FACTORY AUTOMATION

ROBOT SYSTEM SOLUTIONS

MELFA
GLOBAL IMPACT OF MITSUBISHI ELECTRIC

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.
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.

Our robotic solutions allow companies productivity and reducing costs.
Mitsubishi Electric's robots and robotic system solutions solve various issues and satisfy diverse needs of production sites.

We want to improve our process consistency.
We cannot secure sufficient labor.

We want to improve productivity.

We would like to utilize for various kinds of product.
We want to speed up changeovers.

We want to stabilize the quality of products.
We want to simplify how to change production volume.

We want to make our factory the most advanced one.
We want to upgrade their production lines thereby improving productivity and reducing costs.
Introducing Robot System

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 able to download manuals and CAD data etc. and take advantage of various services including e-learning.
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.

The best 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.

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.
Robot System Solution

Delivering the best automation solution

Assembly of electric equipment
- Manpower saving
- Adaptation to a wide variety of products
- Stabilization of quality

Loading/Unloading of parts to a processing machine
- Manpower saving
- Higher operating ratio
- Improvement in cycle time

Alignment and packaging
- Manpower saving
- Improvement of traceability
- Adaptation for load changes

Handling of packed carton boxes
- Manpower saving
- Improvement in cycle time
- Reduction of heavy labor

Automated solution with robots for production sites

Case study: Page 9,10
Case study: Page 11,12
Case study: Page 13,14
Case study: Page 15

Electric and electronic engineering
Machine work and automobile components
Logistics

Food products and medicines
to your plant to eliminate issues and concern

**Merits of robot introduction**

### Productivity improvement

**Productivity will be improved.**

- Fast!
- 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.)
- Robots enable a quick operation mode change by saving various complicated moves and allowing program and automatic hand change.
- 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.**

- 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.
- 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**

- 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.

**Programming**

- 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.
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.

**System configuration diagram**

**Control device 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)

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

**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

**Other merits**
- Adaptation to the production of a wide variety of products
- Simplification of production adjustment
- Stabilization of quality
factory automation system makers, will provide systems through the strong alliance with partners.
**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**

- 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.

**Benefits of introducing**

- Improvements 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 slid 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**

- 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 robot’s Additional axis function

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

**Points for the employment of robots**

- Manpower-saving with the introduction of facility: It is possible to depreciate the investment cost in about 1 year. (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 reduction of dangerous work.
Deburring / Polishing

Appearance inspection

Sealing

Packing of processed parts

Assembly of automobile components

Gate cutting

Alignment of mold goods

Packing of processed parts
Food Products and Medicines

Conveyor alignment for packed food products

System configuration diagram

Control device 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.

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.
Loading/Unloading of parts to a medicine analyzer

Labeling

Label check

Packing

Sorting

Loading/Unloading processes for a filler
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.

**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.

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**
**Clean room**

**Loading and unloading from cassettes**

**System configuration diagram**

- Cassette (Hoop)
- Vertical, multiple-joint type robot
- Wafer
- Wafer gripping hand
- Wafers before cleaning
- Magazine for wafer cleaning
- Cleaning tank
- Touch panel
- Programmable controller (iQ Platform)
- System control panel

**Points for the employment of robots**

- **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.

**Benefits of introducing**

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

**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.

- Equipment control axis
- Motion controller
- Servo amplifier
- Servo motor
- Touch panel
- Equipment control programmable controller network
- Ethernet
- CC-Link
- Safety programmable controller
- Wire-saving system due to the connection of safety equipment, safety programmable controller and CC-Link Safety
No more worries about introduction of robots to your facilities. Application to draw excellent functions and performance of robots can be easily configured.
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.

**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.

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

*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.

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)

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!
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.

