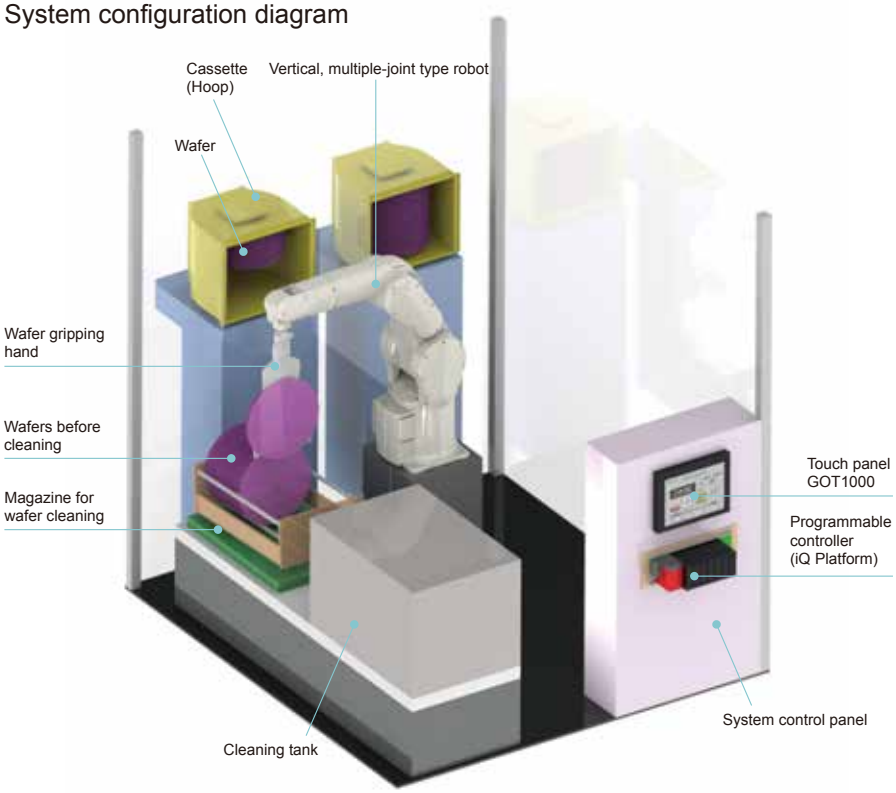
- Manpower-saving from the introduction of facilities: It is possible to depreciate the investment cost in about 1.5 years. (Note: The calculation is based on the conditions that Mitsubishi Electric uses.)
- Introduction merit due to increased production capacity: Production will increase about 4 times due to the shorter cycle time. (Note: The calculation is based on the conditions that Mitsubishi Electric uses.)

Other merits: The simplification of production adjustment, the stabilization of quality, and the reduction of heavy labor

Clean room

Loading and unloading from cassettes

System configuration diagram



Points for the employment of robots

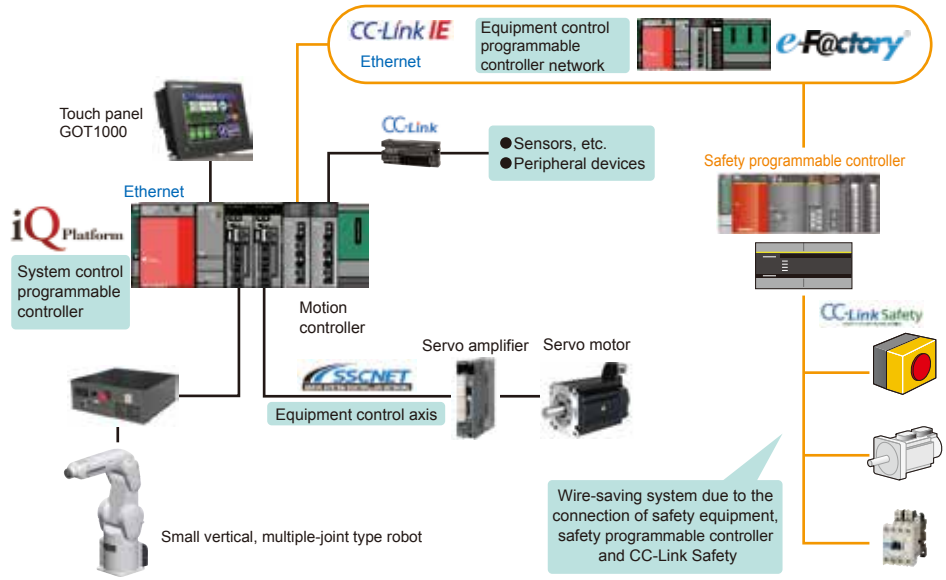
It is possible to perform high-speed loading and unloading of wafer cassettes (hoops) by a vertical, multiple-joint type robot (Long arm and clean room compatible).

Clean room compatible
Clean-type robot is used to satisfy ISO Class 3 clean room.

Space-saving
Layout is space-saving type which utilizes a wide motion range of robot.

Supporting various cassette types
It is possible to hand over wafers to cassette in various styles and requires no dedicated machine such as an inverting machine.

Control device configuration diagram



iQ Platform strengthens the link between programmable controller, GOT and a robot. It enables the best system operation and visualization. In addition, it realizes effective production control utilizing various networks and MES interface.

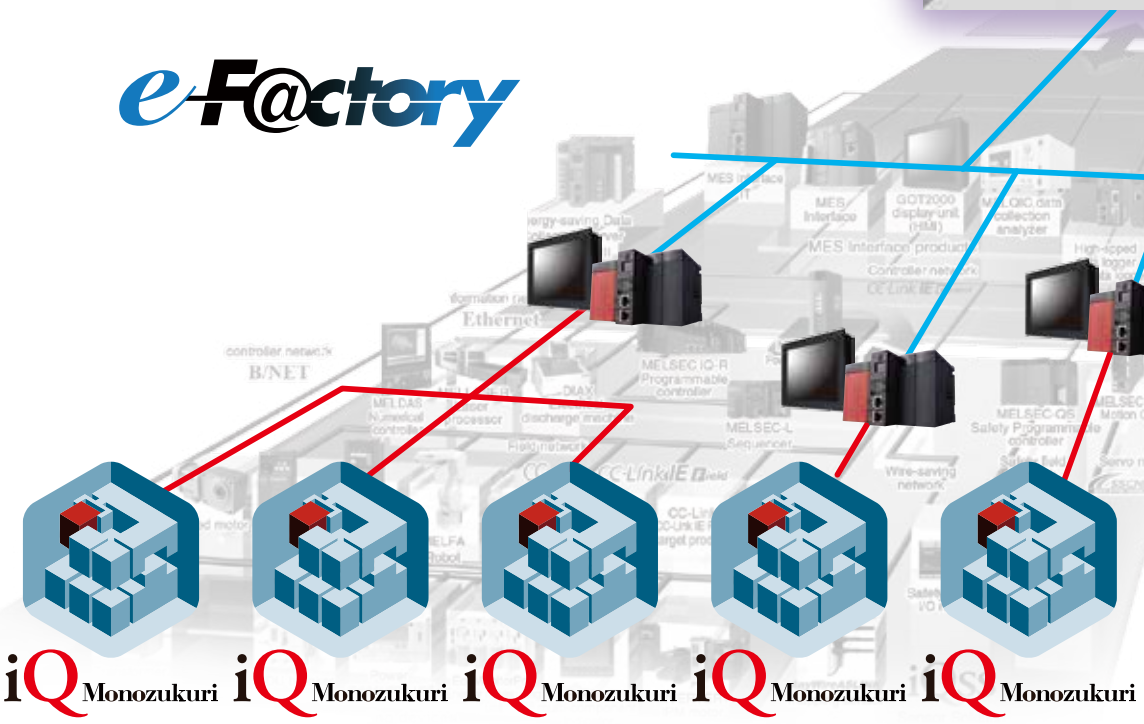
Reduction of cycle time with iQ Platform, which arranges high-speed communication between a robot and a programmable controller.

Visualization of data by linking factory automation equipment and wire-saving of various networks

Benefits of introducing

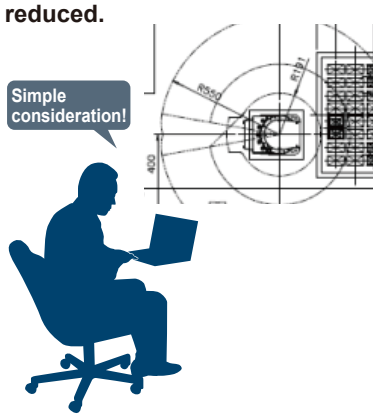
The improvement of cleanness, manpower saving, higher productivity, and the simplification of production adjustment

No more worries about introduction of robots to your facilities. Application to draw excellent functions and performance of robots can be easily configured.



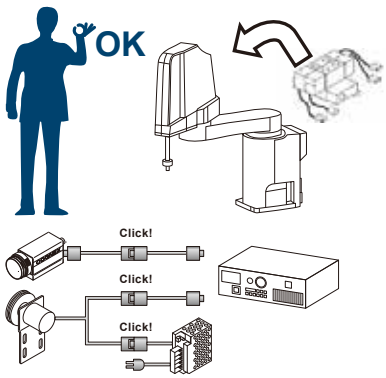
System design

Since essential components are included in a package, burden for system consideration can be reduced.



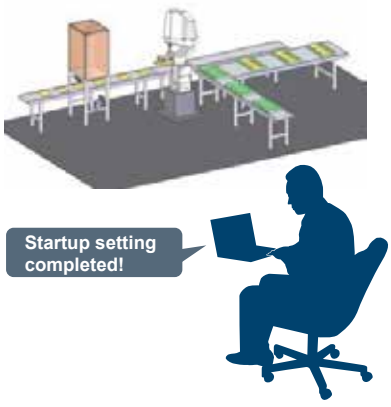
Device connection/setting

Anyone can connect various devices using ready-to-operate robots, easy wiring, and piping.



Programming/setup

Systems can be easily configured using dedicated application programs and startup tools.



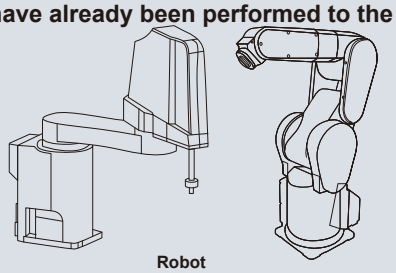
configuration of automation systems are packaged.

Package configuration image

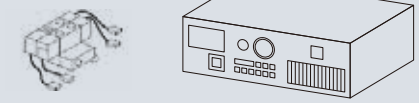
Devices, application programs, and useful startup tools required for automation system configuration and startup are all included in this package.

Robots and controllers

Wiring, piping, and parameter settings have already been performed to the robots.



Robot



Solenoid valve (option) Controller

1) Application program

Pre-installed robot programs

2) Setup wizard and setting tools

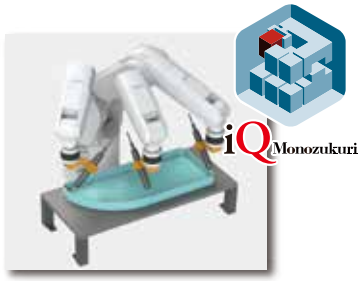
PC tools for easy startup

3) Peripheral device set

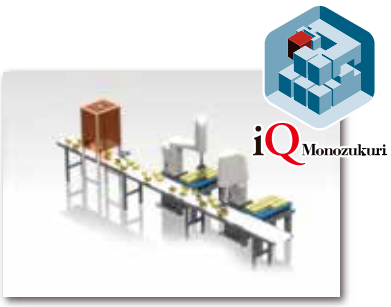
Hands, sensors, and other devices are included.

Hand Vision sensor Encoder Connector

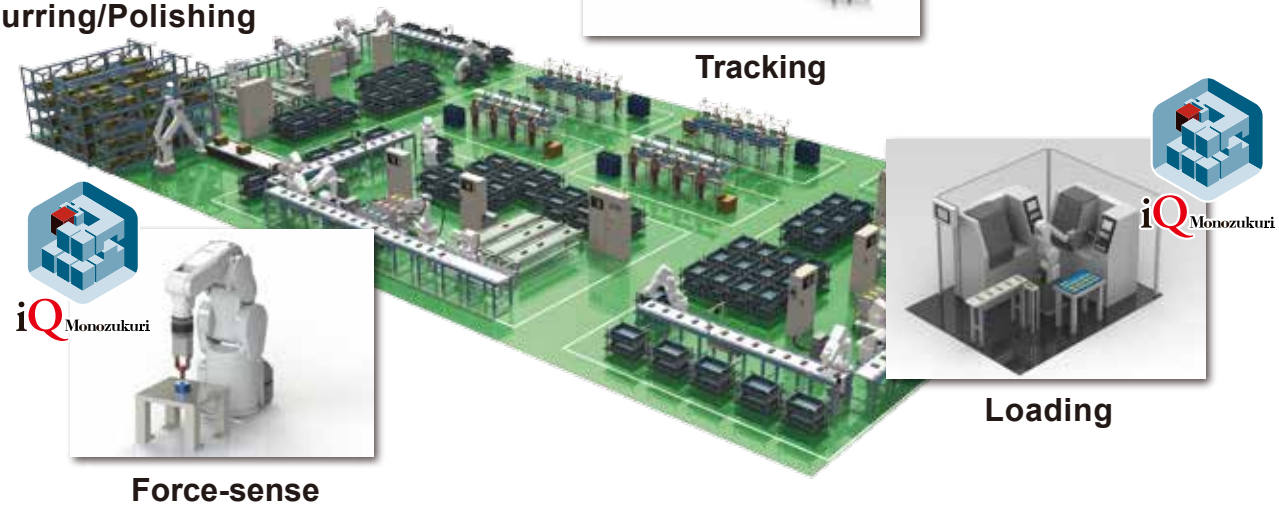
Based on actual performance of various system configurations, Mitsubishi will extend the variety of packages appropriate for various applications, mainly for Mitsubishi industrial robots.



