MITSUBISHI ELECTRIC INDUSTRIAL ROBOT
FR Series
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.
OVERVIEW

Product Lineup

Functions

Robot Specifications

Controller Specifications

Robot Option Specifications

System Configuration / Controller Option Specifications

Options

Technical Information
The new future of automation made by next-generation intelligent robots

Providing improvements in productivity, quality, environmental protection, safety and security to help reduce companies’ TCO* and boost their corporate value.

We offer solutions that use FA technology and IT to reduce total costs in everything from development through to production and maintenance, supporting customers to continuously improve their business operations and achieve truly cutting-edge manufacturing.

*TCO: Total Cost of Ownership

e-F@ctory is Mitsubishi Electric’s trademark and registered trademark.

**MELFA**

Introducing the next generation of intelligent robots, incorporating advanced solutions technology and “e-F@ctory”, technologies and concepts developed and proven using Mitsubishi Electric’s own production facilities that go beyond basic robotic performance to find ways of reducing the TCO in everything from planning and design through to operation and maintenance.
possible and e-F@ctory
Evolved intelligence realizes advances in work procedures, cooperation between people and robots, and e-F@ctory-compatibility, making next-generation manufacturing a reality.

With globalization and increasingly diverse consumer needs in the market, the manufacturing industries face a time of considerable change. It is no longer enough for industrial robots to simply perform a single task. Industry now demands robots with the capacity and flexibility to readily take on more sophisticated tasks. The MELFA FR series provides new, more intelligent solutions that underpin “next-generation manufacturing”, offering a simpler approach to advanced and flexible production. These robots can handle all your automation needs.

**Intelligence**

“MELFA Smart Plus” offers greater accuracy and shorter startup times, making installation simpler and more advanced tasks possible through more sophisticated force sensors and enhanced cooperation with vision sensors.

**Integration**

Connection and integration with a wide range of FA equipment, such as the MELSEC iQ-R series. These machines support the “e-F@ctory” integrated FA solution for seamless integration of robots and IT systems.

**Safety**

A comprehensive range of safety functions, including position and speed monitoring and monitoring of the X, Y and Z components, allow work to be conducted in collaboration with people.

**Greater advances in intelligent technology**

“MELFA Smart Plus” offers greater accuracy and shorter startup times, making installation simpler and more advanced tasks possible through more sophisticated force sensors and enhanced cooperation with vision sensors.

**Enhanced cooperation through e-F@ctory**

Connection and integration with a wide range of FA equipment, such as the MELSEC iQ-R series. These machines support the “e-F@ctory” integrated FA solution for seamless integration of robots and IT systems.

**Improved safety through collaborative work applications**

A comprehensive range of safety functions, including position and speed monitoring and monitoring of the X, Y and Z components, allow work to be conducted in collaboration with people.

**Making difficult automation possible**

Intelligent technology means that it is now possible to automate processes that previously could only be handled by humans due to the difficulty of the tasks involved. And using “Smart Plus”, this can be achieved with ease.

**Promoting smarter factories**

The integration of e-F@ctory machines enables flexible manufacturing tailored to the type of production. This improves productivity and maintainability and reduces the TCO (Total Cost of Ownership).

**Even higher productivity**

Safety functions make collaborative work applications possible, for automation that is simpler and safer. The reductions in required space and stoppage times mean that factories can offer both productivity and flexibility.

Function expansion options further broaden the range of possibilities of the MELFA FR series, offering performance beyond your expectations.

Integration with the MELSEC iQ-R series PLCs enables more advanced tasks!

Integrating these robots with the Mitsubishi Electric MELSEC iQ-R PLCs simplifies startup and improves productivity and maintainability, ensuring that you maximize the potential of the FR series.
“MELFA Smart Plus” offers greater accuracy and shorter startup times, making installation simpler and more advanced tasks possible through more sophisticated force sensors and enhanced cooperation with vision sensors.

Greater advances in intelligent technology mean that it is now possible to automate processes that previously could only be handled by humans due to the difficulty of the tasks involved. And using “Smart Plus”, this can be achieved with ease.

Making difficult automation possible, the integration of e-F@ctory machines enables flexible manufacturing tailored to the type of production. This improves productivity and maintainability and reduces the TCO (Total Cost of Ownership).

Promoting smarter factories, connection and integration with a wide range of FA equipment, such as the MELSEC iQ-R series. These machines support the “e-F@ctory” integrated FA solution for seamless integration of robots and IT systems.

Enhanced cooperation through e-F@ctory with globalization and increasingly diverse consumer needs in the market, the manufacturing industries face a time of considerable change. It is no longer enough for industrial robots to simply perform a single task. Industry now demands robots with the capacity and flexibility to readily take on more sophisticated tasks. The MELFA FR series provides new, more intelligent solutions that underpin “next-generation manufacturing”, offering a simpler approach to advanced and flexible production. These robots can handle all your automation needs.

MELFA FR Series

“Next-generation intelligent functions” make it simple to carry out work that has always defied automation. “Safe, collaborative work applications” allow robots and people to work together with high levels of safety. “FA-IT integration functions” support next-generation manufacturing. With these 3 key features, the FR Series is capable of handling virtually all your automation needs.

Safety

[Safe, collaborative work applications]

Intelligence

[Next-generation intelligence]

A comprehensive range of safety functions, including position and speed monitoring and monitoring of the X, Y and Z components, allow work to be conducted in collaboration with people.

Improved safety through collaborative work applications

Safety functions make collaborative work applications possible, for automation that is simpler and safer. The reductions in required space and stoppage times mean that factories can offer both productivity and flexibility.

Even higher productivity

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Evolved intelligence realizes advances in work procedures, cooperation between people and robots, and e-F@ctory-compatibility, making next-generation manufacturing a reality.
**Vertical, multiple-joint type robots**

**RV-FR SERIES**

- Optimized arm length and 6 joints for a broader range of movement support complex assembly and process operations.
- Compact body and slender arms capable of covering a large work area and large load capacity.
- Suitable for a broad range of layouts, from transporting machine parts to assembling electrical components.
- Designed to withstand environmental conditions, making it ideal for a wide range of applications without having to worry about the installation environment.

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**Vertical, multiple-joint type (RV) series**

<table>
<thead>
<tr>
<th>Type</th>
<th>RV-2FR</th>
<th>RV-2FRL</th>
<th>RV-4FR</th>
<th>RV-4FRL</th>
<th>RV-7FR</th>
<th>RV-7FRL</th>
<th>RV-7FRLL</th>
<th>RV-13FR</th>
<th>RV-13FRL</th>
<th>RV-20FR</th>
</tr>
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<tbody>
<tr>
<td>Maximum load capacity</td>
<td>3kg</td>
<td>4kg</td>
<td>7kg</td>
<td></td>
<td>13kg</td>
<td>20kg</td>
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</tr>
<tr>
<td>Maximum reach radius</td>
<td>504mm</td>
<td>649mm</td>
<td>515mm</td>
<td>649mm</td>
<td>713mm</td>
<td>908mm</td>
<td>1094mm</td>
<td>1388mm</td>
<td>1094mm</td>
<td>1503mm</td>
</tr>
</tbody>
</table>
Horizontal, multiple-joint type robots

**RH-FR SERIES**

- With a wealth of operating areas and variations, it is the perfect fit for a variety of applications.
- Highly rigid arms and cutting-edge servo controls provide superb precision and speed.
- Ideal for a wide range of fields, from high-volume production of foodstuffs and pharmaceuticals that demands fast operation, through to assembly work where high levels of precision are required.

### Product Lineup

<table>
<thead>
<tr>
<th>Type</th>
<th>RH-3FRH</th>
<th>RH-6FRH</th>
<th>RH-12FRH</th>
<th>RH-20FRH</th>
<th>RH-3FRHR</th>
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<tr>
<td>Maximum load capacity</td>
<td>3kg</td>
<td>6kg</td>
<td>12kg</td>
<td>20kg</td>
<td>3kg</td>
</tr>
<tr>
<td>Maximum reach radius</td>
<td>350mm</td>
<td>450mm</td>
<td>550mm</td>
<td>350mm</td>
<td>450mm</td>
</tr>
<tr>
<td>Z stroke</td>
<td>150mm$^1$</td>
<td>200mm</td>
<td>340mm</td>
<td>350mm</td>
<td>450mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>150mm$^2$</td>
</tr>
</tbody>
</table>

*1 Clean specification: 120mm
*2 Clean and waterproof specification: 120mm
Using motors developed in-house, highly rigid arms and our original drive control technology, these machines are capable of high-torque output at high rotation speeds, giving better operating performance. Their capacity for continuous operation is also improved, with higher productivity due to the shorter cycle times.

**R/Q TYPE Controller**

This controller is compatible with the “iQ Platform”, which seamlessly integrates the various controllers used in a production site with HMIs, the engineering environment and the network. It uses a multi-CPU configuration that dramatically improves its interaction with FA equipment and also offers highly precise control and fast yet simple information management.

**Q TYPE Controller**

MELSEC Q series-dedicated

A standalone controller similar to existing models. Enables the construction of cells using robot controllers as the control nucleus. Comes with various interfaces as standard, allowing customers to build a system optimized for their applications.

**D TYPE Controller**

MELSEC Q series-dedicated

[Controller Types]

**R TYPE controller**

MELSEC iQ-R series-dedicated

**Q TYPE controller**

MELSEC Q series-dedicated

**D TYPE controller**

A standalone controller similar to existing models. Enables the construction of cells using robot controllers as the control nucleus. Comes with various interfaces as standard, allowing customers to build a system optimized for their applications.
Using motors developed in-house, highly rigid arms and our original drive control technology, these machines are capable of high-torque output at high rotation speeds, giving better operating performance. Their capacity for continuous operation is also improved, with higher productivity due to the shorter cycle times.

Higher speeds

Dedicated motors for high-speed operation

Using motors developed in-house, highly rigid arms and our original drive control technology, these machines are capable of high-torque output at high rotation speeds, giving better operating performance. Their capacity for continuous operation is also improved, with higher productivity due to the shorter cycle times.

Internal wiring channels provided in the tip axis. Allows wiring and tubes to be routed internally up to the gripper mount.

By routing the body cables internally, areas where body cables might interfere with peripheral equipment can be minimized and the problem of wiring and tube tangles can be eliminated.

Note: Specify models with internal cabling (-SKxx). The types of cable that can be internally routed may vary depending on the model.
Greater advances in intelligent technology

Enhanced cooperation with vision sensors and more advanced force sensors allow more advanced tasks to be accomplished at higher speeds and with greater precision.

Through the use of highly accurate vision sensors and force sensors that control the levels of force applied by robots, it is now possible to automate extremely difficult tasks that have been beyond the scope of automation in the past.

**Force sensor**
- Checks the applied force and the force status during insertion to provide improved work quality
- Assembly of difficult-to-fit workpieces
- Teaching assistance using force information
- Faster control cycles for improved force control

**3D vision sensor**
- Kitting or sorting of irregularly placed or overlapping workpieces
- Supports functions for easier startup

**Preventing interference**

**iQ Platform**
Checking for interference between the arms and grippers of adjacent robots prevents any contact.

**2D vision sensor**
- Setup tools for vision simplify the calibration of robots and cameras
- Simple Ethernet connections between robots and cameras
- Easy control using vision control instructions in the robot programs

**Cooperative control**

**iQ Platform**
- Two robots can be coordinated to transport very long or heavy objects
- Positional relationships of non-fixed parts maintained during transportation and assembly

**Multi-function gripper**
- Multi-function electric grippers capable of working with different part types of varying sizes
- Less need for setup changes

**Example of intelligent technology use**

**Tracking**
Transport, alignment, and assembly work, etc. can be performed while robots are tracked with the workpiece on the conveyor without stopping the conveyor.

**Tracking accuracy enhancement function**
Positional gain is changed in real time for even better tracking accuracy.

**Other functions**
Singular point transit and orthogonal compliance functions facilitate the completion of a range of different tasks.
MELFA Smart Plus supports cell production, using robots to overcome the limitations on lead times, production volumes and location.

**Smart Plus**

Advanced intelligent functions are provided in the form of a function expansion option card. This provides leading-edge functions for all phases of customer’s operations, from design and startup through to operation and maintenance. The functions provided include integration functions for the various sensors and autonomous startup adjustment functions.

*Activated with the insertion of a Smart Plus card.

The high-precision technologies and calibration functions provided by MELFA Smart Plus allow correction of machine deviations between cells, offline teaching and copy cells*1. This then enables coordinated operation between the master cell and other cells.

*1 Offline teaching: Operation where programs created in a simulation are transferred to an actual cell.

Copy cell: Conveys master cell modification information. Processes in cells in other locations are then modified in the same way.

**Robot mechanism temperature compensation function**

Improves positioning accuracy by compensating for thermal expansion in the robot arm.

**Calibration assistance function**

- **Automatic calibration**
  Improves positioning accuracy by automatically correcting the vision sensor coordinates.

- **Workpiece coordinate calibration**
  Improves positioning accuracy by automatically correcting the robot coordinates and workpiece coordinates from the vision sensor.