**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

#### Specifications

<table>
<thead>
<tr>
<th>Type</th>
<th>APR-TR3FH</th>
<th>APR-TR6FH</th>
<th>APR-TR12FH</th>
<th>APR-TR20FH</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Robot model name</strong>&lt;sup&gt;2)&lt;/sup&gt;</td>
<td>RH-3FH5515&lt;sup&gt;-SA&lt;/sup&gt;</td>
<td>RH-6FH5520&lt;sup&gt;-SA&lt;/sup&gt;</td>
<td>RH-12FH8535&lt;sup&gt;-SA&lt;/sup&gt;</td>
<td>RH-20FH10035&lt;sup&gt;-SA&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Environmental specifications</strong>&lt;sup&gt;1)&lt;/sup&gt;</td>
<td>General environmental specifications: IP20</td>
<td>General environmental specifications: IP20</td>
<td>General environmental specifications: IP20</td>
<td>General environmental specifications: IP20</td>
</tr>
<tr>
<td>Maximum reach radius</td>
<td>mm</td>
<td>550</td>
<td>550</td>
<td>850</td>
</tr>
<tr>
<td>Up/Down stroke</td>
<td>mm</td>
<td>150</td>
<td>200</td>
<td>350</td>
</tr>
<tr>
<td><strong>Connected controller</strong>&lt;sup&gt;3)&lt;/sup&gt;</td>
<td>CR751-D/Q</td>
<td>CR750-D/Q, CR751-D/Q</td>
<td>CR751-D/Q</td>
<td>CR750-D/Q</td>
</tr>
<tr>
<td><strong>Power supply specifications</strong></td>
<td>Input voltage range: V</td>
<td>Single phase AC180 to 253</td>
<td>Single phase AC207 to 253, 3-phase AC180 to 253</td>
<td></td>
</tr>
<tr>
<td>Power source capacity</td>
<td>kVA</td>
<td>0.5</td>
<td>1.0</td>
<td>1.5</td>
</tr>
<tr>
<td>Power supply frequency</td>
<td>Hz</td>
<td>50 or 60</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Hand specifications

| Hand setting | Depends on outline dimensions of hand |
| Model | SMC |
| **Type** | Single-hand |
| **Number of units** | 1 or 2<sup>2)</sup> |
| **Standard supply pressure (Pressure range)** | L/min (ANR) | 0.4 (0.3 to 0.6) |
| **Vacuum pressure** | kPa | 90 |
| **Adsorption time (reference value)** | msec | 150<sup>3)</sup> |

### Vision sensor specifications

| **Manufacturer** | COGNEX |
| **Model** | EZ-140 |
| **Power supply specifications for PoE-HUB encoder** | V | AC100 to 240 |
| **Power consumption** | W | 60 |
| **Frequency** | Hz | 50 or 60 |
| **Number of robots** | Unit | 1 or 2<sup>2)</sup> |
| **Installation height** | mm | 370,450,550<sup>4)</sup> |
| **Width** | mm | 200,250,300<sup>4)</sup> |
| **Maximum speed** | mm/sec | 300 |

### Applicable system specifications

| **Type**<sup>2)</sup> | APR-TR3FH | APR-TR6FH | APR-TR12FH | APR-TR20FH |
| **Number of registrations** | Type | 5 places<sup>4)</sup> | 5 places<sup>4)</sup> | 16 places<sup>4)</sup> |
| **Size** | Standard hand (reference value) | mm | 55×75×24<sup>10)</sup> | 160×200×100<sup>5)</sup> |
| **Weight** | Standard hand (reference value) | kg | 0.1<sup>15)</sup> |
| **Ejecting operation** | Simple transport/Pallet alignment<sup>16)</sup> (MAX: 20 × 20)/Workpiece-picking ejection<sup>17)</sup> |
| **Ambient temperature** | °C | 5 to 40 |

### Table 1: Maximum transport capacity (300mm transport)<sup>18)</sup> (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. 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.
5. Select or replace adsorption pads depending on the specifications of workpieces to be transported.
6. The power consumption of when the PoE-HUB described in the specifications is used.
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.
12. For the maximum load capacity of the robot, refer to "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 2 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.
15. This reference value is based on the conditions of the test conducted by Mitsubishi shown in the specification. 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. The reference value is based on the conditions of the test conducted by Mitsubishi shown in the following table.
### Applicable layout

#### 1-robot configuration

![1-robot configuration diagram]

#### 2-robot configuration

![2-robot configuration diagram]