Deburring/Polishing



Tracking



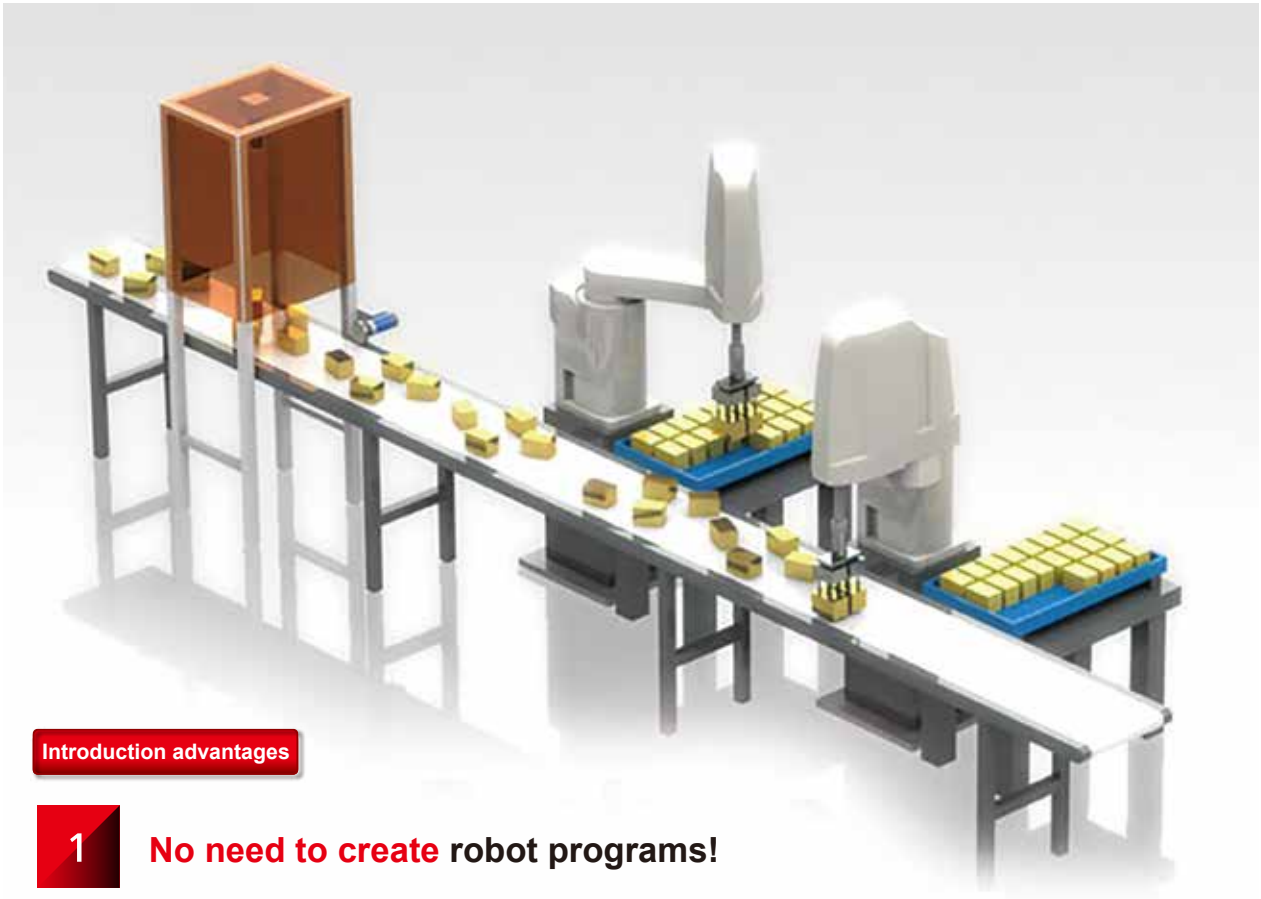
Force-sense

Loading

<Applicable applications are and will be added.>

Conveyor Tracking Application

Vision cameras detect workpieces on conveyors. Workpieces are transported and aligned by robots without stopping conveyors.



Introduction advantages

1. **No need to create robot programs!**

2. **Startup time after the system device installation is reduced by 85%!**

3. **High-level operations including peripheral-device settings, tracking operation, and ejecting operation can be easily configured with dedicated tools!**

<Reference value>

1. Programming
   Time taken for programming: 3 days → 0 hour
   (For the tracking application compatible with the basic specifications/layout)
2. Startup time
   Precondition: The time taken "from wiring connection to operation check"
   after the installation/initial settings of robots and installation of conveyors, vision sensors, and encoders
   1) Wiring and I/O check: 3 hours → 0.5 hours
   2) Connection settings, startup, operation check: 10 hours → 1.5 hours

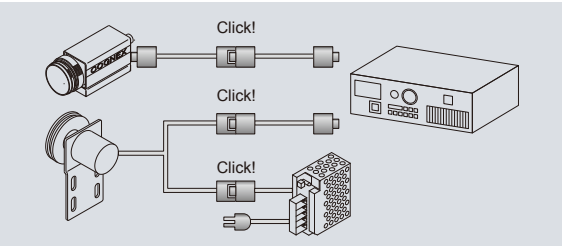
→ **Eleven hours are reduced in total! (13 hours → 2 hours)**

Features

Mitsubishi provides hardware, software, and supporting tools as a package to make designing, programming, and startup on tracking system configuration by customers easy.

Feature 1 No more complex wiring!

- Devices and cables required for tracking are packaged.
- Wiring is completed only by connecting connectors.
- Hands and vacuum solenoid valves for hands have already been installed to robots as default.



Feature 2 Easy startup with just 5 steps!

- Easy startup with wizard format (interactive format) of dedicated tools (No manuals are required. Just touch buttons following messages shown in the screen.)
- No need to create robot programs
- No more complex communication settings and parameter settings (automatic setting)
- Calibration of conveyors and vision sensors is also completed only by following instructions on the wizard.
- Startup adjustment can be easily performed in the wizard format!

* Teaching operation is required in the calibration screen.

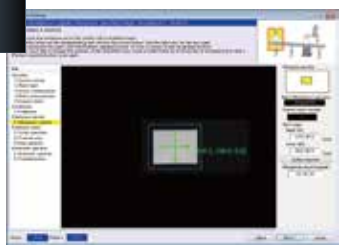
STEP 1

System configuration screen

STEP 2

Calibration screen

STEP 3



Workpiece registration screen

STEP 4

Operation check screen

STEP 5

Automatic operation/adjustment screen

Startup is completed!!

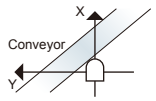
Feature 3 High-accuracy and high-speed operation can be performed!

- Synchronization performance of vision recognition and conveyor speed is improved by the new high-speed input function.
- Dedicated programs optimized for tracking with higher speed and higher accuracy are installed.

Basic specifications

Type[*1]			Unit	APR-□TR3FH	APR-□TR6FH	APR-□TR12FH	APR-□TR20FH
Robot specifications	Robot model name[*2]			RH-3FH5515-● -SA◆◆◆	RH-6FH5520-● -SA◆◆◆	RH-12FH8535-● -SA◆◆◆	RH-20FH10035-● -SA◆◆◆
	Environmental specifications			General environmental specifications: IP20			
	Maximum reach radius		mm	550	550	850	1000
	Up/Down stroke		mm	150	200	350	350
	Connected controller[*3]			CR751-D/Q	CR750-D/Q, CR751-D/Q		
	Power supply specifications	Input voltage range	V	Single phase AC180 to 253		Single phase AC207 to 253, 3-phase AC180 to 253	
		Power source capacity	kVA	0.5	1.0	1.5	
		Power supply frequency	Hz	50 or 60			
Standard installation hand specifications (for hand installation specifications)[*4]	Hand			Depends on outline dimensions of hand			
	Hand setting			Single-hand			
	Adsorption pad[*5] (For operation check)	Manufacturer		SMC			
		Model		ZPR32UN-04-A6 (ϕ32)		ZPR32UN-06-A6 (ϕ32)	
	Weight		kg	0.4		0.8	
	Piping specification			ϕ4 × 2		ϕ6 × 2	
	Standard supply pressure (Pressure range)		MPa	0.4 (0.3 to 0.6)			
	Air consumption[*6]		L/min (ANR)	90			
	Vacuum pressure[*7]		kPa	-60			
	Adsorption time (reference value)		msec	150[*8]			
Vision sensor[*9]	Manufacturer			COGNEX			
	Model			EZ-140			
Power supply specifications for PoE-HUB encoder[*10]	Voltage		V	AC100 to 240			
	Power consumption		W	60			
	Frequency		Hz	50 or 60			
Applicable system[*11]	Number of robots		Unit	1 or 2[*13]			
	Vision sensor	Number of units	Unit	1			
		Installation height	mm	370,450,550[*14]			
	Tracking conveyor	Number of units	Unit	1			
		Width	mm	200,250,300[*14]			
		Maximum speed	mm/sec	300			
	Hand specifications	Setting		Single-hand or double-hand			
		Method		Adsorption pad			
	Applicable workpiece: Number of registrations		Type	4			
	Applicable workpiece: Size	Standard hand (reference value)	mm	55×73×24[*15]			
		Maximum		160×200×100[*15]			
	Applicable workpiece: Weight[*12]	Standard hand (reference value)	kg	0.1[*15]			
	Ejecting operation			Simple transport/Pallet alignment[*16] (MAX: 20 × 20)/Workpiece-picking ejection[*17]			
	Ambient temperature		℃	5 to 40			
Maximum transport capacity (300mm transport)[*18] (Reference value)			Pieces/min (per 1 robot)	50	80	65	60

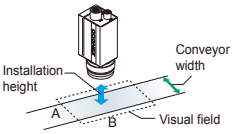
*1) In a model name, □ indicates the number of robots (1 or 2).
*2) In a robot model name, ● indicates a controller type and SA◆◆◆ indicates a special number corresponding to the package used. This product can be used only with this package robot.
*3) When Q type controllers are used, prepare MELSEC-Q series base units, power supply modules, PLC CPUs, and manual pulse generators, create encoder cables, and set parameters with "GX Works2" and "RT ToolBox2".
*4) Hands are supplied with a robot only when the robot has the hand installation specifications.
*5) Select or replace adsorption pads depending on the specifications of workpieces to be transported.
*6) This value may change depending on changes in atmospheric pressure (weather, altitude, etc.) and measuring methods. When the robot is used with double-hand, air consumption will be 90 (L/min) or more.
*7) This value is the detection pressure setting value before shipment.
*8) This value is for one adsorption pad. When the leakage quantity at an adsorption pad is large or when multiple adsorption pads are connected to use on branched pipes, the adsorption time will increase.
*9) Check that workpieces can be recognized with this vision sensor in advance. Lighting is not included in the vision sensor. When lighting is required, prepare it separately by customers. Whether the recognition can be performed or not depends on the usage environment. For details, please contact Mitsubishi.
*10) The power consumption of when the PoE-HUB described in the specifications is used.
*11) The restrictions on the layout placement are as follows:
1) Set the conveyor in nearly parallel to the X axis or Y axis of the robot coordinate.
2) When two robots are used, set the operating range of each robot so as not to overlap each other.



Conveyors cannot be set obliquely against the X axis or Y axis as shown in the left figure.

3) At the tracking start point, end point, and limiting point, all range of the conveyor width (workpiece flow width) shall be within the range of the robot movement.
*12) For the maximum load capacity of the robot, refer to "Standard specifications".
*13) When using two robots, set a single operation to both robots. Setting different operations to the robots is prohibited. For example, when Robot 1 transports Workpiece A and B, Robot B cannot transport Workpiece C and D.
*14) The following table shows the relation among the installation height of a vision sensor, conveyor width, and visual field. Decide the installation height of a vision sensor depending on the conveyor width.

Item	Installation height (mm)		
	370	450	550
Conveyor width (mm)	200	250	300
Visual field A × B (mm)	210×280	260×340	310×415

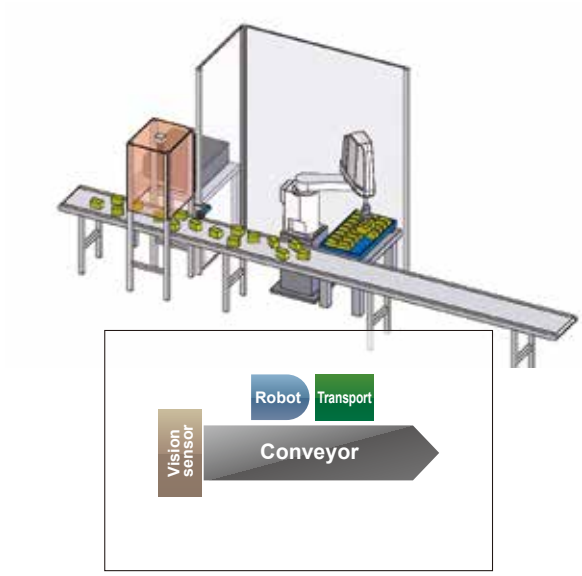


*15) This reference value is based on the conditions of the test conducted by Mitsubishi. The actual value depends on conditions such as the shape and surface state of workpieces.
*16) Pallet alignment can be set to one pallet only. Even though multiple workpieces have been registered, the same pallet shall be set to each workpiece. Align all workpieces to one pallet.
*17) Transportation to a certain position can be set for the workpiece recognition transportation. Pallet alignment cannot be set.
*18) This reference value is based on the conditions of the test conducted by Mitsubishi shown in the following table.