- **Inter-robot relational calibration**
  Uses vision sensors to automatically adjust the robot location relative to other robots. Improves positioning accuracy during coordinated operation.

**3D vision AI**

Shortens startup time by using original AI technology to automatically adjust parameters.

**Preventive maintenance**

Maintains the robot’s health with operation status tracking.

**Coordinated control for additional axes**

Integrates the robot and traveler for machining or assembly at a specified speed.

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3D vision AI

- **NEW**

Preventive maintenance

- **NEW**

**Copy cell A**

① Adjusts startup at master cell

**Copy cell B**

② Compensates machine difference between cells

**Copy cell C**

③ Sends change information to each cell

**Preventive Maintenance screen (RT ToolBox3)**

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**Intelligence**

- Next-generation intelligence

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**MELFA Smart Plus**

CR800 Controller

- MELFA Smart Plus card (2F-DQSXX)

**MELFA Smart Plus card**

2 Functions
Greater advances in intelligent technology

**Force sensor**

Monitors the force applied to the robot gripper so that copying and fitting work can be carried out as it would by a human operator.

**Force control**
Controls “force” and “flexibility.” Modifies control properties during operation.

**Force detection**
Switches operation in response to transitional states.

**Force log**
Checks the work status. Saves log data.

**Gravitational offset cancellation**
Compensates for gravity in response to changes in force on the force sensor in the X, Y and Z directions when the attitude changes. Force control can be exercised correctly even when the attitude changes.

**Teaching work assistance**

**Force GUI included**

- Computer software (RT ToolBox3) and a teaching box (R56TB or R32TB) are standard features of the force GUI screen, making it easy to use force sensors.
- Teaching can be carried out while monitoring the reactive force on the force GUI screen.

*1 GUI: Graphical User Interface

- Force data synchronized to the positional data can be saved as log data.
- Log data can be viewed as graphs using RT ToolBox.
- Log data files can be downloaded to a computer via FTP.

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**More accurate force sensor**

Advances in force sensors allow faster and more accurate testing.

**Gravitational offset cancellation**

Compensates for gravity in response to changes in force on the force sensor in the X, Y and Z directions when the attitude changes. Force control can be exercised correctly even when the attitude changes.

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**Teaching work assistance**

**Force GUI included**

- Force data synchronized to the positional data can be saved as log data.
- Log data can be viewed as graphs using RT ToolBox.
- Log data files can be downloaded to a computer via FTP.
Assembly work (case study)

Fitting a coupling onto a spindle (insertion task with H7h7 tolerance)

Key Points!
- Insertion is by fitting along the Z axis in the soft state while rotating in the θ axis direction.
- Force is specified where both are aligned on the same axis.
- Once they are aligned on the same axis, operation switches to positional control mode and the parts are assembled into their installed positions.
- The parameters required for this work can be set freely.

Operation overview
- Operates by adjusting the position in a direction that releases external force.
- Adjusts for the spindle movement so that no moment applies.
- Because the force applied does not exceed the instructed thrust, the workpiece is not damaged. The work completed state is detected.

Related case studies
- D-cut part insertion work
- Gear assembly work
- Bearing insertion work

Force inspection (case study)

Fitting of a part where the force must be managed and the spring pressure inspected

Key Points!
- The fitting assembly and spring pressure inspection are carried out on one machine.
- Force is inspected at the fitting operation stop position.
- The spring pressure is inspected in the force log.
- Productivity is improved due to assembly reliability and automatic testing.

Spring pressure inspection waveform
- Force
- Abnormal stop
- Normal work

Related case studies
- Spindle size inspection
- Snap mechanism part assembly work

Transportation (case study)

Belt transportation and installation on a pulley

Key Points!
- The belt is transported using force control and coordinated work.
- Quality is assured without applying load to the workplace.
- Suitable for work to install belts on pulleys using force detection.

Deburring and polishing (case study)

Deburring work on machines and plastic parts

Key Points!
- Force detection and force control are used to deburr curved surfaces on mold parts.
- Achieves smooth machining without causing unevenness in the part’s machined surfaces.
Greater advances in intelligent technology

3D vision sensor

Enables bulk feeding
Because the sensors allow bulk feeding without the use of special trays or parts feeders, it reduces the amount of part feeding work.

High-speed picking using original technology
Shortens the image recognition time with high-speed recognition technology. (28% increase compared to Mitsubishi conventional model) Either the model-less recognition, which enables high-speed picking, or the model-matching recognition method, which accurately matches the workpiece position and attitude, can be selected to suit the application.

Recognition parameter automatic adjustment AI
Mitsubishi’s original AI technology and simulation technology automate the sensor parameter adjustment work, which requires expertise knowledge. Anyone can easily achieve the same performance as a skilled worker in a short time. (Compatible only with model-less recognition)

Lightweight and compact for diverse installation
Compact and lightweight sensor section enables installation on robot hand. Both eye-in-hand and fixed installation applications are supported. The work distance and range of view can be changed flexibly by using the enclosed base set or extended option vision.

Adjustment assistance function
Features functions to compensate for lens distortion and for the aperture size and focusing during focus and aperture adjustment. This makes adjustment easier.

Workpiece supply assistance function
Spindle characteristic mode and attitude output mode can be used to ensure a stable grip during model-less recognition. The function to estimate the remaining bulk workpiece level allows the operator to understand the timing to load supplied parts.

Basic performance improved
The grip position recognition speed has been greatly improved by reviewing the operation process method and connecting with a high-performance PC (general-purpose IPC). High-speed picking is now possible.

Conventional

3D Vision Camera
Dedicated controller

NEW

Camera head
Compatible with general-purpose IPC (prepared by customer)
3D Vision SW

Recognition parameter setting AI function
AI automatically adjusts the optimum 3D sensor parameters (image processing parameters, grip position recognition parameters) in a virtual space. Adjustment of complicated parameters is simplified by using the 3D CAD data, even without the camera head. This greatly reduces the vision sensor parameter adjustment time.

Features
• AI automatically adjusts parameters on PC
• No need for expertise knowledge

Mitsubishi’s unique AI technology uses large amounts of learning data generated in a virtual space to efficiently and automatically adjust the optimum parameters.
Multi-function electric gripper

High-functioning operation control not possible using air cylinders

The gripping force and speed can be specified to suit the target, whether it’s a heavy object or involves delicate work. Even when handling multiple workpieces of varying sizes, the operating positions can be specified so that the optimum stroke is configured. Product inspections can be informed by positional feedback from the gripper, such as whether gripping was successful or whether workpiece measurements indicate that it is acceptable.

**Features**

- AI automatically adjusts parameters on PC
- Greater advances in intelligent technology
- Designed for use with a high-performance PC (general-purpose IPC)
- High-speed gripping is now possible.

**Interference prevention function**

**Automatically prevents collisions between robots**

Unanticipated interference can be prevented during jogging or automatic operation because collisions between robots are detected in advance and robot movement is stopped.

**Cooperative control**

**Cooperative control using multiple arms**

Cooperative control between multiple robots is enabled through CPU connection between the robots. Normal operation is through individual robot operation, making operation simple.

**Reduced workload during startup**

The number of recovery processes following collisions due to missed interlocks or teaching errors can be reduced.

**Simple control**

The operation stroke and grip force can easily be configured for the workpiece shape using the robot programming.

**Easy operation**

The gripper can be freely controlled from the dedicated gripper screen in the teaching box.

**Coordinated transportation**

Long or flexible objects can be transported using multiple small robots instead of larger robots.

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**NEW**

- No need for expertise knowledge
- AI automatically adjusts sensor parameters
- Greater advances in intelligent technology
- Mitsubishi’s unique AI technology
- Mitsubishi’s original AI technology and simulation technology (28% increase compared to Mitsubishi conventional model)
- WORKPLACED INTELLIGENCE
- Greater advances in intelligent technology
- Increased speed in image recognition
- Shortens the image recognition time with high-speed recognition
- Recognition parameter setting AI function
- Recognition parameter setting AI function
- Enables bulk feeding
- Complicated parameter configuration is simplified by using 3D CAD data, even without the camera head. This greatly reduces the vision sensor parameter adjustment time.
- AI automatically adjusts the optimum 3D sensor parameters (image processing parameters, grip position recognition parameters) in a virtual space. Adjustment of high-performance PC (general-purpose IPC). High-speed picking is now possible.
- The grip position recognition speed has been greatly improved by reviewing the operation process method and connecting with a general-purpose IPC.
- The work distance and range of view can be changed flexibly by using the enclosed base set or extended option vision.
- The spindle characteristic mode and attitude output mode can be adjusted. This makes adjustment easier.
- Features functions to compensate for lens distortion and for aperture size and focusing during focus and aperture adjustment. This makes adjustment easier.
- Shortens the image recognition time
- Co-operative control

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**Spindle characteristic mode and attitude output mode**

- The gripper hand of the robot sensor section enables installation on a short time. (Compatible only with model-less recognition)
Greater advances in intelligent technology

**Tracking**

- Transport, alignment, and installation work, etc. can be performed while a robot is tracking workpieces on the conveyor without stopping the conveyor.
- Different variations can be selected, including vision tracking in combination with a vision sensor, tracking in combination with an opto-electronic sensor, etc.
- Programs can be created easily in robot language (MELFA BASIC).
- Standard interface function.
  (Separate encoder and vision sensor required.)

<table>
<thead>
<tr>
<th>No need for a positioning device</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce cycle time</td>
</tr>
<tr>
<td>Reduce system costs</td>
</tr>
</tbody>
</table>

![Diagram of tracking system with vision sensor, encoder, conveyor, and robot](image)

Can be used with multiple conveyors (up to 8) at the same time.

**Additional axis function**

- The layout can be set up to include the robot traveling axis and turntable as well as user machines separate from the robot such as loaders and positioning devices.
- Up to 8 additional axes can be controlled excluding the robot.
- Additional axes and user machines can be operated from the robot teaching pendant without any additional motion control hardware. The same JOG operation as for the robot can be used. Robot language can be used for control operations.
- The robot controller has compatibility with the MELSERVO (MR-J4-B, MR-J3-BS) servos.
- Standard interface function.
  (Separate servo amplifier and servo motor required.)
- No need for a dedicated control device

**Robot**

- Up to 8 additional axes
  (Up to 3 groups)

**Additional axis**

- Simultaneous control

**Machine 1**

- Up to 2 axes

**Machine 2**

- Up to 3 axes

**Machine 3**

- Up to 3 axes
Additional axes and user machines can be operated from Up to 8 additional axes can be controlled excluding the The layout can be set up to include the robot traveling axis Different variations can be selected, including vision tracking Transport, alignment, and installation work, etc. can be performed while a robot is tracking workpieces on the conveyor with an opto-electronic sensor, etc.

### Active gain control
- Optimal motor control tuning set automatically based on robot operating position, posture, and load conditions.
- Improves tracking accuracy for the target trajectory.

- Active gain control is a control method that allows the position gain to be changed in real time.
- This is effective when traveling straight and sealing work requiring high accuracy.

### Operating mode setting function
- Trajectory priority mode/speed priority operation can be set in programs to match customer system requirements.
- Optimal motor control tuning set automatically based on robot operating position, posture, and load conditions.
- Improves tracking accuracy for the target trajectory.
- This is effective when traveling straight and sealing work requiring high accuracy.

### Improved accuracy

#### Function for passing through the singular point
- The robot can be made to pass through the singular point. This allows for greater flexibility in the layout of robots and surrounding areas.
- Teaching operations can be performed more easily as there is no longer any need to cancel operations due to the presence of the singular point.

**What a singular point is:**
There is an unlimited number of angles at which the J4 and J6 axes can be set such that the angle of the J5 axis is 0° when linear interpolation operations are performed using position data from a joint coordinate system. This point is the singular point and is the point at which the robot cannot be operated at an assigned position and posture under normal conditions. The position at which this occurs is referred to as a singular point.

- Posture at start point
- Posture at target position

**In moving from P1 → P2, if the robot is passing the singular point (J5 axis = 0°) or a location in the vicinity at a constant posture, the J4 axis on the robot will rotate at high speed and be unable to pass through it.**

### Other functions

#### Other functions

### Orthogonal compliance control
- This function reduces the rigidity of the robot arm and tracks external forces. The robot itself is equipped with a compliance function, which makes special grippers and sensors unnecessary.
- This allows the amount of force generated through interference during chucking and workpiece insertion to be reduced and external movement copying forces to be controlled.
- The compliance direction can be set arbitrarily using the robot coordinate system, the tool coordinate system, etc.
- This is useful in protecting against workpiece interference and cutting down on stoppage.

#### What a singular point is:
- The robot can be operated at an assigned position and posture under normal conditions.
- Position data from a joint coordinate system are used.
- The singular point is the point at which the robot cannot be operated at an assigned position and posture under normal conditions.