*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**

<table>
<thead>
<tr>
<th>a □TR</th>
<th>The number of robots</th>
</tr>
</thead>
<tbody>
<tr>
<td>1TR</td>
<td>1-robot specification</td>
</tr>
<tr>
<td>2TR</td>
<td>2-robot specification</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>b ●FH</th>
<th>Robot model</th>
</tr>
</thead>
<tbody>
<tr>
<td>3FH</td>
<td>RH-3FH5515</td>
</tr>
<tr>
<td>6FH</td>
<td>RH-6FH5520</td>
</tr>
<tr>
<td>12FH</td>
<td>RH-12FH8535</td>
</tr>
<tr>
<td>20FH</td>
<td>RH-20FH10035</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>c ◆</th>
<th>Controller type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1D</td>
<td>CR751-D controller</td>
</tr>
<tr>
<td>1Q</td>
<td>CR751-Q controller</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>d △</th>
<th>Hand type</th>
</tr>
</thead>
<tbody>
<tr>
<td>None: Hand specifications for sink type</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>Hand specifications for source type</td>
</tr>
<tr>
<td>N</td>
<td>No hand</td>
</tr>
</tbody>
</table>

---

*The number of robots*  
1TR : 1-robot specification  
2TR : 2-robot specification

*Robot model*  
3FH : RH-3FH5515  
6FH : RH-6FH5520  
12FH : RH-12FH8535  
20FH : RH-20FH10035

*Controller type*  
1D : CR751-D controller  
1Q : CR751-Q controller

*Hand type*  
None: Hand specifications for sink type  
E : Hand specifications for source type  
N : No hand
### Package components

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

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

<1> **Packaged robot (robot and controllers)**

<2> **MELFA-Tracking (CD-ROM)**

<3> **Easy setup guide**

<4> **Vision sensor module**

<5> **Encoder module**

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

<7> **Vision cable**

<8> **Vision I/O cable**

<9> **Encoder cable**

<10> **Calibration sheet**

<11> **Encoder distribution set**
System configuration example (one robot, robot controller CR750-D)

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.
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!**
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.

### 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.
## Specifications

### Basic specifications

<table>
<thead>
<tr>
<th>Robot specifications</th>
<th>APR-1ML4FM / 4FLM</th>
<th>APR-1ML7FM / 7FLM / 7FLLM</th>
<th>APR-1ML13FM / 13FLM</th>
<th>APR-1ML20FM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Robot model name</strong></td>
<td>RV-4FM / 4FLM – SA</td>
<td>RV-7FM / 7FLM / 7FLLM – SA</td>
<td>RV-13FM / 13FLM – SA</td>
<td>RV-20FM – SA</td>
</tr>
<tr>
<td><strong>Type</strong></td>
<td>APR-1ML4FM / 4FLM</td>
<td>APR-1ML7FM / 7FLM / 7FLLM</td>
<td>APR-1ML13FM / 13FLM</td>
<td>APR-1ML20FM</td>
</tr>
<tr>
<td><strong>Load capacity</strong></td>
<td>kg</td>
<td>4</td>
<td>7</td>
<td>13</td>
</tr>
<tr>
<td><strong>Protection grade of robot</strong></td>
<td>IP67</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Maximum reach radius</strong></td>
<td>mm</td>
<td>515</td>
<td>649</td>
<td>713</td>
</tr>
<tr>
<td><strong>Connected controller</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Protection grade of controller</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Size</strong></td>
<td>mm</td>
<td>H290 × W460 × L140 (protrusions excluded)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Protection grade (IP)</strong></td>
<td>IP54</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Interface</strong></td>
<td>Touch panel 10.4” VGA [640 × 480], TFT color liquid crystal (GOT2000 series)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Others</strong></td>
<td>Emergency stop button × 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Connection</strong></td>
<td>Between a robot and operation box: External emergency stop cable (7m), LAN cable (7m)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>kg</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Power supply specifications</strong></td>
<td>V</td>
<td>Single phase AC 207 to 253</td>
<td>Single phase AC 207 to 253, three-phase AC 180 to 253</td>
<td></td>
</tr>
<tr>
<td><strong>Power source capacity</strong></td>
<td>kVA</td>
<td>1.1</td>
<td>2.1</td>
<td>3.1</td>
</tr>
</tbody>
</table>