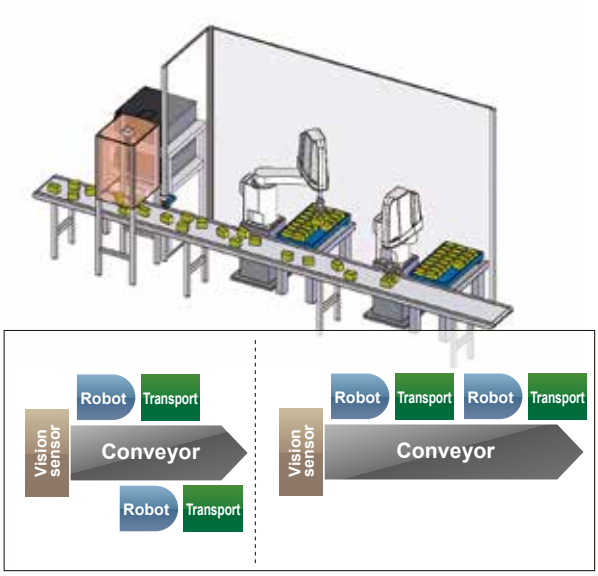
Type		Unit	APR-1TR3FH	APR-1TR6FH	APR-1TR12FH	APR-1TR20FH
Number of robots		Unit	1			
Vision sensor	Number of units	Unit	1			
	Installation height	mm	370		550	
Tracking conveyor	Number of units	Unit	1			
	Width	mm	200		300	
	Speed	mm/sec	60	90	75	70
Hand	Number of settings		Single-hand			
	Pad diameter	mm	ϕ32			
Workpiece	Number of registrations	Pieces	1			
	Size	mm	55×73×24			
	Weight	kg	0.1			
	Interval	mm	60			
Ejecting operation	Pattern		Simple ejection			
	Up/Down stroke	mm	25			
Layout			Mentioned in specifications			

Applicable layout

1-robot configuration



2-robot configuration



* Consider the maximum load capacity, operating range, and speed of the robot used to decide the layout. For details, refer to the specifications.

Composition of tracking application model name

APR–□TR ●FH ◆ △ – E
a b c d

a □TR ····· The number of robots
1TR : 1-robot specification
2TR : 2-robot specification

b ●FH ····· Robot model
3FH : RH-3FH5515
6FH : RH-6FH5520
12FH : RH-12FH8535
20FH : RH-20FH10035

c ◆ ····· Controller type
1D : CR751-D controller
1Q : CR751-Q controller

d △ ····· Hand type
None: Hand specifications for sink type
E : Hand specifications for source type
N : No hand

Package components

No.	Product	Quantity	
		APR-1TR (1-robot specification)	APR-2TR (2-robot specification)
<1>	Packaged robot (robot and controllers)	1	2
<2>	MELFA-Tracking (CD-ROM)	1	1
<3>	Easy setup guide	1	1
<4>	Vision sensor module	1	1
<5>	Encoder module	1	1
<6>	5VDC power supply set (only for D type controllers)	1	—
	24VDC power supply set	—	1
<7>	Vision cable	1	1
<8>	Vision I/O cable	1	1
<9>	Encoder cable	1	—
		—	1
<10>	Calibration sheet	1	1
<11>	Encoder distribution set (only for D type controllers)	—	1

When Q type controllers are used, prepare manual pulse generators and create encoder cables.

<1> Packaged robot (robot and controllers)

1-robot specification: 1 each
2-robot specification: 2 each

(Hand and vacuum unit: already installed)
* The above robot has hand installation specifications.

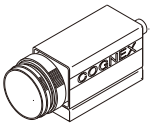
<2> MELFA-Tracking (CD-ROM)

1

<3> Easy setup guide

1

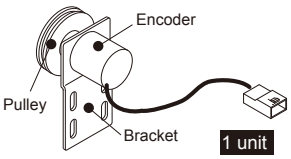
<4> Vision sensor module



(with lens)

1 unit

<5> Encoder module

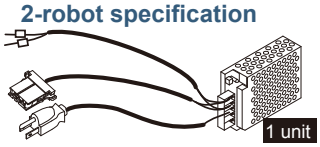


1 unit

<6> 5VDC power supply set: 1-robot specification

1 unit

24VDC power supply set: 2-robot specification



1 unit

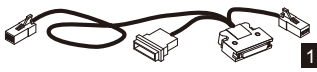
<7> Vision cable

1 cable

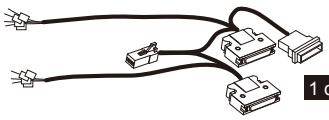
<8> Vision I/O cable

1 cable

<9> Encoder cable

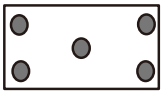


1 cable



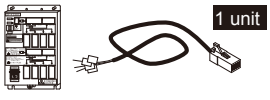
1 cable

<10> Calibration sheet



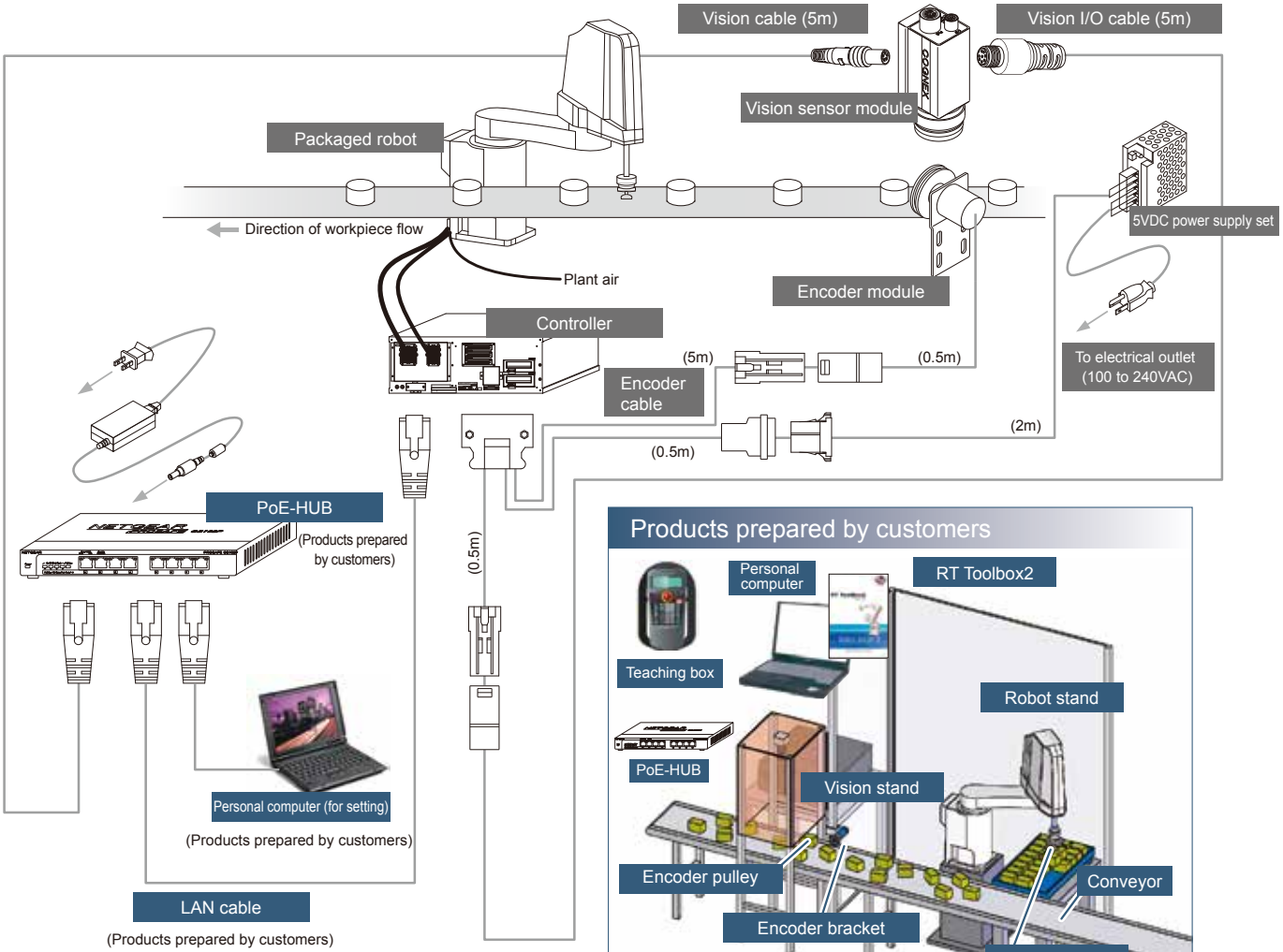
1

<11> Encoder distribution set



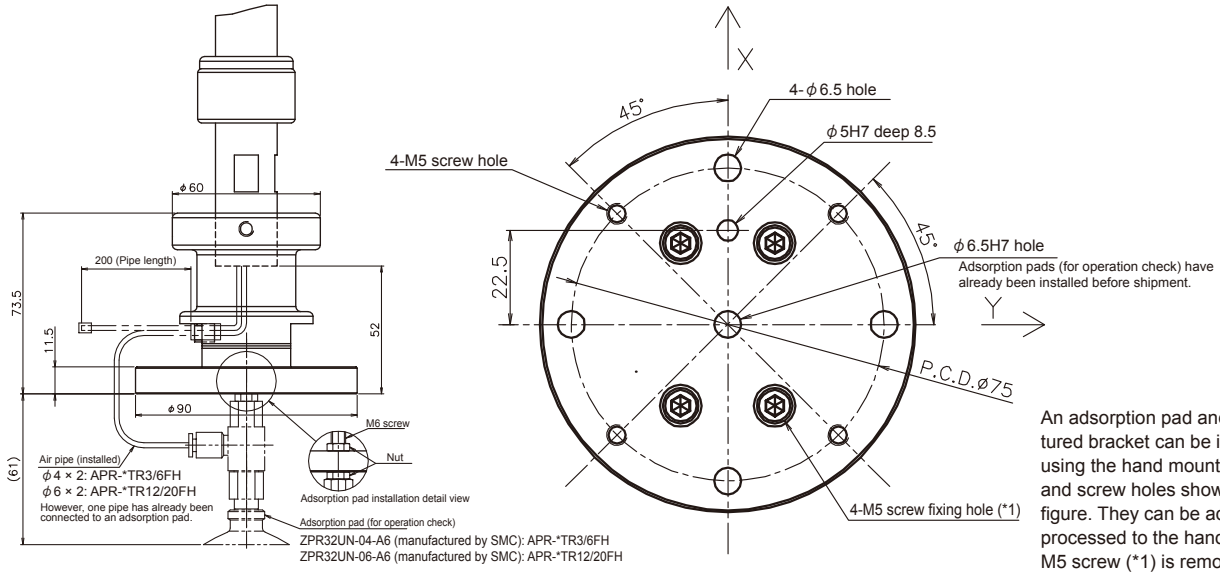
1 unit

System configuration example (one robot, robot controller CR750-D)



* Adsorption pads, encoder pulleys, and encoder brackets are supplied for operation check.
* For any systems that require additional products other than the above, prepare the products yourself.
* For details of T/B and RT2, refer to the F series catalog.