**Posture at start point**

**Posture at target position**

**J4 axis rotation**

**In moving from P1 → P2, if the robot is passing the singular point (J5 axis = 0°) or a location in the vicinity at a constant posture, the J4 axis on the robot will rotate at high speed and be unable to pass through it.**

### Improved accuracy

#### Operating mode setting function
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**How to cancel operations due to the presence of the singular point:**
- Posture at start point
- Posture at target position

**In moving from P1 → P2, if the robot is passing the singular point (J5 axis = 0°) or a location in the vicinity at a constant posture, the J4 axis on the robot will rotate at high speed and be unable to pass through it.**

### Improved accuracy

#### Operating mode setting function
- Trajectory priority mode/speed priority operation can be set in programs to match customer system requirements.
- Optimal motor control tuning set automatically based on robot operating position, posture, and load conditions.
- Improves tracking accuracy for the target trajectory.
- This is effective when traveling straight and sealing work requiring high accuracy.

### Orthogonal compliance control
- This function reduces the rigidity of the robot arm and tracks external forces. The robot itself is equipped with a compliance function, which makes special grippers and sensors unnecessary.
- This allows the amount of force generated through interference during chucking and workpiece insertion to be reduced and external movement copying forces to be controlled.
- The compliance direction can be set arbitrarily using the robot coordinate system, the tool coordinate system, etc.
- This is useful in protecting against workpiece interference and cutting down on stoppage.

**How to cancel operations due to the presence of the singular point:**
- Posture at start point
- Posture at target position

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Greater advances in intelligent technology

Robot mechanism temperature compensation function

- Monitors the robot arm temperature and automatically compensates for deviations caused by thermal expansion in the arm.
- Positional errors due to thermal expansion in the arm when seasonal or time-period-related temperature changes arise are reduced to 1/5th* of previous levels.
  (Under Mitsubishi Electric measurement conditions)
*It may change depends on models and environment around the robot.

Range error relative to start position

![Graph showing range error relative to start position](image)

- Thermal expansion estimated and corrected

Coordinated control for additional axes

- Allows synchronized operation where a robot is installed on an additional axis (linear axis) and its speed relative to the workpiece is specified.
- Supports machining of large workpieces using linear, circular or spline interpolation that exceeds the robot's range of movement.

- Allows synchronized operation where tracking of the robot and workpieces on an additional axis (linear axis) is specified.
- Linear or circular interpolation while the workpiece is being transported allows operations such as precision sealing work and surface inspections.
Automatic calibration

Commands for calibrating the robot and 2D vision are included. This automates the teaching work required for existing calibration and allows calibration to be conducted using robot programs. A function is also provided that uses screen deviation to compensate for vision sensor mounting error, ensuring more accurate calibration.

<table>
<thead>
<tr>
<th></th>
<th>Current method (manual)</th>
<th>Automatic calibration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working time (minutes)</td>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td>Calibration accuracy (mm)</td>
<td>±0.2</td>
<td>±0.05</td>
</tr>
</tbody>
</table>

(Mitsubishi Electric measurements)

Workpiece coordinate calibration

Features 2D vision sensors mounted on the robot gripper and commands that calibrate work coordinates defined on the work palette, automating the teaching work required for existing calibration and allowing calibration to be conducted using robot programs. This simplifies tasks such as the calibration of work palettes and robots installed on dollies or automated guided vehicles (AGVs).

Inter-robot relational calibration

Coordinated work can be simplified by running robot programs to calibrate workpiece coordinates that are shared among multiple robots fitted with 2D vision sensors on their grippers.
Preventive Maintenance

Preventive maintenance function

Maintenance simulation
The maintenance component replacement timing and component overhaul maintenance timing are estimated. This estimated information can be used to review the maintenance cycle beforehand, and to verify operation to long-life of the robot.

Consumption degree calculation function
The wear degree of drive components (grease, timing belt, reduction gears, ball screw/ball spline, bearings) is estimated from the robot operation status. Efficient maintenance is supported by notifying the maintenance timing (with dedicated signal outputs, warning outputs), and by deciding the maintenance priority, etc.

Support for building maintenance system
Various maintenance data can be used in the robot program, and can be output to an IT system or GOT. Smart Plus helps build a maintenance system suitable for your system.

RT ToolBox3 (Preventive Maintenance screen)

The robot status can be quickly checked on the Preventive Maintenance screen.

Details screen for calculating wear degree

The wear degree of maintenance components and overhaul components is color-coded, so components needing replacement can be quickly identified.

Maintenance Simulation Details screen

The maintenance timing can be predicted with pre-operation simulation.
Wear degree calculation function

Streamlined maintenance matching the usage conditions is supported by “visualizing” the component's wear degree.

Feature

See the wear degree of key components
Kinetic models and drive data are used to calculate the physical quantities (force, speed, etc.) applied on the target components (grease, timing belt, reduction gears, ball screw/ball spline, bearings). The wear degree of each component is calculated by comparing these quantities with the component's life expression.

Receive notice on the appropriate maintenance timing
“Warnings” and “general-purpose signal outputs” can be issued at the maintenance timing.

Maintenance simulation

Learn the robot maintenance timing before starting operations

Feature

Maintenance timing is estimated based on the operation
The maintenance timing is calculated estimating that the designated motion (range designated in robot program) is repeated.

Review of robot-friendly motion is supported
The robot life can be estimated with offline simulations. Operations can be verified while changing the operation program, while taking the cycle and life into consideration.

Coordination with host devices

Collectively manage the robot's maintenance data with a host system

Feature

Supporting a diverse maintenance system configuration
The maintenance information is held as status variables. This maintenance data can be used in the robot program, and can be retrieved from a host device using communication middleware.
The seamless integration of machines enables flexible manufacturing tailored to the type of production. This improves productivity and maintainability and can reduce the TCO (Total Cost of Ownership).

**iQ Platform**
- Collaboration with MELSEC Q series/MELSEC iQ-R series realizes more advanced work
- Shorter I/O processing times due to faster communication between CPUs
- PLC management allows large volumes of information to be sent to and from robots in real time
- Allows direct read/write operations to memory shared between robot CPUs

**CC-Link IE Field/SLMP**
Allows seamless data communication from production management down to the level of devices

**GOT integration**
- Provides easy recipe management through checking of robot operations and information, data collection and setup switching
- Integrates production site operations with the GOT for improved operation and maintainability

**Maintenance**
Information before and after errors occur (state changes, I/O, external system variables, etc.) and program run states can be saved as log data, simplifying error identification.

**Easier robot information management**
Data specific to robot mechanisms is recorded and saved inside the mechanisms, simplifying maintenance.
iQ Platform

Integration with the MELSEC iQ-R series PLCs enables more advanced tasks.

Better responsiveness due to faster communications

<table>
<thead>
<tr>
<th>MELSEC Q Series</th>
<th>MELSEC iQ-R Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data exchange cycle among CPUs</td>
<td>888μs</td>
</tr>
<tr>
<td>Data exchange cycle among CPUs</td>
<td>222μs</td>
</tr>
</tbody>
</table>

Shorter I/O processing times due to faster CPU data communication

Large volumes of data

- Expanded shared memory area

PLC management allows large volumes of information to be sent to and from robots in real time.

Direct communication between CPU units

- Improved synchronization
- Less wasted time

Allows direct read/write operations to memory shared between robot CPUs. Less wasted time because large amounts of data can be shared.

Batch management of multiple robots

Robots on the PLC network can be accessed from a computer connected to the main CPU. Allows shorter startup times for robots on the production line and improved maintenance.

Robots 1, 2 and 3 can be monitored from one location

- USB
- Ethernet, or serial communication can be used to access other stations

CC-Link IE Field/SLMP

- Compatible with CC-Link IE Field and SLMP
- Allows seamless data communication system-wide, from the production management level down to the device level.
- Allows simple connection using just LAN cables.
- Enables general-purpose Ethernet devices compatible with SLMP (vision sensors, etc.) to be used with robot programs.
- Allows robot information (device information) to be collected from higher level devices.

Various network options

The various network options allow connection to a variety of devices.

Standard equipment:
- Ethernet
- USB
- SSCNET III
- Link IE Field Basic (VerA1d or later)

Option:
- CC-Link
- Profibus
- DeviceNet
- Network base card (CC-Link IE Field EtherNet/IP, PROFINET, EtherCAT)
Enhanced cooperation with FA products

GOT integration

The GOT integration function makes it easy to use features such as recipe functions through setup switching, data collection and checking of robot operations and information. Production site HMIs can be integrated with GOT to help improve operation and maintainability.

GOT backup/restore functions

Data such as robot programs and parameters can be saved (backed up) onto the GOT SD card or USB memory stick using the GOT backup and restore function. By backing up the GOT beforehand, operation can be restored with the GOT with no need for a personal computer (GT21 and higher). This greatly improves serviceability. The situation is saved even when an unexpected error occurs. This helps prevent data from being lost due to the empty battery or robot malfunction.

Shared memory expansion

Enhanced efficiency of monitoring and maintenance operations onsite using a single GOT (display device) as the Human Machine Interface (HMI).

Example of GOT display

Enables the robot to be controlled from the GOT even without a teaching box. Current robot position data, error information, etc. can be displayed easily on the GOT.

Internal robot information

• Error, variable, and program information
• Robot status (Current speed, current position, etc.)
• Maintenance information (Remaining battery capacity, grease life, etc.)
• Servo data (Load factor, current values, etc.)

Sample image files can be downloaded from the Mitsubishi Electric FA website.

Recipe function

This enables you to store data for each product in GOT and then write only the required data to a PLC, which simplifies the process of changing the setup for very varied manufacturing lines.

GOT connection (transparent function)

Programs and parameters can be edited from the USB interface on the front of the GOT using a transparent function for improved operability. (For GT21 or better)

GOT backup/restore functions

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Device monitoring function

Allows the status of FA equipment such as PLCs, motion controllers, robot controllers and CNCs to be checked without a computer. Useful for tasks such as starting up devices.

Logging & graphs list

Uses GOT to collect and display data from equipment such as PLCs and robots. Data can be checked in readily understandable graphs and lists, allowing early identification and analysis of the causes when faults occur.
Support for the “e-F@ctory” FA integrated solution

Robot information can be sent to the MES database server using PLCs and MES interface units. The simple system construction allows you to obtain the robot production information (using the device allocation function).

Simple connection and integration of various types of FA devices (PLCs, GOT, servos, etc.). The GOT MES interface function can be used to integrate various types of information from FA devices, including robots, thereby improving productivity and maintainability.

Maintenance (log function)

Robot information before and after an error occurs, and the program execution status can be automatically sent to the FTP server or saved on an SD card as log data. The operation log can also be retrieved, so causes of errors can be analyzed efficiently. (RT ToolBox3 is required.)

Easier robot information management

Memory is included in the robot body and used to store robot-specific information. This makes it easy to switch robot controllers. Information can also be collected without visiting the workplace, simplifying the formulation of maintenance plans.
**Improved safety through collaborative work applications**

Safety functions ensure that automation is simpler, safer and more user-friendly.

Collaborative human-machine operation support that includes safety options allows working areas to be used jointly by people and robots. This ensures that factories provide both productivity and flexibility.

*Customers must conduct risk assessments.*

### Safety monitoring function

Safety features are provided that make risk assessment easier.

### Safe I/O

Supports safe system connection through duplicated safe I/O (8 inputs and 4 outputs)

### Position monitoring function

- Monitors robot positions
- Monitors movement into designated areas (8 locations)

### Speed monitoring function

- Monitors robot speeds
- Also capable of monitoring each of the speed components in the X, Y and Z directions for the monitoring point

### Safety logic editing

Allows the working parameters (logic) of the safety monitoring function to be defined.

### Collision detection function

Detects robot arm collisions as a standard function during teaching or operation. Minimizes damage to equipment such as robot arms, workpieces and grippers.
Operators can enter an operation area without stopping robots.

- High safety compliant with international standards
- Robot’s automatic operation continues even with a safety fence opened.
  The safety input function enables safety doors to open without causing an emergency stop of the robot.
- Operators and robots share an operation area. = They can cooperate.
  While an operator is in a cooperative operation area, a robot does not approach the area. (Operation range limit function)
- Robots in cooperative operation keeps the safety speed.
  A robot in cooperative operation continues its operation at the safety speed to secure operator’s safety.
- Robots can automatically shift to single operation from cooperative operation.
  Closing the safety door switches cooperative operation to single operation, and enables the robot to approach to the shared area.

*Risk assessment and safety level proof need to be performed for the system. Please contact us if you require any further information.

### Examples of safety options

- The operator operation area and robot operation area are separated each other with a monitoring plane for safety.
- An operator and a robot access the shared operation area alternately, allowing for cooperative operation with a robot and an operator.
- 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.

<Explanation>
- While the operator enters the limit area, the robot operation speed is limited.
- While the operator enters the stop area, the robot stops its operation.

<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.
Safety features compliant with the requirements of international standards are provided that make risk assessment easier.