### Applicable system

<table>
<thead>
<tr>
<th>CNC*1</th>
<th>Mitsubishi CNC M70V series, M80V series</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Number of units</strong></td>
<td>Unit</td>
</tr>
<tr>
<td><strong>Necessary option</strong></td>
<td>CC-Link option</td>
</tr>
<tr>
<td><strong>Processing machine</strong></td>
<td>Type</td>
</tr>
<tr>
<td><strong>Hand*5</strong></td>
<td>Hand configurations</td>
</tr>
<tr>
<td><strong>Drive method</strong></td>
<td>Air grip</td>
</tr>
<tr>
<td><strong>Workpiece</strong></td>
<td>Size</td>
</tr>
<tr>
<td><strong>Number of steps</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Layout</strong></td>
<td></td>
</tr>
<tr>
<td>*<em>Applicable layout (reference)<em>6</em></em></td>
<td></td>
</tr>
<tr>
<td><strong>Workpiece feed stage</strong></td>
<td>One processing machine, one robot</td>
</tr>
<tr>
<td><strong>Workpiece feed stage</strong></td>
<td>Two processing machines (face-to-face arrangement), one robot</td>
</tr>
<tr>
<td><strong>Workpiece ejection stage</strong></td>
<td>Two processing machines (L-shape arrangement), one robot</td>
</tr>
<tr>
<td><strong>Workpiece transport pattern*8</strong></td>
<td>When using two processing machines, select a parallel or sequential transport pattern.</td>
</tr>
</tbody>
</table>

---

*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.

*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”.

---

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

<table>
<thead>
<tr>
<th>a</th>
<th>●</th>
<th>Robot model</th>
</tr>
</thead>
<tbody>
<tr>
<td>4FM</td>
<td>RV-4FM</td>
<td></td>
</tr>
<tr>
<td>4FLM</td>
<td>RV-4FLM</td>
<td></td>
</tr>
<tr>
<td>7FM</td>
<td>RV-7FM</td>
<td></td>
</tr>
<tr>
<td>7FLM</td>
<td>RV-7FLM</td>
<td></td>
</tr>
<tr>
<td>7FLLM</td>
<td>RV-7FLLM</td>
<td></td>
</tr>
<tr>
<td>13FM</td>
<td>RV-13FM</td>
<td></td>
</tr>
<tr>
<td>13FLM</td>
<td>RV-13FLM</td>
<td></td>
</tr>
<tr>
<td>20FM</td>
<td>RV-20FM</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>b</th>
<th>◆</th>
<th>Controller type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1D: CR751-D controller</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>c</th>
<th>△△</th>
<th>Type of the hand or other I/O signals</th>
</tr>
</thead>
<tbody>
<tr>
<td>N : Sink type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NE: Source type</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Package components

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

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

### Entire configuration

- **Products prepared by customers**
  - Double air hand
  - Solenoid valve set
  - Hand input cable
  - Hand curl tube
  - CC-Link module
  - I/O has been assigned.

- **Teaching box**
  - R56/57TB or R32/33TB

- **Peripheral devices such as conveyors and robot stands necessary for configuring a system by customers**
  - Ethernet HUB
  - RT ToolBox2

* Prepare peripheral devices such as conveyors and robot stands necessary for configuring a system by customers.

### Outline dimensions of an operation box

- Dimensions: 430 x 340 x 190 mm
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.

- RT ToolBox2
- Teaching box
- Ethernet HUB
- LAN cable
- Personal computer (for setting)

- A cable (4 cores, sheath external diameter: \(\phi \) 10.5 to 14.1) equivalent to the primary power cable (AWG#14 (2m²))
- Grounding cable

- When using two processing machines: CC-Link cables for connecting the machines
- Double air hand
- Solenoid valve set
- Hand input cable
- Hand curl tube

Peripheral mechanisms such as safety fences, covers, and doors
Signal tower, door sensor device

Processing equipment set (CNC) (Up to 2 units)

CNC: Communication device (CC-Link module)

- Workpiece feed stage (including the mechanism, drive, and sensor devices)
- Workpiece positioning (including the mechanism, drive, and sensor devices)
- Workpiece ejection stage (including the mechanism, drive, and sensor devices)

Robot stand

Applicable layout

<table>
<thead>
<tr>
<th>Lathe</th>
<th>Tapping center</th>
</tr>
</thead>
<tbody>
<tr>
<td>One processing machine</td>
<td>One processing machine</td>
</tr>
<tr>
<td>Two processing machines</td>
<td>Two processing machines</td>
</tr>
</tbody>
</table>
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!
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)