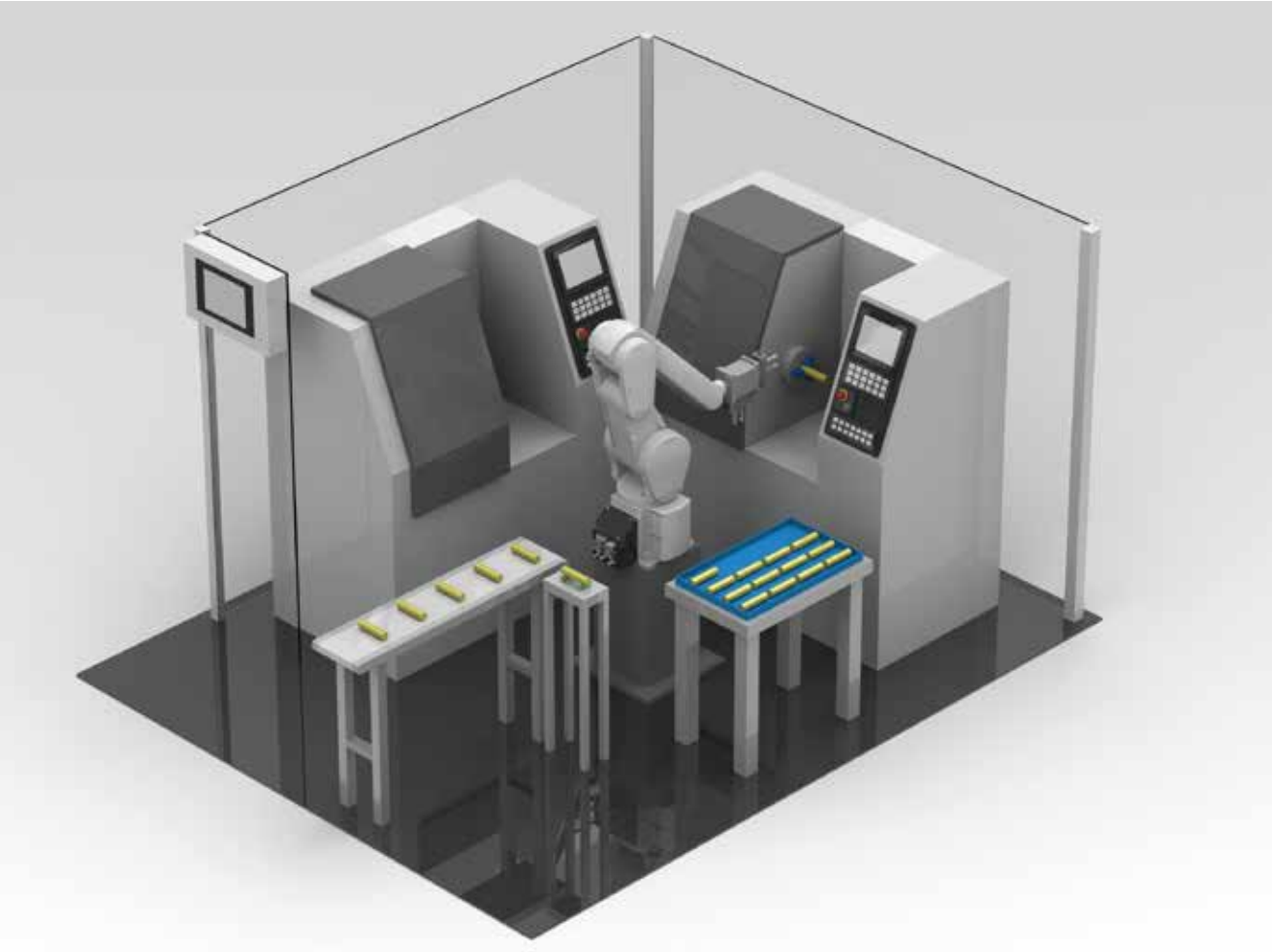
Outline dimensions of hand (Hand installation specifications only)



An adsorption pad and manufactured bracket can be installed using the hand mounting holes and screw holes shown in this figure. They can be additionally processed to the hand when the M5 screw (*1) is removed.

Processing Machine Loading Application

This application facilitates the configuration of a loading/unloading system for processing machines in which a Mitsubishi CNC numerical control devices has been installed.



Introduction advantages

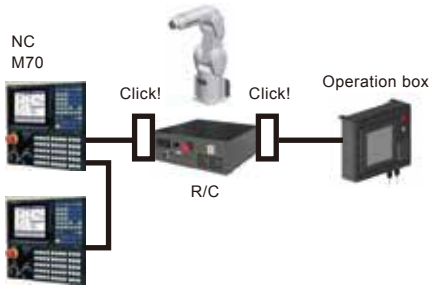
1. **No need to create** robot programs!
2. User-friendly wizard screens **shorten the startup time by 80%!**
3. The system operation can be started smoothly with the various screens **pre-installed on the operation box!**

Features

Mitsubishi provides hardware, software, and supporting tools as a package to make designing, programming, and startup on the configuration of a loading/unloading system easy for customers.

Feature 1 Simple wiring design! Easy wiring work!

- CNC numerical control devices and a robot can be connected via CC-Link, and an operation box and the robot can be connected with a connector.
- A parallel I/O interface for connecting signals of peripheral devices has been installed to a robot controller.



Feature 2 Processing machine loading-dedicated programs and interface functions facilitate easy setting and startup!

- As soon as an operation box is connected, the system can be started!
  (The system can be started by using the dedicated startup software, MELFA-Machine Loading!)
- There is no need to configure communication settings, I/O assignment, and parameter settings of CNC devices and robots! (automatic setting)
- A necessary program is automatically selected by the selection type menu!
  (Robot programs have already been installed.)
- Teaching operations can be performed by following the wizard.

Initial setting: System/hand setting screen

Teaching: Stage/processing machine teaching screen

Startup is completed!!

Operation check and adjustment: Process operation/automatic operation screen

Feature 3 A system that has improved the compatibility of robots and CNC devices can be operated!

- System central control display of maintenance information (including coordinates and tool lives) of a processing machine (CNC) in a system
- The robot status can be displayed and the robot can be operated on the same system screen.

Processing machine monitor screen

Robot manual operation screen

Basic specifications

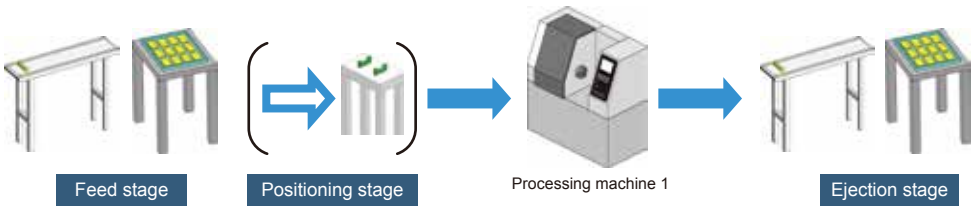
	Type		Unit	APR-1ML4FM /4FLM		APR-1ML7FM/ 7FLM /7FLLM		APR-1ML13FM /13FLM		APR-1ML20FM	
Robot specifications	Robot model name*1)			RV-4FM/4FLM -●-SA◆◆◆		RV-7FM/7FLM/7FLLM -●-SA◆◆◆		RV-13FM/13FLM -●-SA◆◆◆		RV-20FM -●-SA◆◆◆	
	Protection grade of robot			IP67							
	Load capacity*2)		kg	4		7		13		20	
	Maximum reach radius		mm	515	649	713	908	1503	1094	1388	1094
	Connected controller			CR750-D/CR751-D							
	Protection grade of controller			IP20*3)							
Operation box specifications	Size		mm	H290 × W460 × L140 (protrusions excluded)							
	Protection grade (IP)			IP54							
	Interface	Touch panel		10.4" VGA [640 × 480], TFT color liquid crystal (GOT2000 series)							
		Others		Emergency stop button × 1							
	Screen			1) Main screen 2) System monitor 3) Processing machine monitor 4) Stock information 5) Production management 6) Robot manual operation 7) Robot maintenance 8) Settings							
	Connection			Between a robot and operation box: External emergency stop cable (7m), LAN cable (7m)							
	Weight		kg	10							
	Power supply specifications		V	Single phase AC180 to 253		Single phase AC 207 to 253, three-phase AC 180 to 253					
	Power source capacity		kVA	1.1		2.1		3.1			
Applicable system	Number of robots		Unit	1							
	CNC*4)	Type		Mitsubishi CNC M70V series, M80V series							
		Number of units	Unit	1 or 2							
		Necessary option		CC-Link option							
	Processing machine	Type		Small lathe, tapping center							
	Hand*5)	Hand configurations		Double-hand							
		Drive method		Air grip							
	Workpiece	Size	mm	Supported sizes vary depending on the shape of grip jaws and a hand to be prepared by users.							
		Number of steps*6)		5							
	Layout	Applicable layout (reference)*7)		One processing machine, one robot Two processing machines (face-to-face arrangement), one robot Two processing machines (L-shape arrangement), one robot							
		Workpiece feed stage		Conveyor or pallet							
		Workpiece ejection stage		Conveyor or pallet							
		Workpiece transport pattern*8)		When using two processing machines, select a parallel or sequential transport pattern.							

*1) In a robot model name, ● indicates a controller type and SA◆◆◆ indicates a special number corresponding to the package used. This product can be used only with this package robot.
*2) The weight of a workpiece that can be loaded under the limitation of a mechanical interface having a downward attitude
*3) From a consideration of the installation environment of a controller, using an optional protective box is recommended.
*4) This application links robots and CNC devices and operates them. Thus, set CC-Link parameters and create a ladder program for CNC devices, and input and output signals from a processing machine to robots.
A CD for installing MELFA-Machine Loading will be supplied to each customer. This CD includes sample parameter data for setting parameters and creating a ladder program for CNC devices and sample ladder programs for inputting and outputting signals. Refer to the manuals of CNC devices to set parameters and create a ladder program for CNC devices.
*5) Prepare a hand by customers. Design a hand depending on the robot or controller of this package or customer's system.
*6) For details of the number of steps, refer to the "instruction manual".
*7) For reference diagrams of system layouts, refer to the "Instruction Manual".
*8) For details of workpiece transport patterns, refer to the "Instruction Manual".

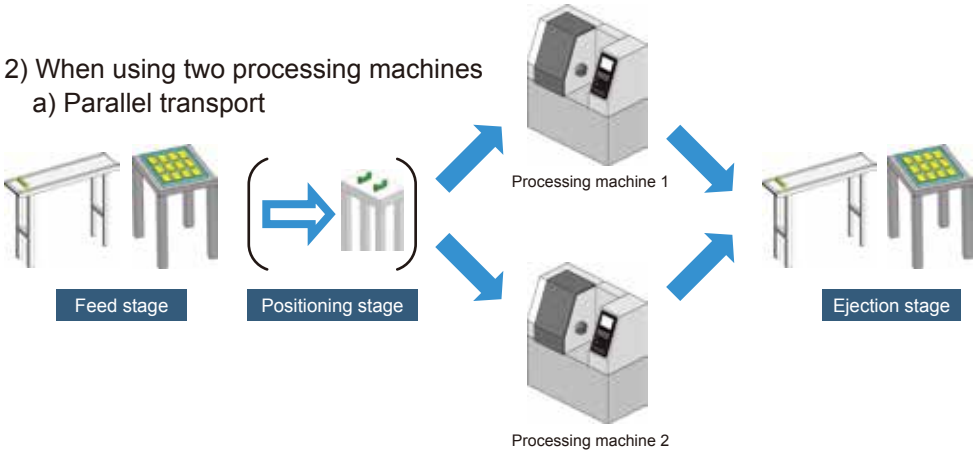
Applicable transport patterns

This application package is applicable to the layout of one processing machine or two processing machines per a robot. Applicable processing machines are lathes and tapping centers.
The following shows system examples.

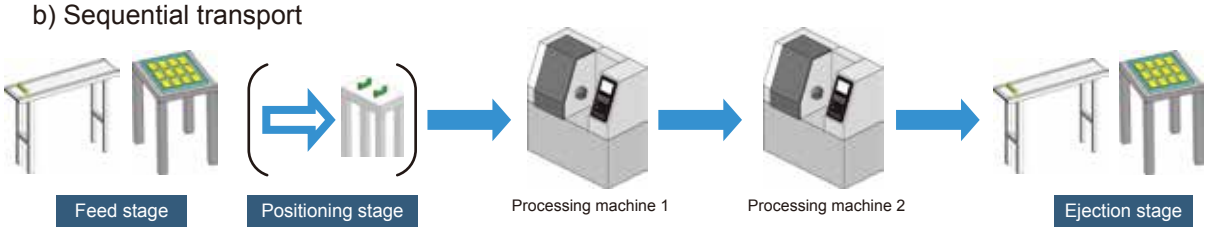
1) When using one processing machine



2) When using two processing machines
a) Parallel transport



b) Sequential transport



Model configuration of the processing machine loading application

APR−1ML ● ◆ △ − S11
a b c

a ● ····· Robot model
4FM : RV-4FM
4FLM : RV-4FLM
7FM : RV-7FM
7FLM : RV-7FLM
7FLLM: RV-7FLLM
13FM : RV-13FM
13FLM: RV-13FLM
20FM : RV-20FM

b ◆ ····· Controller type
1D: CR751-D controller

c △△ ····· Type of the hand or other I/O signals
N : Sink type
NE: Source type

Package components

No.	Product	Quantity
<1>	Package robot (main unit, controller*1))	1
<2>	MELFA-Machine Loading (CD-ROM)	1
<3>	Easy setup guide	1
<4>	Operation box	1
<5>	LAN cable	1
<6>	Emergency stop cable	1
<7>	CC-Link cable	1
<8>	Power connector for the operation box	1
<9>	Power cable for the robot controller	1 (one of the cables)

<1> Packaged robot /controller*1)

1 each

*1) CC-Link interface, a parallel I/O interface has been installed

<2> MELFA-Machine Loading (CD-ROM)