### Safety monitoring function

<table>
<thead>
<tr>
<th>Safety feature</th>
<th>Details</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>STO function</td>
<td>Electrically shuts off power to the motors in the robot body</td>
<td>IEC 61800-5-2, category 4, PLe, SIL3&lt;sup&gt;1&lt;/sup&gt; Supported as standard</td>
</tr>
<tr>
<td>SLS function</td>
<td>Monitors the TCP speed so that it does not exceed the monitoring speed.</td>
<td>EN61800-5-2-compliant Supported in combination with each safety option</td>
</tr>
<tr>
<td>SLP function</td>
<td>Monitors a specified monitoring position so that it does not go beyond the position monitoring surface.</td>
<td>EN61800-5-2-compliant</td>
</tr>
<tr>
<td>SOS function</td>
<td>Monitors the robot to ensure that it does not move from its stopped position</td>
<td>EN61800-5-2-compliant</td>
</tr>
<tr>
<td>SS1 function</td>
<td>Function stopped by STO</td>
<td>IEC 60204-1 stop category 1</td>
</tr>
<tr>
<td>SS2 function</td>
<td>Function stopped by the SOS</td>
<td>IEC 60204-1 stop category 2</td>
</tr>
</tbody>
</table>

<sup>1</sup> Parameter setting is required.

### Safe I/O

Expands duplicated safe I/O to 8 inputs and 4 outputs. Allows the construction of various different safety systems.

### Position monitoring function

- Monitors robot positions.
- Monitors movement into designated areas in up to 8 locations.

### Speed monitoring function

- Monitors robot speeds
- Monitors designated monitoring points on the robot arm and gripper to ensure that they do not exceed the monitoring speed.

- Also allows monitoring of each of the X-, Y- and Z-direction components for each monitoring point.
  By setting a low monitoring speed in the system for directions in which the robot does not move, safe distances can be made smaller to create compact cells safely.

---

**Usage scenarios**

**Safety**

[Safe, collaborative work applications]

Improved safety through collaborative work applications

**Safety**

**barrier**

**Robot movement direction/speed**

**Low monitoring speed set for forward-backward robot movement**

**Small safe distance (more compact)**

---

**RT ToolBox3**

Monitors robot positions.

**Lamp Area sensor Laser scanner**

**Teaching box**

**Robot controller**

Areas designated for position monitoring (up to 8 can be specified)

---

**Safe I/O**

**Position monitoring function**

**Speed monitoring function**

---

**Robot**

**Areas designated for position monitoring**

---

**Safety barrier**

**Without speed monitoring**

**With speed monitoring**

---

**Robot**

**Robot movement direction/speed**

---

**RT ToolBox3**

**Lamp Area sensor Laser scanner**

**Teaching box**

**Robot controller**

Areas designated for position monitoring (up to 8 can be specified)
Safety features compliant with the requirements of international standards are provided that make risk assessment easier. Expands duplicated safe I/O to 8 inputs and 4 outputs. Allows the construction of various different safety systems.

Safety logic editing

The logic for each safe I/O can be edited. Safety logic editing makes it easier to construct and operate safe systems. Because it allows you to freely define the operating parameters (logic) for the safety monitoring functions in the robot controller, you can configure the safety monitoring conditions without having to use a safety CPU.

By configuring the parameters in the editing screen, you can use various different types of monitoring. For example, in area monitoring, specified functions operate in response to the robot position, while in interlock monitoring, specified safety functions operate according to the the positions of other robots.

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Usage scenarios

The robot arm enters the machining area

“Slow movement”

The robot arm enters the transportation area

“Emergency stop”

Light curtain

Collision detection function (Standard feature)

Collision detection function

- This function detects if the arm collides with an obstacle while teaching or operating, and helps reduce damage to the robot arm and tools.
- The collision detection function can be used to protect the workpiece from becoming damaged due to interference between the workpiece and affected objects.
- The detection level can be changed according to the protection targets.
- Operation following collision detection can be programmed to suit the circumstances.
- E.g.) Stop immediately and post an error; retract and then post an error, etc.

- Reduce tooling costs
- Shorten line stop times
- Reduce maintenance costs

Safety logic editing screen

Safety barrier

Robot movement direction/speed

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- Reduce tooling costs
- Shorten line stop times
- Reduce maintenance costs
As well as providing a more complete set of commands, this uses structured programming to give high levels of reusability and readability.

MELFA BASIC VI

This is computer software to assist with a range of tasks from system startup through to debugging and operation. This includes creating and editing programs, checking the operating environment prior to robot installation, estimating cycle times, debugging when robots are started up, monitoring robots states once they are running and monitoring faults.

Its features include a ribbon bar, output window and docking pane, making information easier to see and the software easier to use. Operations in the 3D monitor screen have also been updated to make using the screen more intuitive.

Program editing and debugging

Auto-complete and fold functions make programming easier to use.

Simulation function

Simulation that includes features such as robot dynamics and servo responses as well as robot controller emulation allows realistic simulations that include motor loading, tracking and positioning times.
As well as providing a more complete set of commands, this uses structured programming to give high levels of reusability and readability.

**Structured programming**
Allows structured programs, enabling programming with high levels of reusability and readability. (Also supports existing programming methods.)

**Library function**
Keeping a library of program processing allows knowledge to be accumulated and provides improved reusability. The libraries can also be hidden to prevent knowledge from being disclosed.

---

**3D viewer**
The 3D viewer can be used to check the robot attitude and operation and to visually check information such as limit values for user-defined areas, etc.

**Real time external control**
Robot movement can be controlled from the computer using synchronous units.

**Melfa RXM.ocx communications middleware**
Allows RT ToolBox functions to be run from computer applications.

**Monitoring functions**
As well as monitoring program run states, variables, input/output signals and other events, these functions can show graphs of robot operation waveforms (speeds and current values) and I/O states in real time. This makes it easy to see the correlation between program execution steps and waveform data, making debugging markedly more efficient.
Compact body and slender arms cover large work areas. An ideal robot for compact cell construction. Perfect for transporting, assembling and inspecting small components.

- Among the fastest moving robots in its class
  [Max. composite speed: 5.0 m/s] (RV-2FR)
- Standard cycle time
  [0.6 second range] (RV-2FR)
- Pivotal operating range: ±240°
- Environmental specifications [standard: IP30]
- Standards compliance
  Compliant with European Machinery Directives (CE) as standard. Compliance with other standards is available in specialized machines. Contact Mitsubishi Electric for details.

### Specifications

<table>
<thead>
<tr>
<th>Type</th>
<th>Unit</th>
<th>RV-2FR (B)</th>
<th>RV-2FRL (B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental specifications</td>
<td></td>
<td>Standard</td>
<td></td>
</tr>
<tr>
<td>Protection degree</td>
<td></td>
<td>IP30</td>
<td></td>
</tr>
<tr>
<td>Installation</td>
<td></td>
<td>Floor type, ceiling type, [wall-mounted type *2]</td>
<td></td>
</tr>
<tr>
<td>Structure</td>
<td></td>
<td>Vertical multiple-joint type</td>
<td></td>
</tr>
<tr>
<td>Degrees of freedom</td>
<td></td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Drive system *1</td>
<td></td>
<td>AC servo motor *(J2, J3 and J6, with brake)</td>
<td></td>
</tr>
<tr>
<td>Position detection method</td>
<td></td>
<td>Absolute encoder</td>
<td></td>
</tr>
<tr>
<td>Maximum load capacity</td>
<td>kg</td>
<td>Maximum 3 (Rated 2) *5</td>
<td></td>
</tr>
<tr>
<td>Arm length</td>
<td>mm</td>
<td>230±70</td>
<td>310±335</td>
</tr>
<tr>
<td>Maximum reach radius</td>
<td>mm</td>
<td>604</td>
<td>649</td>
</tr>
<tr>
<td>J1, J2, J3, J4, J5, J6</td>
<td>deg</td>
<td>240 (-120 to +120)</td>
<td>237 (-117 to +120)</td>
</tr>
<tr>
<td>Maximum speed</td>
<td>deg/sec</td>
<td>300</td>
<td>225</td>
</tr>
<tr>
<td>J1, J2, J3, J4, J5, J6</td>
<td></td>
<td>150</td>
<td>165</td>
</tr>
<tr>
<td></td>
<td></td>
<td>300</td>
<td>165</td>
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<tr>
<td></td>
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<tr>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>720</td>
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</tr>
<tr>
<td>Maximum composite speed *3</td>
<td>mm/sec</td>
<td>4955</td>
<td>4200</td>
</tr>
<tr>
<td>Cycle time *4</td>
<td>sec</td>
<td>0.6</td>
<td>0.7</td>
</tr>
<tr>
<td>Position repeatability</td>
<td>mm</td>
<td>±0.02</td>
<td></td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>°C</td>
<td>0 to 40</td>
<td></td>
</tr>
<tr>
<td>Mass</td>
<td>kg</td>
<td>19</td>
<td>21</td>
</tr>
<tr>
<td>Tolerable amount of inertia</td>
<td>kgm²</td>
<td>0.18</td>
<td>0.18</td>
</tr>
<tr>
<td>J4, J5, J6</td>
<td></td>
<td>4.17</td>
<td>4.17</td>
</tr>
<tr>
<td>Tolerable moment</td>
<td>Nm</td>
<td>2.45</td>
<td></td>
</tr>
<tr>
<td>J4, J5, J6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tool wiring</td>
<td></td>
<td>Gripper: 4 input points/4 output points</td>
<td></td>
</tr>
<tr>
<td>Tool pneumatic pipe</td>
<td></td>
<td>Signal cable for the multi-function gripper</td>
<td></td>
</tr>
<tr>
<td>Machine cable</td>
<td></td>
<td>5m (connector on both ends)</td>
<td></td>
</tr>
<tr>
<td>Connected controller *6</td>
<td></td>
<td>CR800-D, CR800-R, CR800-Q</td>
<td></td>
</tr>
</tbody>
</table>
Perfect for transporting, assembling and inspecting small components.

An ideal robot for compact cell construction.

Compact body and slender arms cover large work areas.

Contact Mitsubishi Electric for details.

**RV-2FR**

- **Robot structure**: RV: Vertical, multiple-joint type
- **Maximum load capacity**: 2kg
- **Series**: FR: FR series

**Controller type**
- D: CR800-D
- R: CR800-R
- Q: CR800-Q

**Brake specification**
- Blank: No brake for J1, J4 and J6 axes
- B: All axis with brake

**RV-2FRL**

- **Robot structure**: RV: Vertical, multiple-joint type
- **Maximum load capacity**: 2kg
- **Series**: FR: FR series

**Controller type**
- D: CR800-D
- R: CR800-R
- Q: CR800-Q

**Brake specification**
- Blank: No brake for J1, J4 and J6 axes
- B: All axis with brake

**Arm length**
- Blank: Standard arm
- L: Long arm

*1: The standard model does not have a brake on the J1, J4, or J6 axes. There are models available with brakes included for all axes.

*2: The wall-mounted specification is a custom specification where the operating range of the J1-axis is limited.

*3: This is the value at the surface of the mechanical interface when all axes are composited.

*4: The cycle time is based on back-and-forth movement over a vertical distance of 25 mm and horizontal distance of 300 mm when the load is 1 kg.

*5: The maximum load capacity indicates the maximum payload when the mechanical interface is facing downward (±10° to the perpendicular).

*6: Select a controller according to the application. CR800-D: Standalone type, CR800-R: MELSEC iQ-R compatible type, CR800-Q: MELSEC Q compatible type.

*Operating range limit
When the J1-axis angle is inside the range of -75°<J1<70° and the J2-axis angle is J2<-110°, operating range of the J3-axis is limited to 80°<J3.

Contact Mitsubishi Electric for details.

I

[0.6 second range](RV-2FR)

(Max. composite speed: 5.0 m/s)(RV-2FR)

I

**Contact Mitsubishi Electric for details.**

Tolerable amount

Connected controller *6

Machine cable

Tool pneumatic pipes

Tool wiring

Tolerable moment

Mass

Ambient temperature

Position repeatability

Cycle time *4

Maximum composite speed *3

Operating range

- Maximum reach radius
- Arm length
- Maximum load capacity
- Position detection method

Structure

Installation

Protection degree

Environmental specifications

Standards compliance

Environmental specifications [standard: IP30]

Pivotal operating range: ±240°

Standard cycle time

Compliant with European Machinery Directives (CE) as standard.
Cutting-edge servo control and optimized arm construction provide extremely fast and precise heavy-duty operation. Flap-style arms provide a range of movement ideally suited to compact areas. The use of space is highly efficient. Perfect for transporting, assembling and inspecting small components.

- Among the fastest moving robots in its class  
  [Max. composite speed: 9.0 m/s]
- Standard cycle time  
  [0.36 s]
- Pivotal operating range: ±240°
- Environmental specifications  
  [standard: IP40; oil mist: IP67; cleanroom: ISO class 3]
- Standards compliance  
  Compliant with European Machinery Directives (CE) as standard. Compliance with other standards is available in specialized machines. Contact Mitsubishi Electric for details.