- **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

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

Operation check screen

Oscillograph screen

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

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

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

#### Basic specifications

<table>
<thead>
<tr>
<th>Type</th>
<th>Unit</th>
<th>AP10-AFS2F</th>
<th>AP10-AFS2L</th>
<th>AP10-AFS4/8F</th>
<th>AP10-AFS4/8L</th>
<th>AP10-AFS7/8F</th>
<th>AP10-AFS7/8L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Robot model name</td>
<td></td>
<td>RV-2F</td>
<td>RV-2FL</td>
<td>RV-4F</td>
<td>RV-4FL</td>
<td>RV-7F</td>
<td>RV-7FL</td>
</tr>
<tr>
<td>Environmental specifications</td>
<td></td>
<td>General environmental specifications: IP20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum reach radius</td>
<td>mm</td>
<td>504</td>
<td>649</td>
<td>515</td>
<td>649</td>
<td>713</td>
<td>908</td>
</tr>
<tr>
<td>Load capacity</td>
<td>kg</td>
<td>Maximum 3 (Rating 2)</td>
<td>Maximum 4 (Rating 4)</td>
<td>Maximum 7 (Rating 7)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connected controller</td>
<td></td>
<td>CR750-DQ, CR751-DQ</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Power supply specifications</td>
<td></td>
<td>Input voltage range</td>
<td>V</td>
<td>Single-phase AC180 to 253</td>
<td>Single phase AC 207 to 253</td>
<td></td>
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<tr>
<td>Power source capacity</td>
<td>kVA</td>
<td>0.5</td>
<td>1.0</td>
<td>2.0</td>
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</tr>
<tr>
<td>Power supply frequency</td>
<td>Hz</td>
<td>50 or 60</td>
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<td></td>
<td></td>
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<tr>
<td>Rated load</td>
<td>Px, Fy, Fz</td>
<td>N</td>
<td>200</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Max. static load</td>
<td>Mx, My, Mz</td>
<td>Nm</td>
<td>4</td>
<td></td>
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<tr>
<td>Breaking load</td>
<td>Px, Fy, Fz</td>
<td>N</td>
<td>1000</td>
<td></td>
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<td></td>
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<tr>
<td>Minimum control force</td>
<td>Mx, My, Mz</td>
<td>Nm</td>
<td>6</td>
<td></td>
<td></td>
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<tr>
<td>Consumption current</td>
<td>mA</td>
<td>300</td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Weight (sensor unit)</td>
<td>g</td>
<td>200</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protective structure</td>
<td></td>
<td>IP30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interface</td>
<td>RS-422</td>
<td>ch</td>
<td>1 (for connecting sensors)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power supply</td>
<td>SSCNETIII</td>
<td>ch</td>
<td>1 (For connecting robot controllers and additional axis amplifiers)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Power supply specifications</td>
<td>Input voltage</td>
<td>Vdc</td>
<td>24 ± 5%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power consumption</td>
<td>W</td>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>External dimensions</td>
<td>mm</td>
<td>225(W)×111(D)×38(H)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>kg</td>
<td>Approx. 0.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structure</td>
<td></td>
<td>IP20 (Panel installation, open type)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*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

This product includes the following components:
- Robot model (BD: CR751-D controller, BQ: CR751-Q controller)
- Force sensor (1F-FS001-W200)
- Force sense interface unit (2F-TZ561)
- Power supply (2F-PWR-01)
- Cable between devices (LAN, USB)
- RT ToolBox2 (3D-11C-WINJ, 3D-12C-WINJ)
- MELFA-Force Sense Plus (3F-AFS-WIN)
- 24VDC power supply output cable (2F-PWRCBL-01)
- 24VDC power supply input cable (2F-PWRCBL-02)

### Composition of a force-sense application model name

**AP10—AFS0 ● ◆ — E0**

**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

* Prepare hands and peripheral devices by customers.