1

<3> Easy setup guide

1

<4> Operation box

1 unit

<5> LAN cable

1 cable

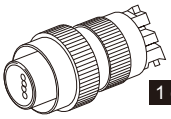
<6> Emergency stop cable

1 cable

<7> CC-Link cable

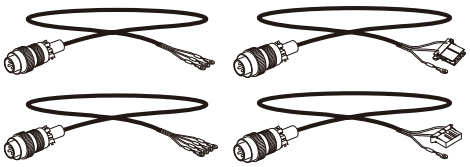
1 cable

<8> Power connector for the operation box



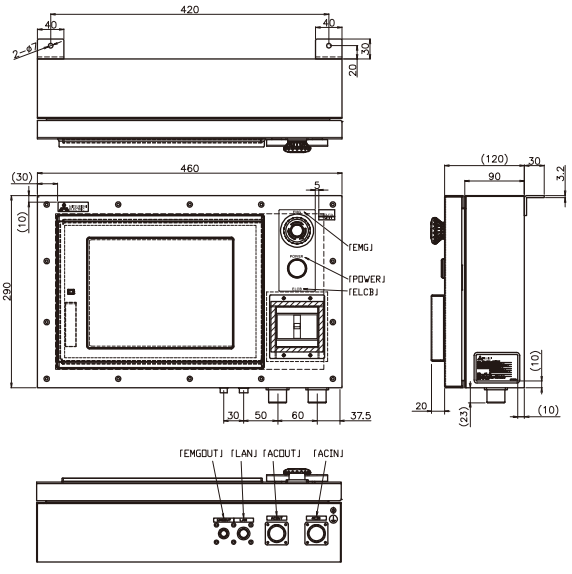
1 connector

<9> Power cable for the robot controller

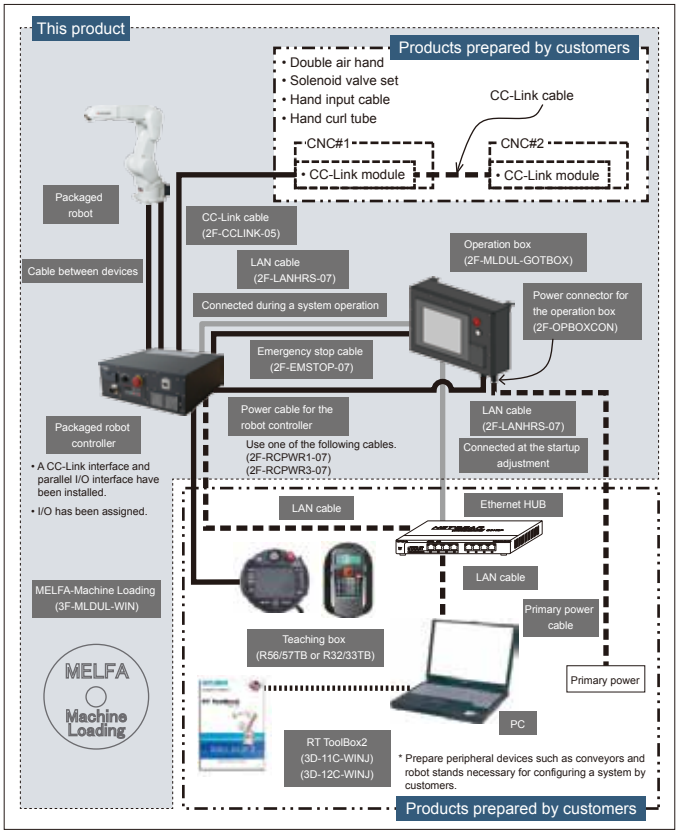


One of the cables

Outline dimensions of an operation box



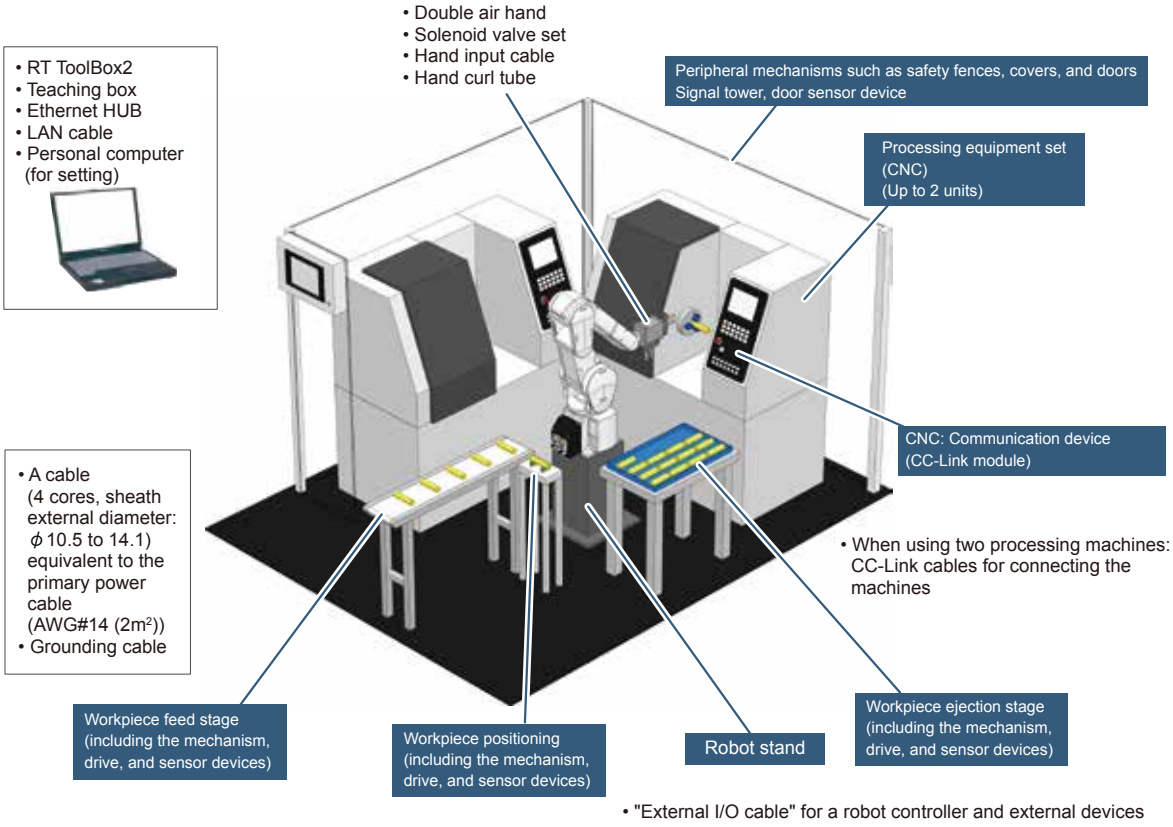
Entire configuration



System configuration

Products prepared by customers
(The following image diagram is for when two processing machines have been used.)

Prepare devices necessary for configuring a processing machine loading system, robot peripheral devices, and a personal computer to start up the system.

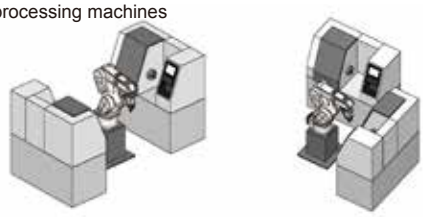


Applicable layout

Lathe

One processing machine

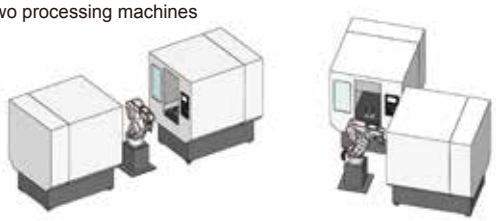
Two processing machines



Tapping center

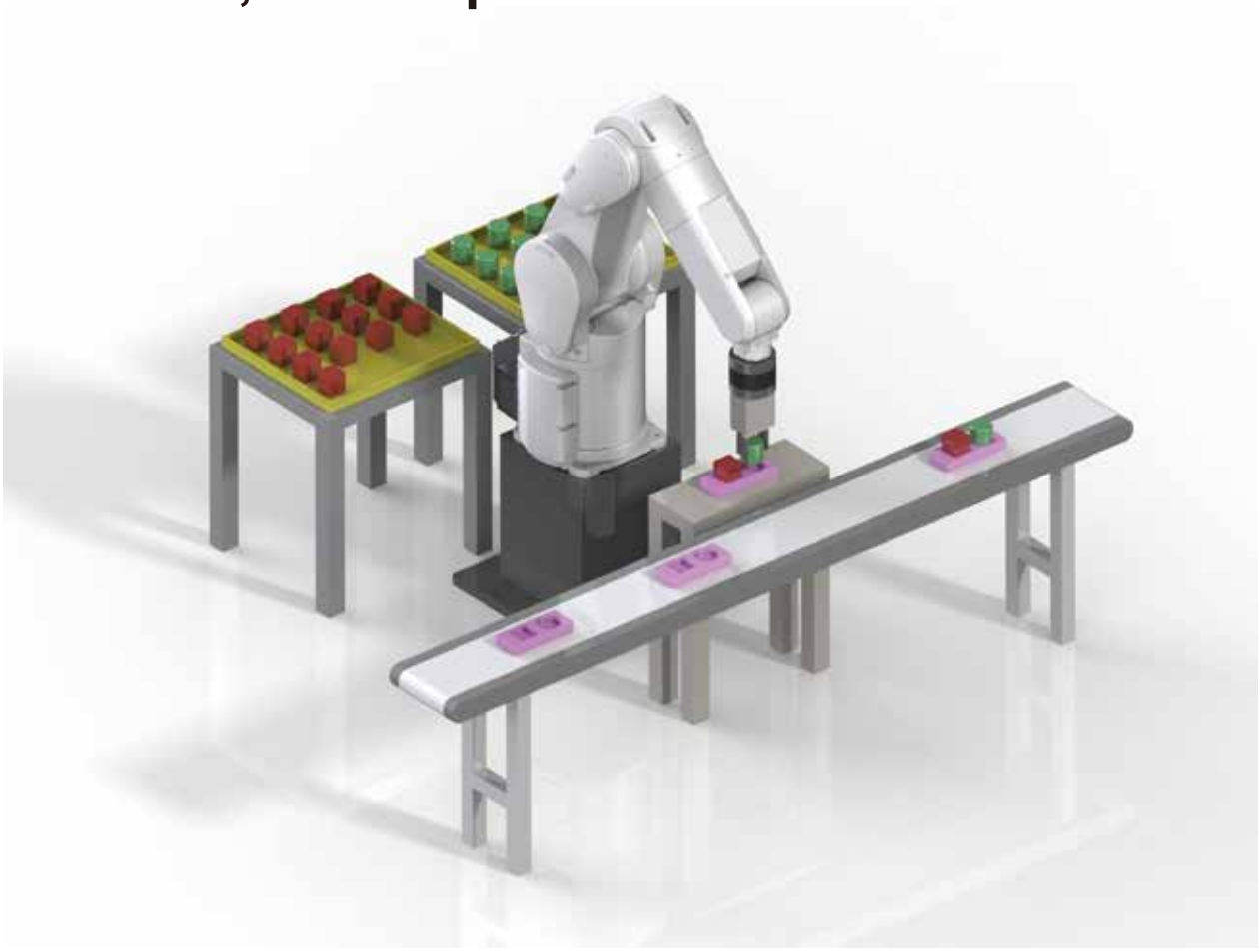
One processing machine

Two processing machines



Force-sense Applications

Techniques and know-how are added to MELFA robots to achieve the automation of force-sense operations such as assembly, insertion, and inspection.



Introduction advantages

1. **No need to create force-sense programs!**
2. **The startup time of force-sense operations can be reduced by 80%!**
3. **Operations including force sensor settings and force-sense application operations can be easily configured with dedicated tools!**

Features

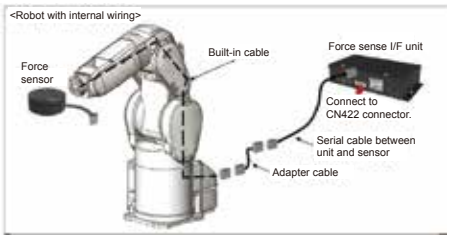
Mitsubishi provides hardware, software, and supporting tools as a package to make designing, programming, and startup on the configuration of a force-sense application system easy for customers.

Feature 1 No more complex initial setting!

- Wiring for a force sensor is completed only by connecting connectors.
- The initial setting of a force sensor is completed only by pressing one button.

Initial setting screen of the force-sense application software (RT-ToolBox2 add-on)

Connection example



Initial setting parameter for force sensors

• Force-sense IF recognition • Coordinate system • Attachment position
• Permissible value • Corrected limit value • Setting number • Mechanical number

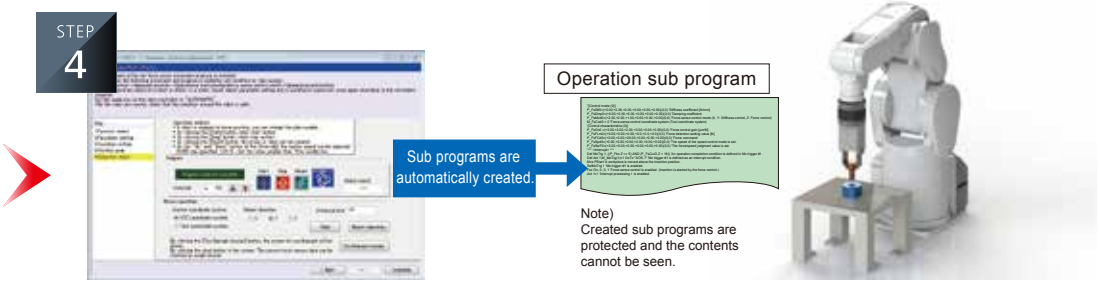
Feature 2 Difficult operations that use force sensors can be created easily!

- Operation sub programs that use a force sense can be easily created on a dedicated screen.

Start the operation setting wizard (Step-type dialog).

Operation sub programs are automatically created (for each workpiece operation).

Parameter adjustment



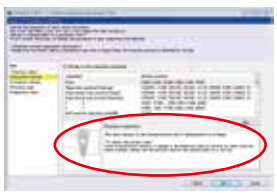
Operation check

Insertion operation

Feature 3 No more complex adjustments!

- Complex programming of the force-sense operation parameters can be easily adjusted on a dedicated screen.

Parameter adjustment screen

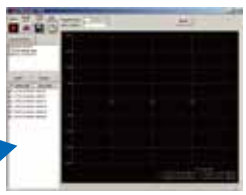


Initial values have already been set to necessary parameters. Parameters are explained with user-friendly diagrams.