### Specifications

<table>
<thead>
<tr>
<th>Type</th>
<th>Unit</th>
<th>RV-4FR (M) (C)</th>
<th>RV-4FRL (M) (C)</th>
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<td>Floor type, ceiling type, (wall-mounted type)*2</td>
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<td>kg</td>
<td>Maximum 4 (Rated 3)*3</td>
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<tr>
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<td></td>
</tr>
<tr>
<td>J1</td>
<td></td>
<td>480 (-240)</td>
<td>300 (-240)</td>
</tr>
<tr>
<td>J2</td>
<td></td>
<td>240 (-120 to +120)</td>
<td>160 (-120 to +120)</td>
</tr>
<tr>
<td>J3</td>
<td></td>
<td>181 (-0 to +181)</td>
<td>164 (-0 to +164)</td>
</tr>
<tr>
<td>J4</td>
<td></td>
<td>400 (-200)</td>
<td>240 (-200)</td>
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<tr>
<td>J5</td>
<td></td>
<td>240 (-120 to +120)</td>
<td>160 (-120 to +120)</td>
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<td>J6</td>
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<td>720 (-360)</td>
<td>480 (-360)</td>
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<tr>
<td>J1</td>
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<tr>
<td>J2</td>
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<td>450</td>
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<td>J3</td>
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<td>J6</td>
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<tr>
<td>Tool wiring</td>
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<td>Gripper: 8 input points/8 output points</td>
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<td>Signal cable for the multi-function gripper and sensors</td>
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<td></td>
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<td>LAN x 1 +100 BASE-TX&gt; -3</td>
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<td>Tool pneumatic pipes</td>
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<td>Primary: ø4 x 2 Secondary: ø4 x 8, ø4 x 4 (from base portion to forearm)</td>
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<tr>
<td>Machine cable</td>
<td></td>
<td>5m (connector on both ends)</td>
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</tr>
<tr>
<td>Connected controller *6</td>
<td></td>
<td>CR800-D, CR800-R, CR800-Q</td>
<td></td>
</tr>
</tbody>
</table>
External Dimensions/Operating Range Diagram

RV-4FR

Motion space at point P

For internal gripper wiring and piping specifications: (SH**)

Limits on operating range for the rear (*1)

Motion space at point P

Wrist’s downward limit

Control point (R point) for SH** specifications

RV-4FRL

Motion space at point P

For internal gripper wiring and piping specifications: (SH**)

Limits on operating range for the rear (*1)

Motion space at point P

Wrist’s downward limit

Control point (R point) for SH** specifications

Mounting cable specifications (*1)

Devices that can be mounted

- SH01
- SH02
- SH03
- SH04
- SH05

Model (machine no.)

Air 4

Gripper input & points

*1: The J6 axis range of motion is ±200deg. Protection level is IP40.

*2: Limits on the operating range for the back and side parts: When the J1-axis angle is inside the range of -35°<J1<+35°, the operating range of the J2-axis is limited to -114°<J2<+120°.

*3: Make sure to leave enough space open for removing and attaching covers during maintenance work.

*4: Specify a thread engagement length of 7.5 to 8 mm.

*5: Value for a 25mm up/down and 300mm horizontal reciprocal movement with 1kg load. The cycle time is the value for RV-4FR-R and RV-4FRL-R.

*6: Make sure to leave enough space open for cable connections between devices.

*7: Make sure to leave enough space open for removing and attaching covers during maintenance work.

*8: Limits on the operating range for the back and side parts: When the J1-axis angle is inside the range of -35°<J1<+35°, the operating range of the J2-axis is limited to -114°<J2<+120°.

*9: Please contact our sales offices if you request a five axes long arm model.

RV - 4 F R L | D |

Special device No.

SFloC Internal wiring specifications

Controller type

D: CR800-D
R: CR800-R
Q: CR800-Q

Environment specification

Blank: Standard specifications
M: Oil mist specifications
C: Cleanroom specifications

Robot structure

RV: Vertical, multi-joint type
FR: FR series
L: Long arm

Maximum load capacity

4: 4kg

Series

Blank: Standard arm
L: Long arm

For details, refer to the specifications sheet.

1. The J6 axis range of motion is ±200deg. Protection level is IP40.

2. Make sure to leave enough space open for cable connections between devices.

3. Make sure to leave enough space open for removing and attaching covers during maintenance work.

4. This is the value at the surface of the mechanical interface when all axes are composited.

5. This is the value for RV-4FR-R and RV-4FRL-R.

6. This can also be used as a spare wire [0.18sq-4-pair wire]. The wire is prepped up to inside the forearm.

7. Preserves cleanliness levels depend on conditions of a downstream flow of 0.3 m/s in the cleanroom and internal robot auctioning. A 8-6 mm coupler for suctioning is provided at the back of the base.

8. The maximum load capacity indicates the maximum payload when the mechanical interface is facing downward (±10° to the perpendicular).

9. Make sure to leave enough space open for cable connections between devices.
Cutting-edge servo control and optimized arm construction provide extremely fast and precise heavy-duty operation. Increased range of movement along each axis and slender arms to cover large work areas. An ideal robot for compact cell construction. The product line includes a model with a maximum reach radius of 1503 mm for a larger operating range.

- Among the fastest moving robots in its class
  [Max. composite speed: 11.0 m/s (RV-7FR)]
- Standard cycle time [0.32 s (RV-7FR)]
- Pivotal operating range: ±240° (RV-7FR/7FRL)

**Environmental specifications**
- [standard: IP40; oil mist: IP67; cleanroom: ISO class 3]
- Standards compliance
  - Compliant with European Machinery Directives (CE) as standard.
  - Compliance with other standards is available in specialized machines.

**Specifications**

<table>
<thead>
<tr>
<th>Type</th>
<th>Unit</th>
<th>RV-7FR (M) (C)</th>
<th>RV-7FRL (M) (C)</th>
<th>RV-7FRLL (M) (C)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Environmental specifications</strong></td>
<td></td>
<td>Standard Oil mist/ Cleanroom</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Installation</strong></td>
<td></td>
<td>Floor type, ceiling type, (wall-mounted type)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Degrees of freedom</strong></td>
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<td>6</td>
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<tr>
<td><strong>Position detection method</strong></td>
<td></td>
<td>Absolute encoder</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Maximum load capacity</strong></td>
<td>kg</td>
<td>7</td>
<td></td>
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<td><strong>Arm length</strong></td>
<td>mm</td>
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<td>435±470</td>
<td>565±805</td>
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<td><strong>Maximum reach radius</strong></td>
<td>mm</td>
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<td>908</td>
<td>1503</td>
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<td><strong>Operating range</strong></td>
<td>deg</td>
<td>360</td>
<td>288</td>
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<tr>
<td><strong>Maximum speed</strong></td>
<td>deg/sec</td>
<td>401</td>
<td>321</td>
<td>164</td>
</tr>
<tr>
<td><strong>Maximum composite speed</strong></td>
<td>mm/sec</td>
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<td>10977</td>
<td>15300</td>
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<td><strong>Cycle time</strong></td>
<td>sec</td>
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<td>0.35</td>
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<td><strong>Position repeatability</strong></td>
<td>mm</td>
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<td>±0.06</td>
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<td><strong>Ambient temperature</strong></td>
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<td>0 to 40</td>
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<tr>
<td><strong>Mass</strong></td>
<td>kg</td>
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<td>67</td>
<td>130</td>
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<tr>
<td><strong>Tolerable moment</strong></td>
<td>Nm</td>
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<td>16.2</td>
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<tr>
<td><strong>Tolerable amount of inertia</strong></td>
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<td>0.45</td>
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<tr>
<td><strong>Test wire</strong></td>
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<tr>
<td><strong>Test pneumatic pipes</strong></td>
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<tr>
<td><strong>Machine cable</strong></td>
<td>5m</td>
<td>(connector on both ends)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*1: Please contact Mitsubishi Electric dealer since the environmental resistance may not be secured depending on the characteristics of oil you use.
*2: The wall-mounted specification is a custom specification where the operating range of the J1-axis is limited.
*3: The value at the surface of the mechanical interface when all axes are composed.
*4: Value for a 25mm upward and 300mm horizontal reciprocal movement with 1kg. The cycle time is the value for RV-7FR-R, RV-7FRL-R, RV-7FRLL-R.
*5: Can be also used as a spare line (0.13 sq. mm, 4-pair cable) for conventional models.
*6: Select either controller according to your application. CR800-D: Standalone type. CR800-R: MELSEC iQ-R compatible type. CR800-Q: MELSEC Q Series compatible type.
*7: Preservation of cleanliness levels depends on conditions of a downstream flow of 0.3 m/s in the cleanroom and internal robot suctioning. A ø8-mm coupler for suctioning is provided at the back of the base.
*8: The maximum load capacity indicates the maximum payload when the mechanical interface is facing downward (±10° to the perpendicular).

**RV-7FR**
- RV-7FR (M) (C) [reference]
- RV-7FRL (M) (C) [reference]
- RV-7FRLL (M) (C) [reference]
### Robot Specifications

**RV-7FR**

- **Type**: RV-7FR (M) (C)
- **Joint (deg/sec)**: J6: ±360°, J5: ±120°, J4: ±200°, J3: 0° to 162°, J2: -110° to 130°, J1: ±240°
- **Maximum speed**: 4.5 m/s
- **Maximum composite speed**: 11.0 m/s
- **Maximum reach radius**: 1503 mm
- **Drive system**: Absolute encoder
- **Environment specification**: Oil mist/Cleanroom, 6 mm (Standard), 12 mm (Oil mist) 8 mm (Cleanroom)
- **Connection**: CR800-D, CR800-R, CR800-Q
- **Gripper specifications**: 8 input points, Signal cable for the multi-function gripper, LAN × 1 <100 BASE-TX> *5

**RV-7FRL**

- **Type**: RV-7FRL (M) (C)
- **Joint (deg/sec)**: J6: ±360°, J5: ±120°, J4: ±200°, J3: 0° to 162°, J2: -110° to 130°, J1: ±240°
- **Maximum speed**: 4.5 m/s
- **Maximum composite speed**: 11.0 m/s
- **Maximum reach radius**: 1503 mm
- **Drive system**: Absolute encoder
- **Environment specification**: Oil mist/Cleanroom, 6 mm (Standard), 12 mm (Oil mist) 8 mm (Cleanroom)
- **Connection**: CR800-D, CR800-R, CR800-Q
- **Gripper specifications**: 8 input points, Signal cable for the multi-function gripper, LAN × 1 <100 BASE-TX> *5

**RV-7FRLL**

- **Type**: RV-7FRLL (M) (C)
- **Joint (deg/sec)**: J6: ±360°, J5: ±120°, J4: ±200°, J3: 0° to 162°, J2: -110° to 130°, J1: ±240°
- **Maximum speed**: 4.5 m/s
- **Maximum composite speed**: 11.0 m/s
- **Maximum reach radius**: 1503 mm
- **Drive system**: Absolute encoder
- **Environment specification**: Oil mist/Cleanroom, 6 mm (Standard), 12 mm (Oil mist) 8 mm (Cleanroom)
- **Connection**: CR800-D, CR800-R, CR800-Q
- **Gripper specifications**: 8 input points, Signal cable for the multi-function gripper, LAN × 1 <100 BASE-TX> *5

---

**Note:** For detailed specifications and installation instructions, please refer to the official Mitsubishi Electric documentation or contact their dealers.
Cutting-edge servo control and optimized arm construction provide extremely fast and precise heavy-duty operation. Optimized arm length and 6 joints for a broader range of movement support a wide range of layouts. Designed to withstand environmental conditions, it can be used in a wide range of applications without having to worry about the installation environment. Suitable for various types of work, such as transporting mechanical parts, assembling electrical components and even packaging products such as pharmaceuticals and foodstuffs.

Among the fastest moving robots in its class
[Max. composite speed: 10.5 m/s (RV-13FR)]

Standard cycle time [0.53 s (RV-13FR)]

Pivotal operating range: ±190°

Environmental specifications
[standard: IP40; oil mist: IP67; cleanroom: ISO class 3]

Standards compliance
Compliant with European Machinery Directives (CE) as standard.

Compliance with other standards is available in specialized machines.

Contact Mitsubishi Electric for details.

### Specifications

<table>
<thead>
<tr>
<th>Type</th>
<th>Unit</th>
<th>RV-13FR (M) (C)</th>
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<td>J6 720</td>
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<td>deg/sec</td>
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<td>mm/s</td>
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<td>mm/s</td>
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<td>J5 9700</td>
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<td>mm/s</td>
<td>J6 9700</td>
<td>J6 9700</td>
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<td>LAN x 1 +100 BASE-TXc ~5</td>
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<td>Tool pneumatic pipes</td>
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<td>Secondary: ø6 x 8, ø4 x 4 (from base portion to forearm)</td>
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<td>CRB00-D, CRB00-R, CRB00-Q</td>
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</table>
**External Dimensions/Operating Range Diagram**

**RV-13FR**

- Motion space at point P
- Top view

**RV-13FRL**

- Motion space at point P
- Top view

---

### Mounting cable specifications (**1**)

<table>
<thead>
<tr>
<th>Devices that can be mounted</th>
<th>-SH01</th>
<th>-SH02</th>
<th>-SH03</th>
<th>-SH04</th>
<th>-SH05</th>
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<td>Electric gripper</td>
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**Model (machine no.)**

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<td>○</td>
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**Installation Dimension Detail**

- Shared parts
  - 2×300, height 6
  - 4×14 installation hole
  - 2×190, height 10
- P/C.D. and P/C.T. connectors
  - M12, male (10×20)
  - Female (6×20, 6×25)
- Mechanical Interface Detail (°)

---

### Robot Specifications

**RV-13FRL-D**

- Special device No.
  - Shx: Internal wiring specifications
  - Controller type
    - D: CR800-D
    - R: CR800-R
  - C: CR800-Q
- Environment specification
  - Blank: Standard specifications
  - M: Oil mist specifications
  - C: Cleanroom specifications
- Controller connection
  - LAN × 1 <100 BASE-TX> **5**
  - 2×300, height 6
  - 4×14 installation hole
- Force sensor
- Adapter cable
- Multi gripper
- Vision sensor
- Interior cable

---

**3 Robot Specifications**

---

*1: Operating range for the front and side parts. When the J1-axis angle is inside the range of J1+120° or J1-130°, the operating range of the J2-axis is limited to -90°<J2<+130°.