---

*Attachment diagram of a force sensor*

- Sensor attachment adapter (1F-FSLG-01)
- Force sensor (3F-AFS-WIN)
- 24VDC power supply output cable (2F-PWRCBL-01)
- 24VDC power supply input cable (2F-PWRCBL-02)
- RT ToolBox2 (3D-11C-WINJ, 3D-12C-WINJ)
- MELFA-Force Sense Plus (3F-AFS-WIN)
- 24VDC power supply output cable (2F-PWRCBL-01)
- 24VDC power supply input cable (2F-PWRCBL-02)
- RT ToolBox2 (3D-11C-WINJ, 3D-12C-WINJ)

---

* Prepare hands and peripheral devices by customers.
### 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
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 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.

**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.
### Specifications

#### Basic specifications

<table>
<thead>
<tr>
<th>Type*1)</th>
<th>Unit</th>
<th>AP10-BRP07F</th>
<th>AP10-BRP07L</th>
<th>AP10-BRP08L</th>
<th>AP10-BRP03F</th>
<th>AP10-BRP03L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Robot model name</td>
<td></td>
<td>RV-7FM ✧</td>
<td>RV-7FLM ✧</td>
<td>RV-7FLM ✧</td>
<td>RV-13FM ✧</td>
<td>RV-13FLM ✧</td>
</tr>
<tr>
<td>Environmental specifications</td>
<td>Protection specification: IP67</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum reach radius</td>
<td>mm</td>
<td>713</td>
<td>908</td>
<td>1503</td>
<td>1094</td>
<td>1388</td>
</tr>
<tr>
<td>Load capacity</td>
<td>kg</td>
<td>Maximum 7 (Rating 7)*2)</td>
<td>Maximum 13 (Rating 12)*2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connected controller</td>
<td></td>
<td>CR750-D/Q, CR751-D/Q</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 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 workplace 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 workplace 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.

*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—BRPO  ■■  ▲▲  —  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)
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.

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

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.

---

### Collision Avoidance

**iQ Platform** [iQ 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.

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** [iQ 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.

Coordinated transport

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

---

Please contact your local representative or sales office.

MELFA-3D Vision

Picking of discretely placed parts

Model-less recognition

Model matching recognition

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---

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**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.

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 de-burring 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.

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

Workpiece gripping & transportation
Assembly
Hand opening

Benefits of electric hands:

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

Prevents deformation of resin moldings

Workpiece gripping
Transportation
Assembly

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.
**Series configuration of vertical, multiple-joint type robots**

<table>
<thead>
<tr>
<th>Model</th>
<th>RV-2F</th>
<th>RV-2FL</th>
<th>RV-4F</th>
<th>RV-4FL</th>
<th>RV-7F</th>
<th>RV-7FL</th>
<th>RV-7FLL</th>
<th>RV-13F</th>
<th>RV-13FL</th>
<th>RV-20F</th>
<th>RV-35F</th>
<th>RV-50F</th>
<th>RV-70F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum load capacity</td>
<td>3kg</td>
<td>4kg</td>
<td>7kg</td>
<td>13kg</td>
<td>20kg</td>
<td>35kg</td>
<td>50kg</td>
<td>70kg</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reach</td>
<td>504mm</td>
<td>515mm</td>
<td>649mm</td>
<td>649mm</td>
<td>713mm</td>
<td>908mm</td>
<td>1094mm</td>
<td>1388mm</td>
<td>1094mm</td>
<td>2050mm</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Series configuration of horizontal, multiple-joint type robots**

<table>
<thead>
<tr>
<th>Model</th>
<th>RH-3FH</th>
<th>RH-6FH</th>
<th>RH-12FH</th>
<th>RH-20FH</th>
<th>RH-3FHR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum load capacity</td>
<td>3kg</td>
<td>6kg</td>
<td>12kg</td>
<td>20kg</td>
<td>3kg</td>
</tr>
<tr>
<td>Reach</td>
<td>350mm</td>
<td>450mm</td>
<td>550mm</td>
<td>850mm</td>
<td>1000mm</td>
</tr>
<tr>
<td>Z stroke</td>
<td>150mm*1</td>
<td>200mm</td>
<td>340mm</td>
<td>350mm</td>
<td>450mm</td>
</tr>
</tbody>
</table>

*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.
Mitsubishi Electric delivers a wide variety of FA products including FA devices, such as programmable controllers and AC servos, and industrial mechatronics products, such as CNC and industrial robots.

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