Operation check screen

The oscillograph screen can be started from the operation check screen.

Oscillograph screen



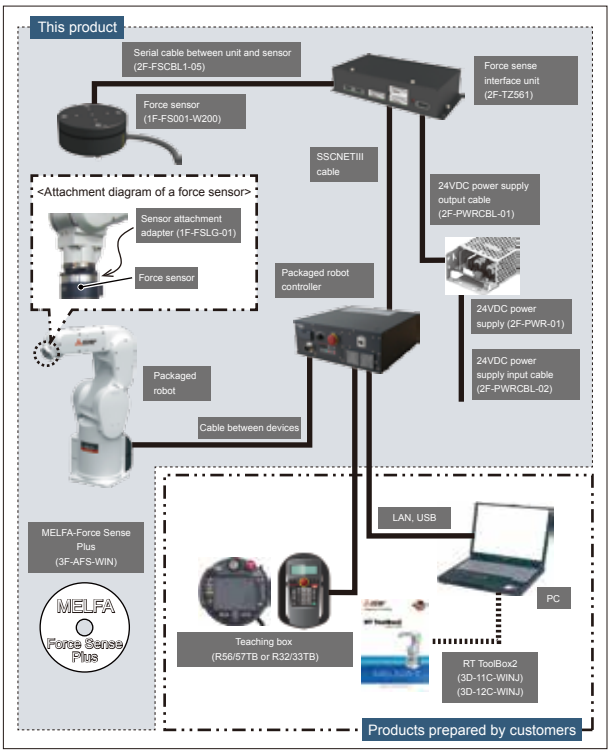
Users can check operations by seeing force-sense data in an oscillograph.

Basic specifications

Type			Unit	AP10-AFS2F	AP10-AFS2L	AP10-AFS4/5F	AP10-AFS4/5L	AP10-AFS7/8F	AP10-AFS7/8L
Robot specifications	Robot model name*1)			RV-2F-●-S◆*4)	RV-2FL-●-S◆*4)	RV-4F-●-S◆	RV-4FL-●-S◆	RV-7F-●-S◆	RV-7FL-●-S◆
	Environmental specifications			General environmental specifications: IP20					
	Maximum reach radius		mm	504	649	515	649	713	908
	Load capacity		kg	Maximum 3 (Rating 2)		Maximum 4 (Rating 4)		Maximum 7 (Rating 7)	
	Connected controller			CR750-D/Q, CR751-D/Q					
	Power supply specifications	Input voltage range	V	Single-phase AC180 to 253				Single phase AC 207 to 253 Three-phase AC180 to 253	
		Power source capacity	kVA	0.5		1.0		2.0	
		Power supply frequency	Hz	50 or 60					
Force sensor specifications	Rated load	Fx, Fy, Fz	N	200					
		Mx, My, Mz	Nm	4					
	Max. static load	Fx, Fy, Fz	N	1000					
		Mx, My, Mz	Nm	6					
	Breaking load	Fx, Fy, Fz	N	10000					
		Mx, My, Mz	Nm	300					
	Minimum control force	Fx, Fy, Fz	N	0.3					
		Mx, My, Mz	Nm	3					
	Consumption current		mA	200					
	Weight (sensor unit)		g	360					
	External dimensions		mm	ϕ80×32.5					
	Protective structure			IP30					
Force sensor interface unit specifications	Interface	RS-422	ch	1 (for connecting sensors)					
		SSCNETIII	ch	1 (For connecting robot controllers and additional axis amplifiers)					
	Power supply	Input voltage	Vdc	24±5%					
		Power consumption	W	25					
	External dimensions		mm	225(W)×111(D)×38(H)					
	Weight		kg	Approx. 0.8					
	Structure			IP20 (Panel installation, open type)					
Operations settable with the force-sense application software*2),*3)				1) Insertion attitude adjustment operation, 2) Push-in operation, 3) Insertion operation, 4) Contact position detection					

*1) In a robot model name, ● indicates a controller type and S◆ indicates a special number corresponding to the package used. This product can be used only with this package robot.
*2) Set these operation conditions using "MELFA-Force Sense Plus" (dedicated screen on RT ToolBox2) and add the conditions to a program.
*3) Check whether the operations can be actually performed or not using actual workpieces in advance.
*4) Force sensor cables will be exteriorly wired.

Entire configuration



* Prepare hands and peripheral devices by customers.

Composition of a force-sense application model name

AP10−AFS0 ● ◆ − E0
a b

a ● ..... Robot model
- 2F: RV-2F
- 2L: RV-2FL
- 4F: RV-4F-SH03
- 4L: RV-4FL-SH03
- 5F: RV-4F-SH04
- 5L: RV-4FL-SH04
- 7F: RV-7F-SH03
- 7L: RV-7FL-SH03
- 8F: RV-7F-SH04
- 8L: RV-7FL-SH04

b ◆ ..... Controller type
- BD: CR751-D controller
- BQ: CR751-Q controller

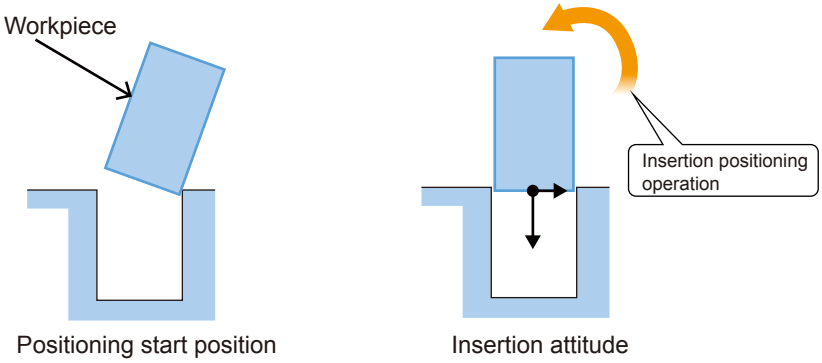
Insertion adjustment

Operation

The insertion attitude of a gripped workpiece is positioned on an insertion position by getting up the workpiece along the edge of the insertion position.

Application

This operation is effective for moving workpieces that are relatively less chamfered or having a small mating tolerance.

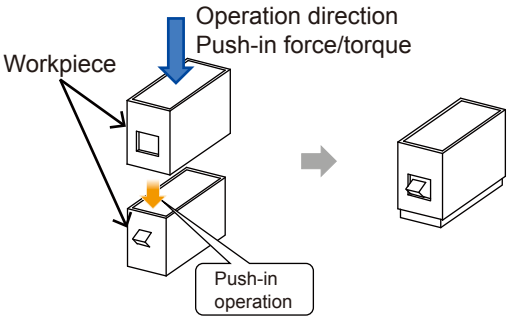


Push-in operation/insertion operation

Operation

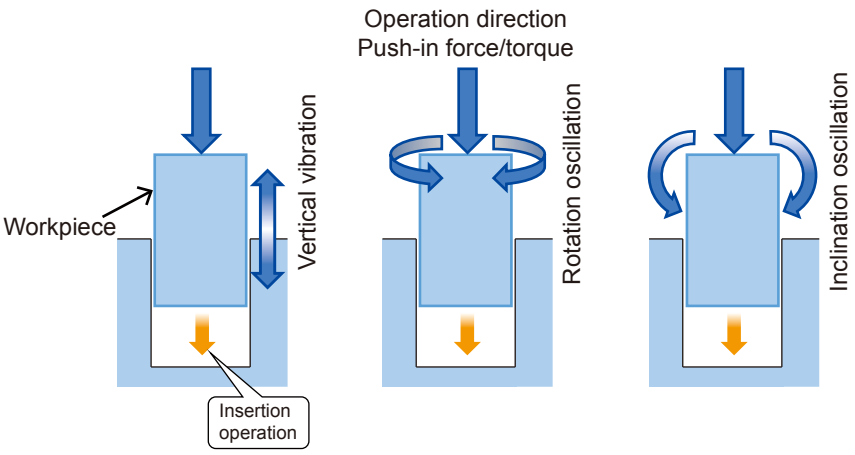
A workpiece is inserted by adding a force in a given direction.

- Push-in operations such as engaging workpieces can be performed by setting a force strength and direction.
- In an insertion operation, a workpiece can be inserted without being caught during the insertion by setting a periodic travel amount (vertical movement, rotation, inclination) during operation.



Application

- Pushing snap mechanism parts with a constant force
- Pulling inspections of assembly parts
- Engagement of parts having tightening margins
- Engagement of parts having small mating tolerances
- Operation to avoid the friction of engagement parts
- Shaft diameter inspection with a master gauge



Contact position detection

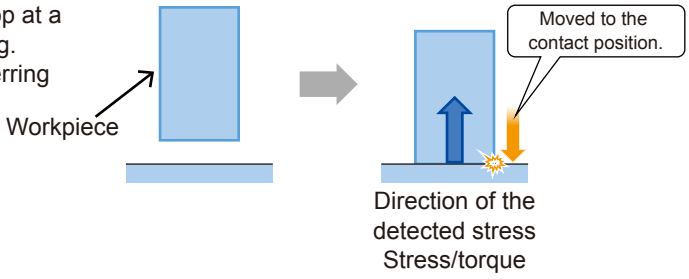
Operation

While a force is being monitored, a workpiece is moved in a given direction from the original attitude and will stop at a position where the workpiece contacts with something.

- The position of a workpiece can be detected by referring to the current position of the robot after the stop.

Application

- Inspecting part grip positions
- Detecting the positions of peripheral assembly jigs
- Positioning or phase focusing of parts



Deburring/Polishing Application Package

Easily creates a machining path of deburring /polishing and performs machining!
On-site operators can automate their teaching process with rough teaching using a master workpiece and tools.

Introduction advantages

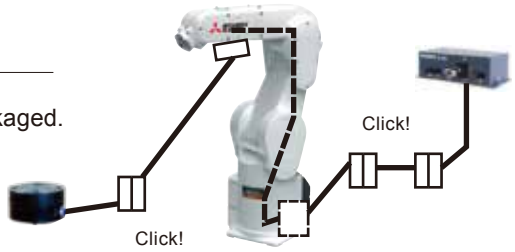
1. On-site operators can create a machining path **at their sites!**
2. Teaching can be **easily performed** with the simple configuration!
3. Compared with the offline teaching that uses an actual workpiece, the startup time has **decreased by 80%!**

Feature

Mitsubishi provides hardware, software, and supporting tools as a package to make designing, programming, startup, and adjustment required for the deburring/polishing operation with a robot easy for users.

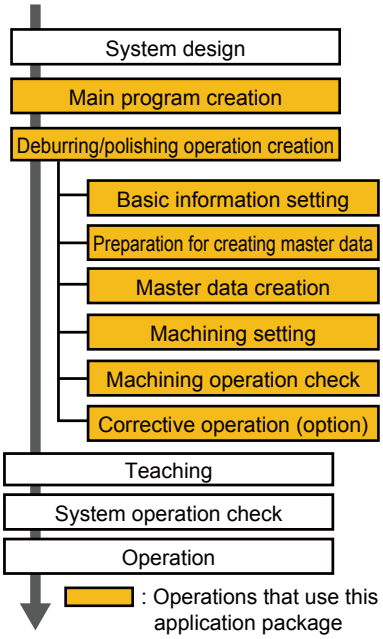
Feature 1 No more complex wiring!

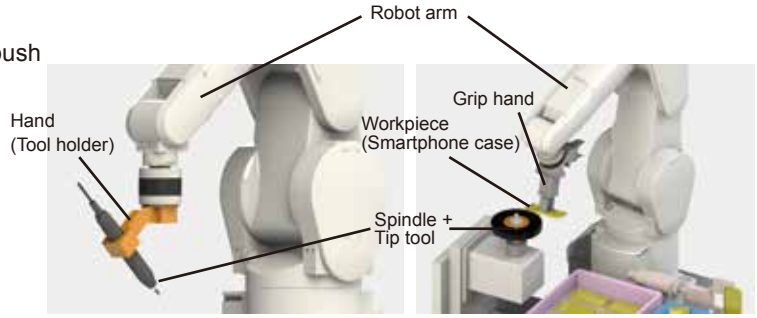
- Devices and cables required for deburring/polishing are packaged.
- Wiring is completed only by connecting connectors.
- Option cables have already been connected to the main unit!



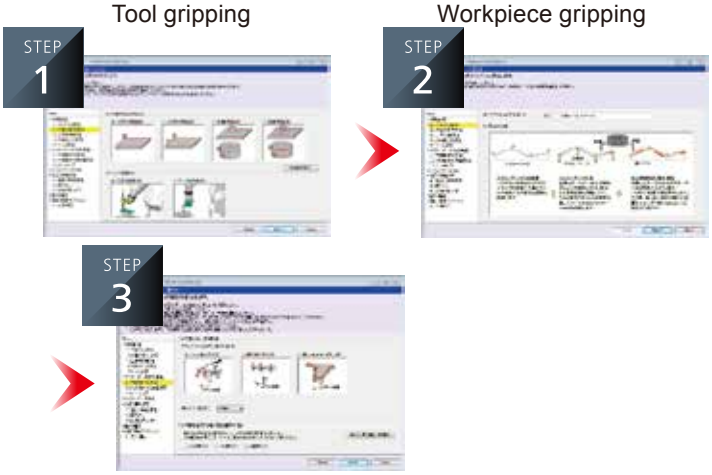
Feature 2 Both [workpiece gripping] and [tool gripping] with a robot can be performed!