*2: Make sure to leave enough space open for cable connections between devices.

*3: Value for a 25mm up/down and 300mm horizontal reciprocal movement with 5kg load. The cycle time is the value for RV-13FR-R and RV-13FRL-R.

*4: Refer to the standard specification manual for detailed specification of -SH.

*5: Please contact Mitsubishi Electric dealer since the environmental resistance may not be secured depending on the characteristics of oil you use.

---

**Notes**

1. Operating range for the front and side parts. When the J1-axis angle is inside the range of J1±190° or J1±130°, the operating range of the J2-axis is limited to -90°<J2<+130°.

2. Make sure to leave enough space open for cable connections between devices.

3. Value for a 25mm up/down and 300mm horizontal reciprocal movement with 5kg load. The cycle time is the value for RV-13FR-R and RV-13FRL-R.

4. Select either controller according to your application. CR800-D: Standalone type, CR800-R: MELSEC-Q-R compatible type, CR800-Q: MELSEC Q Series compatible type.

5. The maximum load capacity indicates the maximum payload when the mechanical interface is facing downward (±10° to the perpendicular).
Highly portable RV-F series (maximum load capacity: 20 kg). Cutting-edge servo control and optimized arm construction provide extremely portable and precise heavy-duty operation. Optimized arm length and 6 joints for a broader range of movement support a wide range of layouts. Designed to withstand environmental conditions, it can be used in a wide range of applications without having to worry about the installation environment. Plenty of scope for using multiple grippers or multi-function grippers and capable of handling work such as transporting high-load mechanical parts, assembling electrical components and packaging pharmaceutical products.

- **Standard cycle time [0.7 s]**
- **Pivotal operating range: ±190°**
- **Environmental specifications** [standard: IP40; oil mist: IP67; cleanroom: ISO class 3]
- **Standards compliance**

Compliant with European Machinery Directives (CE) as standard. Compliance with other standards is available in specialized machines. Contact Mitsubishi Electric for details.

### Specifications

<table>
<thead>
<tr>
<th>Type</th>
<th>Unit</th>
<th>RV-20FR (M) (C)</th>
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<tbody>
<tr>
<td>Environmental specifications</td>
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<td>Standard/Oil mist/Cleanroom</td>
</tr>
<tr>
<td>Protection degree</td>
<td></td>
<td>IP40 (standard); IP67 (oil mist); IS0 class 3</td>
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<td>Installation</td>
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<td>Structure</td>
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<tr>
<td>Drive system</td>
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<td>AC servo motor</td>
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<tr>
<td>Position detection method</td>
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<td>Absolute encoder</td>
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<tr>
<td>Maximum load capacity</td>
<td>kg</td>
<td>Maximum 20 (Rated 15)°8</td>
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<tr>
<td>Arm length</td>
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<tr>
<td>Maximum reach radius</td>
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<tr>
<td>Operating range</td>
<td>deg</td>
<td></td>
</tr>
<tr>
<td>J1</td>
<td></td>
<td>380 (±190)</td>
</tr>
<tr>
<td>J2</td>
<td></td>
<td>240 (90 to ±150)</td>
</tr>
<tr>
<td>J3</td>
<td></td>
<td>157.5 (10 to ±157.5)</td>
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<tr>
<td>J4</td>
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<td>400 (±200)</td>
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<tr>
<td>J5</td>
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<td>240 (-120 to +120)</td>
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<tr>
<td>J6</td>
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<td>720 (±360)</td>
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<td>J4</td>
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<td>J4</td>
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<td>J5</td>
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<td>J6</td>
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<td>J4</td>
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<td>1.40</td>
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<td>J5</td>
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<td></td>
<td>Gripper: 8 input points/8 output points</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Signal cable for the multi-function gripper</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LAN x 1 ×100 BASE-TX × 5</td>
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<tr>
<td>Tool pneumatic piping</td>
<td></td>
<td>Primary: ø6 x 2  Secondary: ø6 × 8, ø4 × 4 (from base portion to forearm)</td>
</tr>
<tr>
<td>Machine cable</td>
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<td>5m (connector on both ends)</td>
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<tr>
<td>Connected controller °6</td>
<td></td>
<td>CR800-D, CR800-F, CR800-Q</td>
</tr>
</tbody>
</table>

*1: Please contact Mitsubishi Electric since the environmental resistance may not be secured depending on the characteristics of oil you use.

*2: The wall-mounted specification is a custom specification where the operating range of the J1-axis is limited.

*3: Specify a thread engagement length of 10 to 9mm.

*4: Make sure to leave enough space open for cable connections between devices.

*5: Can also be used as a spare line (0.13 sq. mm, 4-pair cable) for conventional models. Provided up to the inside of the forearm.

*6: Select either controller according to your application. CR800-D: Standalone type, CR800-R: MELSEC iQ-R compatible type, CR800-Q: MELSEC Q Series compatible type.

*7: Preservation of cleanliness levels depends on conditions of a downstream flow of 0.3 m/s in the cleanroom and internal robot suctioning.

*8: The maximum load capacity indicates the maximum payload when the mechanical interface is facing downward (±10° to the perpendicular).
and packaging pharmaceutical products.

High-load mechanical parts, assembling electrical components, using grippers and capable of handling work such as transporting. Plenty of scope for using multiple grippers or multi-function without having to worry about the installation environment. It can be used in a wide range of applications, mental conditions, it can be used in a wide range of applications, specifically for the RV-F series (maximum load capacity: 20 kg).

Compliance with other standards is available in specialized machines.

Specifications

<table>
<thead>
<tr>
<th>Type</th>
<th>RV-20FR (M) (C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drive system</td>
<td></td>
</tr>
<tr>
<td>Structure</td>
<td></td>
</tr>
<tr>
<td>Installation</td>
<td></td>
</tr>
<tr>
<td>Protection degree</td>
<td>IP40 (standard)/ IP67 (oil mist) *1/ ISO class3 *7</td>
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<td>Signal cable for the multi-function gripper</td>
<td>CR800-D, CR800-R, CR800-Q</td>
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<tr>
<td>Primary: ø6 × 2</td>
<td>Secondary: ø6 × 8, ø4 × 4 (from base portion to forearm)</td>
</tr>
</tbody>
</table>

For internal gripper wiring and piping specifications (*SH**)

- SH01
- SH02
- SH03
- SH04
- SH05

Air ø4
Gripper input 8 points
Vision sensor
Force sensor
Electric gripper

*1: Operating range for the front and side parts. When the J1-axis angle is inside the range of J1+150° or J1-150°, the operating range of the J2-axis is limited to -90°<J2<+130°.
*2: Specify a thread engagement length of 10 to 9mm.
*3: Make sure to leave enough space open for cable connections between devices.
*4: Refer to the standard specification manual for detailed specification of -SH.
*5: Operating range for the front and side parts: When the J1-axis angle is inside the range of J1+120° or J1<-130°, the operating range of the J2-axis is limited to -90°<J2<+130°.
*6: Operating range for each axis: J1: ±190° J2: ±120° to 150° J3: -10° to 157.5° J4: ±200° J5: ±120° J6: ±180° J6 when -SH specifications are used: ±200°

---

**RV-20FR**

Robot structure
RV: Vertical, multiple-joint type

Maximum load capacity
20: 20kg

Series
F: FR series

Controller type
D: CR800-D
R: CR800-R
Q: CR800-Q

Environment specification
Blank: Standard specifications
M: Oil mist specifications
C: Cleanroom specifications

---

*1: Please contact Mitsubishi Electric dealer since the environmental resistance may not be secured depending on the characteristics of oil you use.
*2: The wall-mounted specification is a custom specification where the operating range of the J1-axis is limited.
*3: This is the value at the surface of the mechanical interface when all axes are composited.
*4: Value for a 25mm up/down and 300mm horizontal reciprocal movement with 5kg load. The cycle time is the value for RV-20FR-R.
*5: Can also be used as a spare line (Ø13 sq. mm, 4-pair cable) for conventional models. Provided up to the inside of the forearm.
*6: Select either controller according to your application. CR800-D: Standalone type, CR800-R: MELSEC IQ-R compatible type, CR800-Q: MELSEC Q Series compatible type.
*7: Preservation of cleanliness levels depends on conditions of a downstream flow of 0.3 m/s in the cleanroom and internal robot suctioning. A 8mm coupler for suctioning is provided at the back of the base.
*8: The maximum load capacity indicates the maximum payload when the mechanical interface is facing downward (±10° to the perpendicular).
Ideal for compact cell construction, such as assembling or transporting small workpieces.

- Among the fastest moving robots in its class
  - [XY composite: 8,300 mm/s]
  - [J4 (θ axis): 3,000 deg/s]
- Standard cycle time
  - [0.41 s (RH-3FRH35)]
- Pivotal operating range: ±170°
- Environmental specifications
  - [standard: IP20; cleanroom: ISO class 3]
- Standards compliance
  - Compliant with European Machinery Directives (CE) as standard.
  - Compliance with other standards is available in specialized machines.
  - Contact Mitsubishi Electric for details.

### Specifications

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<tr>
<td>Maximum load capacity</td>
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<tr>
<td>Arm length (NO1 arm)</td>
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<td>250</td>
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<td>Arm length (NO2 arm)</td>
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<td>Maximum reach radius</td>
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<td>Maximum composite speed *2</td>
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<td>8300</td>
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<td>0.46</td>
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<td>±0.012</td>
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<td>Tool pneumatic pipes</td>
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<tr>
<td>Connected controller *5</td>
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* *1 Standard/ Cleanroom<br>Postioning method<br>Structure<br>Degrees of freedom<br>Drive system<br>Position detection method<br>Maximum load capacity<br>Arm length<br>Maximum reach radius<br>Operating range<br>Maximum speed<br>Maximum composite speed<br>Cycle time<br>Position repeatability<br>Ambient temperature<br>Mass<br>Tolerable amount of inertia<br>Tool wiring<br>Tool pneumatic pipes<br>Machine cable<br>Connected controller*5<br>
**Transporting small workpieces.**

Ideal for compact cell construction, such as assembling or
disprocessing small workpieces. Compliance with other standards is available in specialized machines.

- **Standard:** IP20; **Cleanroom:** ISO class 3
- **Axis:** 3,000 deg/s
- **J1:** 3,000 deg/s
- **J2:** 3,000 deg/s
- **J3 (Z):** 3,000 deg/s
- **J4:** 11,200 mm/sec
- **XY composite:** 8,300 mm/sec
- **NO2 arm:** 3,000 deg/s
- **NO1 arm:** 3,000 deg/s

### Specifications

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<tr>
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<th>Maximum</th>
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<table>
<thead>
<tr>
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<tbody>
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<td>RH: Horizontal, multiple-joint type</td>
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<tr>
<td>FRH: FR series</td>
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<td>3: 3kg</td>
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**Variable dimensions**

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<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
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*1: Space required for the battery replacement
*2: Space required for the interconnection cable
*3: Screw holes (M4, 6 mm long) for affixing user wiring and piping. (6 locations on both sides and 2 locations on the front of the No. 2 arm.)
*4: Can also be used as a spare line (0.2 sq. mm, 4-pair cable) for conventional models.
*5: Select either controller according to your application. CR800-D: Standalone type, CR800-R: MELSEC iQ-R compatible type, CR800-Q: MELSEC Q Series compatible type.
*6: Preservation of cleanliness levels depends on conditions of a downstream flow of 0.3 m/s in the cleanroom and internal robot suctioning. A ø8-mm coupler for suctioning is provided at the back of the base.
A horizontal, multiple-joint type robot with highly rigid arms and cutting-edge servo controls to provide extremely fast and precise heavy-duty operation. Ideal for a wide range of fields, from transportation of small components that demands high-speed operation through to assembly work where excellent precision is required.

- Among the fastest moving robots in its class
  - [XY composite: 8,300 mm/s]
  - [J4 (θ axis): 2,400 deg/s]
- Standard cycle time
  - [0.29 s (RH-6FRH55)]
- Pivotal operating range: ±170°
- Environmental specifications
  - [standard: IP20; oil mist: IP65; cleanroom: ISO class 3]
- Standards compliance
  Compliant with European Machinery Directives (CE) as standard.
  Compliance with other standards is available in specialized machines. Contact Mitsubishi Electric for details.

### Specifications

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Gripper: 8 input points/8 output points (20 pins total)
Signal cable for the multi-function gripper (2-pin + 2-pin power line)
LAN x 1 < 100 BASE-Tx – (8-pin) *4
Primary: ø6 × 2 Secondary: ø4 × 8
5m (connector on both ends)
CR600-D, CR600-F, CR600-Q
**External Dimensions/Operating Range Diagram**

Variable dimensions

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<th>C</th>
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**Robot Structure**
- RH: Horizontal, multiple-joint type

**Maximum load capacity**
- 6 kg

**Series**
- FRH: FR series

**Arm length**
- 35: 350mm
- 45: 450mm
- 55: 550mm

**Controller type**
- D: CR800-D
- R: CR800-R
- Q: CR800-Q

**Environment specification**
- Blank: Standard specifications
- M: Oil mist specifications
- C: Cleanroom specifications

**Vertical stroke**
- 20: 200mm
- 34: 340mm
A horizontal, multiple-joint type robot with highly rigid arms and cutting-edge servo controls to provide extremely fast and precise heavy-duty operation. Enhancements to the wrist axis also mean that the robot has ample scope for handling multi-function grippers and offset grippers. Ideal for assembly and palletizing work.

- Among the fastest moving robots in its class [XY composite: 13,283 mm/s (RH-2FRH)]
- [J4 (θ axis): 2,400 deg/s (RH-2FRH)]

- Standard cycle time
  [0.30 s (RH-12FRH85)]
- Pivotal operating range: ±170°
- Environmental specifications
  [standard, Oil mist: IP65; cleanroom: ISO class 3]

- Standards compliance
  Compliant with European Machinery Directives (CE) as standard. Compliance with other standards is available in specialized machines. Contact Mitsubishi Electric for details.

<table>
<thead>
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<th>Specifications</th>
<th>Type</th>
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*1 Standard/ Oil mist/ Cleanroom
*2 Maximum composite speed *2
*3 Cycle time *3
*5 Connected controller *5
precise heavy-duty operation. Enhancements to the wrist and cutting-edge servo controls to provide extremely fast and
A horizontal, multiple-joint type robot with highly rigid arms

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<td>RH-20FRH85xx</td>
<td>RH-20FRH85xx</td>
<td>RH-20FRH85xx</td>
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<tr>
<td><strong>Series</strong></td>
<td>RH-12FRH</td>
<td>RH-12FRH</td>
<td>RH-12FRH</td>
<td>RH-12FRH</td>
<td>RH-12FRH</td>
</tr>
<tr>
<td><strong>Robot structure</strong></td>
<td>RH</td>
<td>RH</td>
<td>RH</td>
<td>RH</td>
<td>RH</td>
</tr>
<tr>
<td><strong>Clean specifications only</strong></td>
<td>RH-12FRH85xx</td>
<td>RH-12FRH85xx</td>
<td>RH-12FRH85xx</td>
<td>RH-12FRH85xx</td>
<td>RH-12FRH85xx</td>
</tr>
</tbody>
</table>

**Note:**

*1: The environmental resistance specifications (M: Oil mist specifications, C: Cleanroom specifications) are factory-set custom specifications.
*2: The value assumes composition of J1, J2, and J4.
*3: Value for a maximum load capacity of 2 kg. The cycle time may increase if specific requirements apply such as high work positioning accuracy, or depending on the operating position.

(1) The cycle time is based on back-and-forth movement over a vertical distance of 25 mm and horizontal distance of 300 mm.)

*4: Can also be used as a spares line (0.2 sq. mm, 4-pair cable) for conventional models.
*5: Select either controller according to your application. CR800-D: Standalone type, CR800-R: MELSEC IQ-R compatible type, CR800-Q: MELSEC Q Series compatible type.
*6: Please contact Mitsubishi Electric dealer since the environmental resistance may not be secured depending on the characteristics of oil you use. Direct jet to the bellows is excluded.
*7: Preservation of cleanliness levels depends on conditions of a downstream flow of 0.3 m/s in the cleanroom and internal robot suctioning. A ø8-mm coupler for suctioning is provided at the back of the base.
A horizontal, multiple-joint type robot with a space-saving suspended installation mode. Suitable for a wide range of applications, from precision assembly of electrical, electronic and other small components through to inspections, high-speed transportation and packaging.

- Among the fastest moving robots in its class
  - [XY composite: 6,267 mm/s]
  - [J4 (θ axis): 3,146 deg/s]
- Standard cycle time
  - [0.32 s (RH-3FRHR35)]
- Pivotal operating range: ±225°
- Environmental specifications
  - [standard: IP20; cleanroom: ISO class 5; Waterproof: IP65]
- Standards compliance
  - Compliant with European Machinery Directives (CE) as standard. Compliance with other standards is available in specialized machines. Contact Mitsubishi Electric for details.

### Specifications

<table>
<thead>
<tr>
<th>Type</th>
<th>Unit</th>
<th>RH-3FRHR35</th>
<th>RH-3FRHR3512C</th>
<th>RH-3FRHR3512W</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental specifications</td>
<td>Standard</td>
<td>Cleanroom</td>
<td>Waterproof</td>
<td></td>
</tr>
<tr>
<td>Protection degree *1</td>
<td>IP20</td>
<td>ISO class 5</td>
<td>IP65 *6</td>
<td></td>
</tr>
<tr>
<td>Installation</td>
<td>Ceiling type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structure</td>
<td>Horizontal multiple-joint type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Degrees of freedom</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drive system</td>
<td>AC servo motor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Position detection method</td>
<td>Absolute encoder</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum load capacity</td>
<td>kg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arm length</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No.1 arm</td>
<td>mm</td>
<td>175</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No.2 arm</td>
<td></td>
<td>175</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum reach radius</td>
<td>mm</td>
<td>350</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating range</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>J1 (θ)</td>
<td>deg</td>
<td>450 ±225</td>
<td></td>
<td></td>
</tr>
<tr>
<td>J2</td>
<td></td>
<td>450 ±225</td>
<td></td>
<td></td>
</tr>
<tr>
<td>J3 (Z)</td>
<td>mm</td>
<td>150</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>J4 (θ)</td>
<td>deg</td>
<td>1440 ±72</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum speed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>J1</td>
<td>deg/sec</td>
<td>672</td>
<td>708</td>
<td></td>
</tr>
<tr>
<td>J2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>J3 (Z)</td>
<td>mm/sec</td>
<td>1500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>J4 (θ)</td>
<td>deg/sec</td>
<td>3146</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum composite speed *2</td>
<td>mm/sec</td>
<td>6267</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cycle time *3</td>
<td>sec</td>
<td>0.32</td>
<td>0.32</td>
<td>0.65</td>
</tr>
<tr>
<td>Position repeatability</td>
<td></td>
<td>±0.01</td>
<td>±0.01</td>
<td>±0.01</td>
</tr>
<tr>
<td>Y-X composite</td>
<td>mm</td>
<td>±0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>J3 (Z)</td>
<td></td>
<td>±0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>J4 (θ)</td>
<td>deg</td>
<td>±0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>°C</td>
<td>0 to 40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mass</td>
<td>kg</td>
<td>24</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>Tolerable amount of inertia</td>
<td>kgm²</td>
<td>0.005</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>Tool wiring</td>
<td>Gripper: 8 input points (up to 4 points for shaft) / 8 output points, 8 spare lines</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tool pneumatic pipes</td>
<td>Primary: ø6 x 2 Secondary: ø4 x 8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Machine cable</td>
<td>Fixed: 5m (connector on both ends)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connected controller *4</td>
<td>CR800-D, CR800-R, CR800-Q</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*1: Hygiene-related guidelines from the US NSF (National Sanitation Foundation)
*2: The value assumes composition of J1, J2, and J4.
*3: Space required for the machine cable between devices
*4: Select either controller according to your application. CR800-D: Standalone type, CR800-R: MELSEC iQ-R compatible type, CR800-Q: MELSEC Q Series compatible type.
*5: Preservation of cleanliness levels depends on conditions of a downstream flow of electronic components and pharmaceutical products.
*6: Direct jet to the bellows is excluded.

Among the fastest moving robots in its class

- [XY composite: 6,267 mm/s]
- [J4 (θ axis): 3,146 deg/s]
External Dimensions/Operating Range Diagram

- Reduced equipment space
  By suspending the machine from the ceiling, wasted space is eliminated and less space is needed for the entire installation.

- Easy installation and startup
  (1) Constructed so that it can be suspended from fittings installed on top of the ceiling posts, making installation simple.
  (2) Internal gripper tubing channels are provided in the tip axis, making tube installation easy and eliminating the problem of tangled tubes. (Handles up to 4 inside the shaft.)

Waterproof specification
- IP65-rated and can be washed with water
- Uses food-grade grease (NSF H1)*1
- *1: Hygiene-related guidelines from the US NSF (National Sanitation Foundation)

Cleanroom specification
- ISO Class 5 cleanliness
- Suitable for clean environments, such as transporting electrical/electronic components and pharmaceutical products.
- Wiring and tubing can be installed internally in the tip. Prevents contamination produced by problems such as cable twisting or abrasion

Features

Reduction of equipment area

No.1 arm
No.2 arm

RH-3FRHR3512D

Controller type
CR800-Q

Protection specification:
Cleanroom specifications

W: Waterproof specifications

*1: Installation platform is prepared by customer
*2: Space required for the battery replacement, etc.
*3: Space required for the machine cable between device

Specifications
- Cycle time *3
- Maximum load capacity
- Rated 1
- 25 mm and horizontal distance of 300 mm.

No.1 arm rotation radius
No.2 arm rotation radius

Installation specification
- RH: Horizontal, multiple-joint type
- RH: FR series

Maximum load capacity
3 Kg

Arm length
350 mm

Vertical stroke
120 mm: 150 mm

Standard specifications
- Water resistant: IP65*6
- Robustness: ISO class 5
- Protection degree: IP20
- Gripper: 8 input points (up to 4 points for shaft) / 8 output points, 8 spare lines

![Diagram of the robot's dimensions and operating range](image-url)
MELSEC IQ-R/Q compatible robot controller
Uses a multi-CPU configuration that dramatically improves its interaction with FA equipment and also offers highly precise control and fast yet simple information management.

Controller Specifications

### Specifications

<table>
<thead>
<tr>
<th>Type</th>
<th>Unit</th>
<th>CR800-R</th>
<th>CR800-Q</th>
<th>CR800-D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Robot CPU</td>
<td>R16RTCPU</td>
<td>Q172DSRCPU</td>
<td>Built-in</td>
<td></td>
</tr>
<tr>
<td>Path control</td>
<td>PTP control</td>
<td>CP control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of axes controlled</td>
<td>Maximum 6 + additional 8 axes available</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Robot language</td>
<td>MELFA-BASIC V, VI</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Position teaching method</td>
<td>Teaching method, MD method</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Memory capacity**

- **Number of teaching points**: 39000, 26000, 39000
- **Number of steps**: 78000, 52000, 78000
- **Number of programs**: 512

**External input/output**

- **General-purpose I/O**: 0 input/0 output (8192 input points/8192 output points with the multiple CPU common device), 0 input/0 output (Up to 256/256 when options are used)
- **Dedicated I/O**: points Assigned to multiple CPU common device, Assigned to general-purpose I/O

**Gripper open/close**

- 8 input / 8 output *

**Emergency stop input**

- 1 (redundant)

**Door switch input**

- 1 (redundant)

**Enabling device input */7**

- 1 (redundant)

**Emergency stop output**

- 1 (redundant)

**Mode output**

- 1 (redundant)

**Robot error output**

- 1 (redundant)

**Synchronization of additional axes**

- 1 (redundant)

**Encoder input**

- Channels: 2, 0 (Q173QDX (optional)), 2

**RS-422**

- Ports: 1 (dedicated T/R)

**Ethernet**

- Ports: 1 (for customer: 10BASE-T/100BASE-TX/1000BASE-T)

**USB */5**

- Ports: 1 (USB port of programmable controller CPU unit), 1 (Ver. 2.0 device functions only, mini B terminal)

**Additional-axis interface**

- Channels: 1 (SSCNET III H)

**Extension slot */1**

- Slots: 1 (Available only for function expansion option card)

**RC communication interface**

- Channels: 2 (daisy chain)

**Remote I/O**

- Channels: 1 (Ver.2)

**Memory extension slot**

- Slots: 1

**Ambient temperature**

- C: 0 to 40 (controller) / 0 to 55 (robot CPU)

**Relative humidity**

- %RH: 45 to 85

**Input voltage range */2**

- RV-12FR/20FR/3FR/7FR, RH-3FR: Three-phase AC 200V to 230V

**Power capacity */3**

- KVA: RV-2FR, RH-3FR: 0.5
- RV-3FRH, RH-4FR, RH-6FRH: 1.0
- RH-12FR/20FR/6FRH: 1.5
- RV-7FR (except RV-TRU): 3.0
- RV-7FRH, RV-13FRH, RV-20FR: 3.0

**External dimensions (including legs)**

- mm: 430(W) × 425(D) × 99.5(H)

**Weight**

- kg: Approx. 12.5

**Structure [protective specification]**

- Self-contained floor type/open structure (Vertical and horizontal position can be placed) [SP20]

**Grounding */4**

- 1: For installing option interface.
- 2: The rate of power-supply voltage fluctuation is within 10%.
- 3: The power capacity indicates the rating for normal operation. Take note that the power capacity does not include the current when the power is turned on.
- 4: The power capacity is only a rough guide and whether or not operation can be guaranteed depends on the input power-supply voltage.
- 5: Recommended USB cable (USB A-to-USB mini B): MR-J2USB/CEMLM (Mitsubishi Electric), GT09-C30USB-5P (Mitsubishi Electric System & Service Co., Ltd)
- 6: RV-2FR series has 4 inputs and 4 outputs.
- 7: Mode selection switch provided by the customer.
Controller

CR800-R/CR800-Q

*1: The power capacity indicates the rating for normal operation. Take note that the power capacity does not include the current being input when the power is turned on.