- Easy startup with wizard format (interactive format) of dedicated tools (No manuals are required. Just touch buttons following messages shown in the screen.)
  Operation commands (Deburring/polishing)
  Pushing methods (tool coordinate system/ orthogonal coordinate system/stiffness)
  Easy setting of force sensor parameters
  Detailed machining commands such as push amount, the number of machining times, approach run/overrun, etc.





Tool gripping　　Workpiece gripping



Feature 3 New functions including know-how required for deburring/ polishing operations have been implemented!

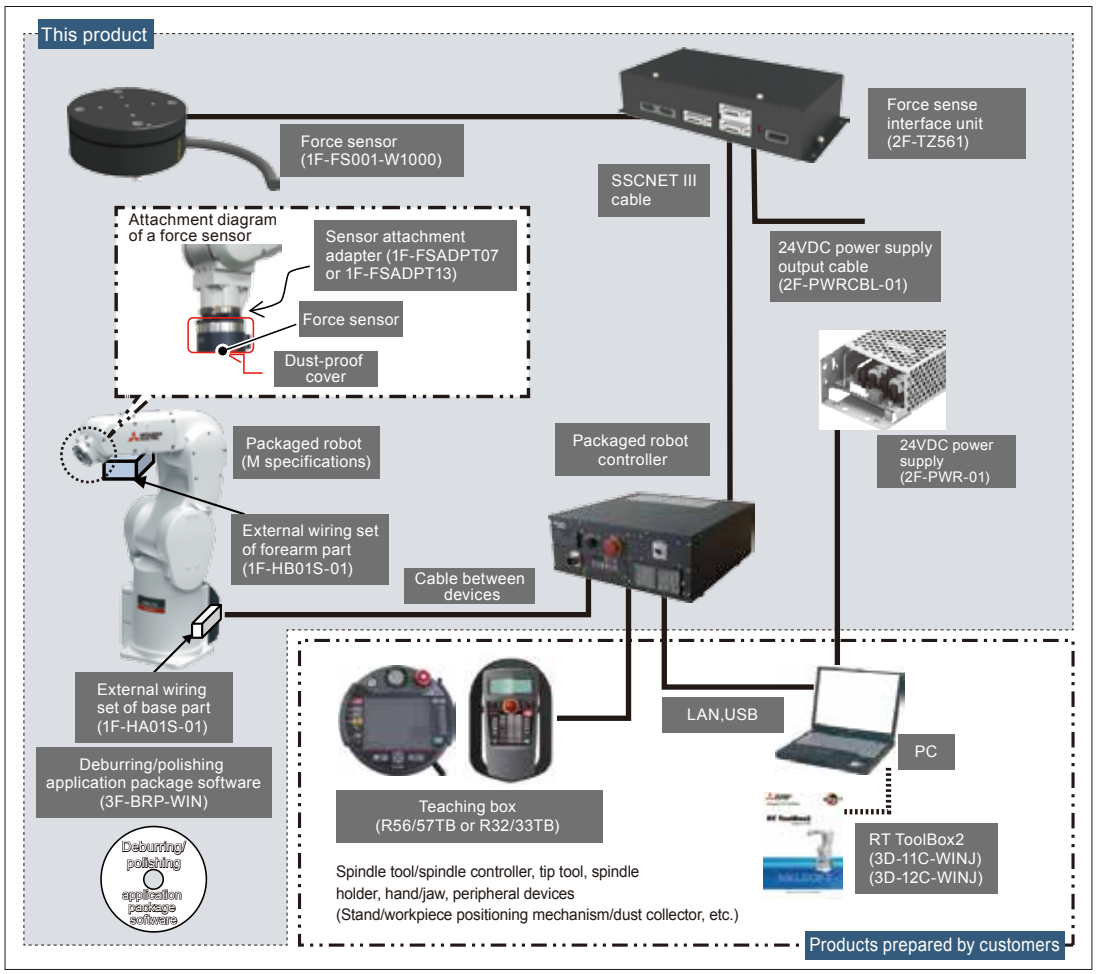
- Rough teaching using a master workpiece and a force sensor hand automatically creates a machining path.
  Prevents a short-period stop caused by deceleration when the maximum load is detected at machining.
  The wear amount of a tip tool is detected for the machining path correction function.

Basic specifications

Type[*1]			Unit	AP10-BRP07F	AP10-BRP07L	AP10-BRP08L	AP10-BRP03F	AP10-BRP03L
Robot specifications	Robot model name			RV-7FM -▲-S◇	RV-7FLM -▲-S◇	RV-7FLLM -▲-S◇	RV-13FM -▲-S◇	RV-13FLM -▲-S◇
	Environmental specifications			Protection specification: IP67				
	Maximum reach radius		mm	713	908	1503	1094	1388
	Load capacity		kg	Maximum 7 (Rating 7)[*2]			Maximum13(Rating12)[*2]	
	Connected controller			CR750-D/Q,CR751-D/Q[*3]				
Force sensor specifications	Rated load	Fx,Fy,Fz	N	1000				
		Mx,My,Mz	Nm	30				
	Minimum control force	Fx,Fy,Fz	N	Minimum 0.3				
		Mx,My,Mz	Nm	Minimum 0.03				
	Weight (sensor unit)		g	580				
	External dimensions		mm	ϕ90×H40				
	Protective structure			IP30				
Force sensor interface unit specifications	Interface	RS-422	ch	1(for connecting sensors)				
		SSCNETIII	ch	2(For connecting robot controllers and additional axis amplifiers)				
	External dimensions		mm	225(W)×111(D)×38(H)				
	Weight		kg	Approx. 0.8				
	Structure			IP20(Panel installation, open type)[*4]				
Dust-proof cover	Dust-proof cover			Dust-proof cover for force sensor				
	Protective structure			IP50				
Tool	Spindle			MS01-R03 (MINITOR CO.,LTD) and EMS-3060A (NAKANISHI INC.) are supposed to be used.				
	Tip tool			Tool that can be used for the spindle and material to be machined				
	Connection to R/C			D type controller: Connection via the parallel I/O interface (purchased separately) Q type controller: Connection via an I/O module of the iQ Platform-compatible PLC.				
	Control			Selection of the spindle controller control (startup, stop, error check, etc.) with I/Os With the spindle controller specifications, tools can be controlled by a robot controller using a general-purpose I/O module. (Create a user program.)				
Peripheral device				Robot stand, workpiece positioning/loading/unloading mechanism, dust collector, safety cover, etc.: Separately created by users				
Functions of the application package			Machining path creation function	Automatically creates a machining path with rough teaching using a master workpiece and acquiring force sensor contact position data.				
			Machining condition setting	Detailed machining commands such as operation commands (deburring/polishing), pushing methods (tool coordinate system/orthogonal coordinate system/stiffness), easy setting of force sensor parameters, push amount, the number of machining times, and approach run/overrun				
			Machining error processing function	Prevents a short-period stop caused by deceleration when the maximum load is detected at machining.				

*1) In a robot model name, ▲ indicates a controller type and ◇ indicates a special number corresponding to the package used. This product can be used only with this package robot.
*2) The maximum weight of a workpiece that can be loaded under the limitation of a mechanical interface having a downward attitude (±10° from the vertical line). For the shape, size, and weight of the tool holder and the workpiece grip hand designed by users, check that all these specifications including the machining reaction force are within the specification values of the load capacity/allowance moment of the robot and force sensors.
*3) The protection grade of a robot controller is IP20.
*4) The machining quality is not guaranteed with this application package.
Select the optimal tools (spindle, tip tool) and set the optimal machining conditions (speed, position, push amount, the number of machining times).
*5) The ambient temperature of the location where robots and controllers are installed is 0 to 40°C. Always use them within the temperature range.
*6) The relative humidity of the location where controllers are installed is 45 to 85%. Always use them within the humidity range.
*7) Dry type deburring/polishing operations around robots are supposed to be performed. Do not perform wet type deburring/polishing operations (including spraying and using cooling liquid/lubricating liquid/mold release agent).
*8) Prevent dust from entering the unit as necessary. For example, store the unit inside the robot stand with covers or a control panel.

Entire configuration



Composition of model name

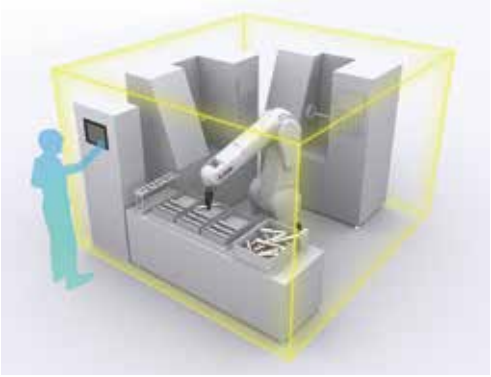
A10−BRP0 ■■ ▲▲ − E0

a ■■ ····· Robot model
- 3F :RV-13FM
- 3L :RV-13FLM
- 7F :RV-7FM
- 7L :RV-7FLM
- 8L :RV-7FLLM

b ▲▲ ····· Controller type
- AD :CR750-D controller
- AQ :CR750-Q controller
- BD :CR751-D controller
- BQ :CR751-Q controller
- CD :CR750-D controller(CE standard)
- CQ :CR750-Q controller(CE standard)
- DD :CR751-D controller(CE standard)
- DQ :CR751-Q controller(CE standard)

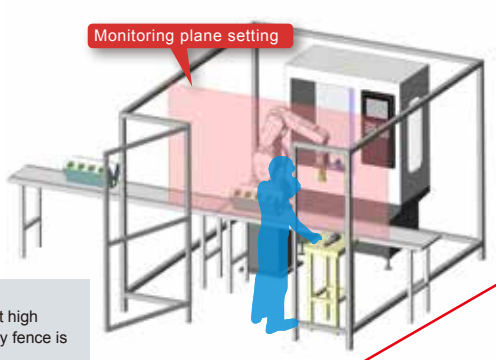
■Safety Solution

- Cooperative operation of humans and robots to further improve the productivity -



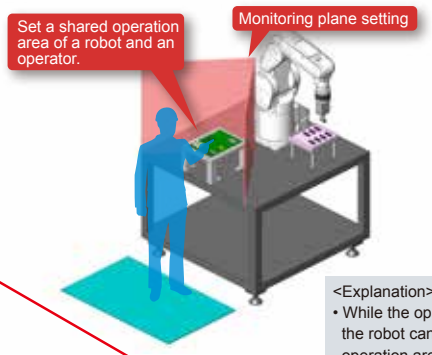
•The increased safety compliant with the international safety standards enables the cooperative operation.
•It is possible to continue the production without the need to stop the system even when a person enters or exits the robot operation area.

The operator operation area and robot operation area are separated each other with a monitoring plane for safety.



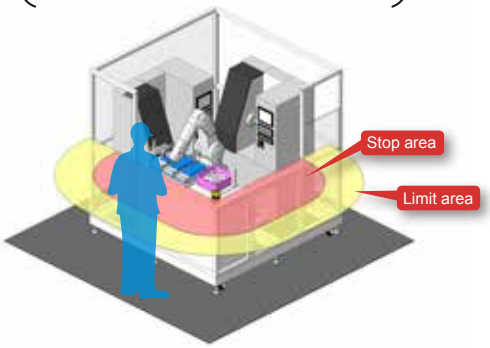
<Explanation>
• The robot operates at high speed while the safety fence is close.
• While the safety fence is open, the robot continues its operation at low speed inside the monitoring plane.
The operator can perform inspection inside the safety fence and outside the monitoring plane.

An operator and a robot access the shared operation area alternately, allowing for cooperative operation with a robot and an operator.



<Explanation>
• While the operator is on the mat, the robot cannot enter the shared operation area.
• While the operator is not on the mat, the robot operates inside the shared operation area.

Area sensors secure the safety without safety fence.



<Explanation>
• When the operator enters the limit area, the robot operation speed is limited.
• Further, the operator approaches to the stop area, the robot stops its operation.

Item	Description	Remarks
STO function	Electronically shuts off the power to the motor of the robot.	Corresponds to the Stop category 0 of IEC 60204-1
SS1 function	Controls and decelerates the motor speed of the robot.	Corresponds to the Stop category 1 of IEC 60204-1
SLS function	Monitors the TCP speed not to exceed the monitoring speed.	Complies with EN61800-5-2
SLP function	Monitors a specified monitoring position not to exceed the position monitoring surface.	Complies with EN61800-5-2
STR function	Monitors the torque feedback not to exceed the allowable torque range.	Complies with EN61800-5-2

For further advanced applications

3D vision sensor

Realizes supply of discretely placed parts

The use of 3D vision sensors realizes supply of discretely placed parts without dedicated trays and part feeders, reducing part supply work.

Realizes high-speed bin picking using our unique technology

Eliminates the need to register the 3D model of a target workpiece, shortening the startup time.

3D modeling is no longer required - this sensor changed the common sense of vision sensors!

3D vision sensors changed the common sense of vision sensors and realized bin picking (picking of discretely placed parts), eliminating the need to register the shape of workpieces. With a bit of information required for gripping (hand jaw width, jaw dimensions, adsorption pad size etc.), this hand grips various workpieces, shortening the startup time.

*Some other devices such as 2D vision sensors are required for final positioning.
* When 3D and 2D vision sensors are used together, adjust 2D vision sensors.

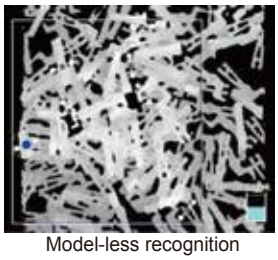
Applicable to multiple recognition methods

Users can use different recognition methods, such as model-less recognition or model matching, for their applications.

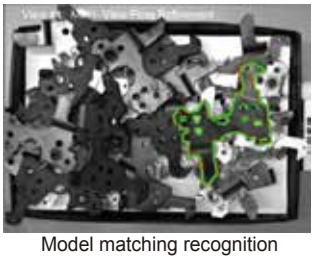
Please contact your local representative or sales office.

MELFA-3D Vision

Picking of discretely placed parts



Model-less recognition



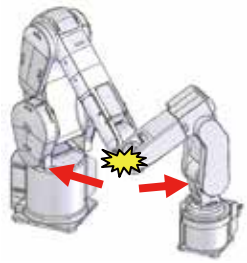
Model matching recognition

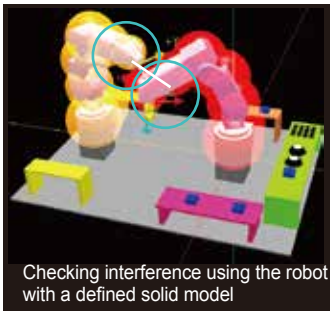
Collision Avoidance

iQ Platform [Q type controllers only]

For automatic prevention of collisions between robots

The software constantly monitors robots motion, predicts collisions before they occur, and immediately stops the robots. This avoids damage to the robot during both the JOG operations and automatic mode operations.





Checking interference using the robot with a defined solid model

Decreases downtime during startup operation

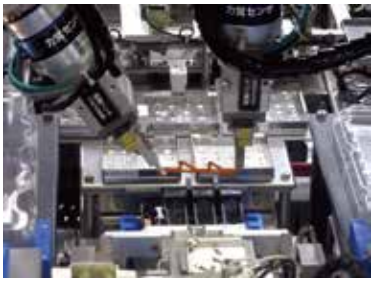
Reduces the number of recovery man-hours required after collisions due to teaching operation errors or failure to set interlocks

Coordinated control

iQ Platform [Q type controllers only]

Coordinated control between multiple robots

Enables coordinated control between multiple robots through CPU connection between the robots. Easy to operate and use under normal operation through individual robot operation.



Enables installation work to be completed while gripper positions between robots are maintained.

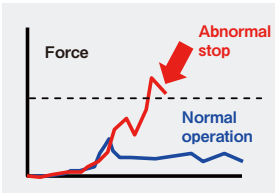
Coordinated transport

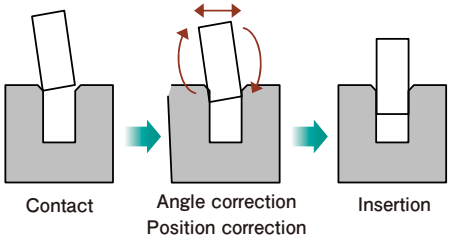
Enables transport of lengthy or heavy objects using multiple small-sized robots instead of larger ones.

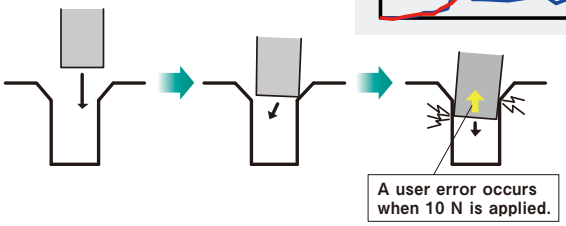
Force control function

Highly-accurate mating operation, quality assurance, reliability improvement

Flexible control + Error detection
The robot can be flexibly controlled and operated profiling the target workpiece.
When a workpiece is inserted with an excessive force, an error is generated to stop the operation.

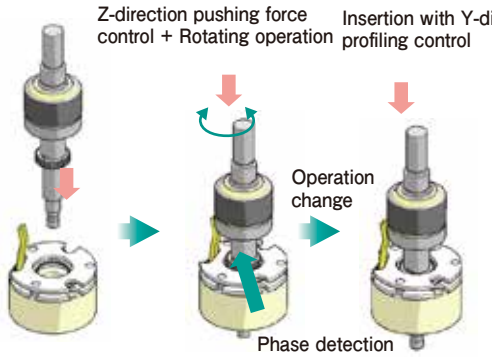






Performs complex assembly works such as phase focusing.

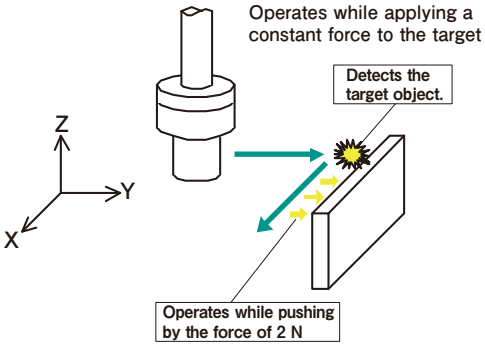
Operation change with force detection
Contact detection switches operation directions or force controls. This function realizes highly-flexible assembly works by changing the force control characteristics during interpolation operation.



Phase focusing assembly

Performs operations with a constant force.

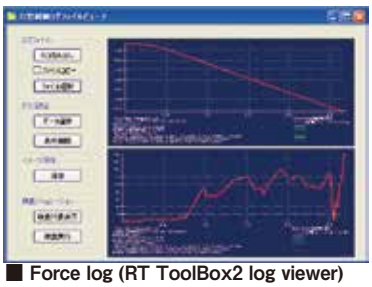
Pushing force control
A robot performs pushing operations in a specified direction with a constant force This control can also be used for deburring works and tension applying works.



Teaching support

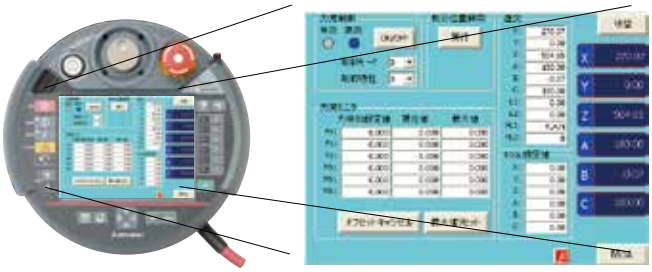
Force GUI has been installed.

- Because force GUI screens are utilized for the personal computer support software (RT ToolBox2) and teaching boxes (R56TB/R57TB, R32TB/R33TB) as standard, users can easily operate force sensors.
- The force data synchronized with position data can be saved as log data.
- RT ToolBox2 displays log data in a graph.
- Log data files can be transferred to a personal computer via FTP.



■ Force log (RT ToolBox2 log viewer)

R32TB/R33TB



R56TB/R57TB

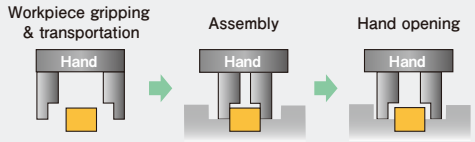
Users can perform teaching while checking the force status on the force control-dedicated screen of the teaching boxes, realizing the optimal position teaching.

Multifunctional electric hand

The highly-functional operation control that cannot be performed with air cylinders

Users can set the grip force and gripping speed depending on a target workpiece, such as a soft one and heavy one. When users need to handle workpieces with different sizes, they can set the optimal stroke in the operating position setting. Position feedback of hands can be utilized for the judgments of success/failure in gripping and OK/NG products with the measurement of workpiece dimensions and product inspections.

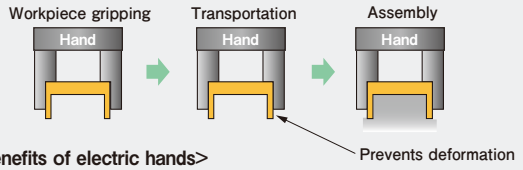
Prevents interference using the opening/closing stroke control



<Benefits of electric hands>

◎ Multipoint position control
(applicable to a wide variety of products, opening/closing stroke adjustment)

Prevents deformation of resin moldings



<Benefits of electric hands>

◎ Speed control (workpiece shape retention, impact cushioning)
◎ Grip force control (prevention of workpiece deformation)

Please contact your local representative or sales office.

● **Multifunctional electric hand (manufactured by TAIYO)**

Easy control

With a robot program, users can easily set the operation stroke and grip force according to the dimensions of workpieces.

Easy operation

Users can flexibly operate electric hands on the hand-dedicated screen of the teaching box.

Robot Lineup

Series configuration of vertical, multiple-joint type robots

Model	RV-2F	RV-2FL	RV-4F	RV-4FL	RV-7F	RV-7FL	RV-7FLL	RV-13F	RV-13FL	RV-20F	RV-35F	RV-50F	RV-70F
Maximum load capacity	3kg		4kg		7kg			13kg		20kg	35kg	50kg	70kg
Reach	504mm	649mm	515mm	649mm	713mm	908mm	1503mm	1094mm	1388mm	1094mm	2050mm		

Series configuration of horizontal, multiple-joint type robots

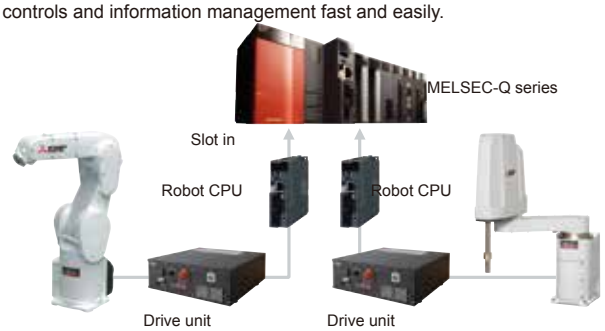
Model	RH-3FH	RH-6FH	RH-12FH	RH-20FH	RH-3FHR
Maximum load capacity	3kg	6kg	12kg	20kg	3kg
Reach	350mm / 450mm / 550mm	350mm / 450mm / 550mm / 700mm / 850mm / 1000mm			350mm
Z stroke	150mm*1	200mm / 340mm	350mm / 450mm		150mm*2

*1: Clean room specification machine: 120mm *2: Clean room specification machine, waterproof specification machine: 120mm

Controller type

Q-TYPE controller

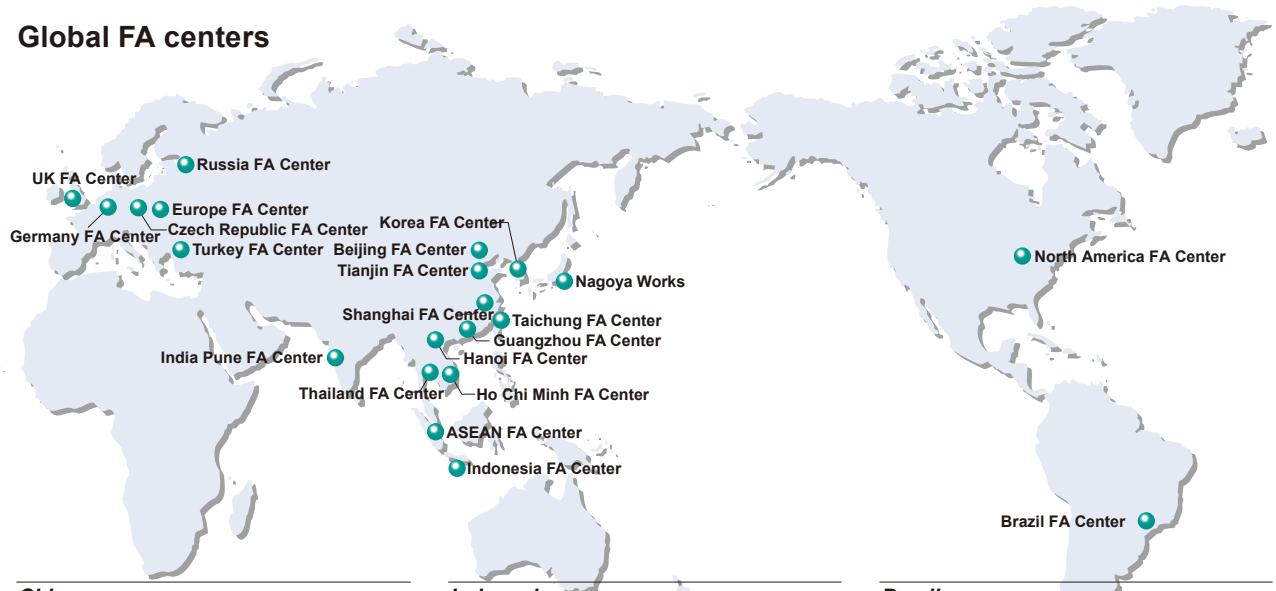
This type of controller is compatible with "iQ Platform" that seamlessly integrates controllers, HMIs, engineering environment, and networks in a manufacturing site. A multiple-CPU configuration dramatically improves the compatibility with FA devices, and allows users to perform elaborate controls and information management fast and easily.



D-TYPE controller

This type of controller is a stand-alone type, just like conventional controllers. Cells can be built by using a robot controller as the core of a control. Because various interfaces have been mounted into a robot controller as standard, the most suitable system can be configured in accordance with your application.

Global FA centers



China

Shanghai FA Center RB
MITSUBISHI ELECTRIC AUTOMATION (CHINA) LTD.
No.1386 Hongqiao Road, Mitsubishi Electric Automation Center, Shanghai, China
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82-2-3660-9632(PLC/HMI)
82-2-3660-9630(SV/INV/Robot)
82-2-3660-9631(NC)
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1-847-478-2334 INV/SV
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Fax: 1-847-478-2253
1-847-478-2650(NC)
1-847-478-2396(LVS,MC)

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