*2: The rate of power-supply voltage fluctuation is within 10%.

*3: Grounding works are the customer's responsibility.

*4: The power capacity is only a rough guide and whether or not operation can be guaranteed depends on the input power-supply voltage.

*5: Recommended USB cable (USB A-to-USB mini B): MR-J3USBCBL3M (Mitsubishi Electric), GT09-C30USB-5P (Mitsubishi Electric System & Service Co., Ltd)

*6: RV-2FR series has 4 inputs and 4 outputs.

*7: Mode selection switch provided by the customer.

External Dimensions

Multiple CPU environment

<table>
<thead>
<tr>
<th>CR800-R</th>
<th>CR800-Q</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unit</strong></td>
<td><strong>Type</strong></td>
</tr>
<tr>
<td>Base</td>
<td>R35B</td>
</tr>
<tr>
<td>Base</td>
<td>R38B</td>
</tr>
<tr>
<td>Base</td>
<td>R312B</td>
</tr>
<tr>
<td>Power supply</td>
<td>R61P</td>
</tr>
<tr>
<td>Power supply</td>
<td>R62P</td>
</tr>
<tr>
<td>Power supply</td>
<td>R63P</td>
</tr>
<tr>
<td>Power supply</td>
<td>R64P</td>
</tr>
<tr>
<td>PLC CPU</td>
<td>R00CPU</td>
</tr>
<tr>
<td>PLC CPU</td>
<td>R01CPU</td>
</tr>
<tr>
<td>PLC CPU</td>
<td>R02CPU</td>
</tr>
<tr>
<td>PLC CPU</td>
<td>R04CPU</td>
</tr>
<tr>
<td>PLC CPU</td>
<td>R08CPU</td>
</tr>
<tr>
<td>PLC CPU</td>
<td>R16CPU</td>
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<tr>
<td>PLC CPU</td>
<td>R32CPU</td>
</tr>
<tr>
<td>PLC CPU</td>
<td>R120CPU</td>
</tr>
<tr>
<td>PLC CPU</td>
<td>Q100UD(E/H)CPU</td>
</tr>
<tr>
<td>PLC CPU</td>
<td>Q12UD(E/H)CPU</td>
</tr>
<tr>
<td>PLC CPU</td>
<td>Q13UD(E/V)CPU</td>
</tr>
<tr>
<td>PLC CPU</td>
<td>Q03UD(E/V)CPU</td>
</tr>
<tr>
<td>Universal Model</td>
<td>Q64PN</td>
</tr>
</tbody>
</table>

Note: For details of the PLC units, refer to the PLC manual or the Mitsubishi Electric FA website, etc.
OPTIONS

Robot arm options (RV)

Machine cable (standard)
- Fixed: 5 m

Machine cable (replacement)
- Fixed: 2, 10, 15 or 20 m
- Flexible: 10, 15 or 20 m

Solenoid valve set (sink/source type)
- With dedicated hand output cable
- 1 to 4 valves

Hand output cable
- Used when solenoid valves are provided by the customer

Hand input cable
- For gripper sensor signal input

Hand curl tube
- Tube for pneumatic grippers (1 to 4 tubes)

J1 axis movement range modification
- RV-2FR series

J2 axis movement range modification (RV-2FR series)

J3 axis movement range modification (RV-2FR series)
- To be installed by the customer.

Cable outlets in the machine
- Forearm external wiring set
- Base external wiring set

Internal wiring/tubing specifications

The factory default specification is for wiring/tubing to be routed internally to the wrist with an outlet from the mechanical interface.
### RV-FR Mechanical Options

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Type</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>①</td>
<td>Solenoid valve set</td>
<td></td>
<td>1 to 2 valves with solenoid valve cable.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1E-VDC0 (sink)</td>
<td>o □ indicates the number of valves (1 or 2); output: 4e</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1E-VDC0E (source)</td>
<td>□ indicates the number of valves (1, 2, 3, 4); output: 4e</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1F-VDC0-02 (sink)</td>
<td>□ indicates the number of valves (1, 2, 3, 4); output: 4e</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1F-VDC0-02 (source)</td>
<td>□ indicates the number of valves (1, 2, 3, 4); output: 4e</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1F-VDC0-03 (sink)</td>
<td>□ indicates the number of valves (1, 2, 3, 4); output: 4e</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1F-VDC0-03 (source)</td>
<td>□ indicates the number of valves (1, 2, 3, 4); output: 6e</td>
</tr>
<tr>
<td>②</td>
<td>Hand output cable</td>
<td></td>
<td>Straight cable for 2-valve systems, robot connector on one end,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1E-GRSS</td>
<td>terminal on the other. Total length: 500 mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1F-GRSS-02</td>
<td>Straight cable for 4-valve systems, robot connector on one end, terminal on</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>the other. Total length: 1000 mm</td>
</tr>
<tr>
<td>③</td>
<td>Hand input cable</td>
<td></td>
<td>4-point type, with a robot connector on one side and terminated on the other.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1S-HC30C-11</td>
<td>4-point type, with a robot connector on one side and terminated on the other.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1F-HC30C-02</td>
<td>4-point type, with a robot connector on one side and terminated on the other.</td>
</tr>
<tr>
<td>④</td>
<td>Hand curl tube</td>
<td></td>
<td>For 1- to 4-ø6-valve systems; total length: 630 mm (including 180 mm curled</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1E-ST04C-0C</td>
<td>section) □ indicates No. of tubes (2, 4, 6 or 8); total length: 1500 mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1N-ST04C-0C</td>
<td>(including 250 mm curled section) □ indicates No. of tubes (2, 4, 6 or 8)</td>
</tr>
<tr>
<td>⑤</td>
<td>Forearm external wiring set 1</td>
<td></td>
<td>For the forearm. External wiring box used for connecting the gripper input,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1F-HB01S-01</td>
<td>electric gripper, force sensor and Ethernet cable.</td>
</tr>
<tr>
<td>⑥</td>
<td>Forearm external wiring set 2</td>
<td></td>
<td>For the base. External wiring box used for connecting the gripper</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1F-HB02S-01</td>
<td>sensor, electric gripper and Ethernet cable.</td>
</tr>
<tr>
<td>⑦</td>
<td>Base external wiring set 1</td>
<td></td>
<td>For the base. External wiring box used for connecting the gripper sensor,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1F-HA01S-01</td>
<td>electric gripper, force sensor and Ethernet cable.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1F-HA02S-01</td>
<td>Includes gripper input, output, electric gripper and Ethernet cable.</td>
</tr>
<tr>
<td>⑧</td>
<td>Machine cable (replacement)</td>
<td></td>
<td>Replacement type, 2, 10, 15 or 20 m</td>
</tr>
<tr>
<td></td>
<td>(fixed)</td>
<td>1F-□□□□□□-41</td>
<td>□□□□□□ indicates cable length (2m, 10, 15, 20 m)</td>
</tr>
<tr>
<td></td>
<td>Machine cable (replacement)</td>
<td></td>
<td>Replacement type, 10, 15 or 20 m</td>
</tr>
<tr>
<td></td>
<td>(flexible)</td>
<td>1F-□□□□□□-41</td>
<td>□□□□□□ indicates cable length (10, 15 or 20 m)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>□□□□□□ indicates cable length (2m, 10, 15, 20 m)</td>
</tr>
<tr>
<td>⑨</td>
<td>J1 axis movement range</td>
<td></td>
<td>Stopper for changing the range, installed by customer</td>
</tr>
<tr>
<td></td>
<td>modification</td>
<td>1S-DH-11J1</td>
<td>Stopper for changing the range, installed by customer (Also compatible with RV-7FRLL)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1F-DH-02J1</td>
<td>Stopper for changing the range, installed by customer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1F-DH-04</td>
<td>Stopper for changing the range, installed by customer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1F-DH-06</td>
<td>Stopper for changing the range, installed by customer</td>
</tr>
<tr>
<td>⑩</td>
<td>J2 axis movement range</td>
<td></td>
<td>Stopper for changing the range, installed by customer</td>
</tr>
<tr>
<td></td>
<td>modification</td>
<td>1S-DH-11J2</td>
<td>Stopper for changing the range, installed by customer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1S-DH-11J3</td>
<td>Stopper for changing the range, installed by customer</td>
</tr>
</tbody>
</table>

### RV-4FR/7FR/13FR/20FR series tooling machine configurations

The required options differ depending on the gripper (tool) configuration. The table below lists the “Forearm external wiring sets” and “Base external wiring sets” required for the different gripper configurations. Select wiring sets accordingly.

<table>
<thead>
<tr>
<th>Gripper configuration</th>
<th>Wiring mode</th>
<th>Body specifications</th>
<th>Forearm external wiring set</th>
<th>Base external wiring set (*3)</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Internal</td>
<td>Externa Standard</td>
<td>SH01</td>
<td>(1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Internal</td>
<td>Externa Standard</td>
<td>SH05</td>
<td>(1)</td>
<td></td>
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<td></td>
<td>Internal</td>
<td>Externa Standard</td>
<td>SH14</td>
<td>(1)</td>
<td></td>
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<tr>
<td></td>
<td>Internal</td>
<td>Externa Standard</td>
<td>SH02</td>
<td>(1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Internal</td>
<td>(External air tube)</td>
<td>SH02</td>
<td>(1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Internal</td>
<td>Externa Standard</td>
<td>SH03</td>
<td>(1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Internal</td>
<td>Externa Standard</td>
<td>SH03</td>
<td>(1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Internal</td>
<td>Externa Standard</td>
<td>SH02</td>
<td>(1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Internal</td>
<td>Externa Standard</td>
<td>SH01</td>
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<td>SH01</td>
<td>(1)</td>
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<tr>
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<td>Internal</td>
<td>Externa Standard</td>
<td>SH03</td>
<td>(1)</td>
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<tr>
<td></td>
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<td>Externa Standard</td>
<td>SH03</td>
<td>(1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Internal</td>
<td>Externa Standard</td>
<td>SH02</td>
<td>(1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Internal</td>
<td>Externa Standard</td>
<td>SH02</td>
<td>(1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Internal</td>
<td>Externa Standard</td>
<td>SH03</td>
<td>(1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Internal</td>
<td>Externa Standard</td>
<td>SH03</td>
<td>(1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Internal</td>
<td>Externa Standard</td>
<td>SH02</td>
<td>(1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Internal</td>
<td>Externa Standard</td>
<td>SH02</td>
<td>(1)</td>
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<td>Internal</td>
<td>Externa Standard</td>
<td>SH03</td>
<td>(1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Internal</td>
<td>Externa Standard</td>
<td>SH03</td>
<td>(1)</td>
<td></td>
</tr>
</tbody>
</table>

1) For prismatic grippers with internal wiring, solenoid valves should be provided.
2) For prismatic grippers with external wiring, solenoid valves, tubing and input cables, etc. should be provided as necessary.
3) For machines with internal wiring and tubing, a base external wiring set is included with the machine and does not need to be provided separately.
Options

Robot arm options (RH)

1. Solenoid valve set (sink/source type)
   With dedicated hand output cable
   1 to 4 valves

2. Hand output cable
   Used when solenoid valves are provided
   by the customer

3. Hand input cable
   For gripper sensor signal input

4. Hand curl tube
   Tube for pneumatic grippers (1 to 4 tubes)

5. Hand tube (for RH-3FRHR series)
   Tube for pneumatic grippers (2 tubes)

6. Internal wiring and tubing set for grippers
   An air tube and cable set used to run air tubes
   and gripper input signal cables from inside
   the second arm to the shaft tip

7. External wiring and tubing box
   A useful option for taking air tubes and signal
   wires out from the back end of the second arm or
   running gripper wiring and/or tubing outside the robot

8. Machine cable (standard)
   Fixed 5 m

9. Machine cable (replacement)
   Fixed 2, 10, 15 or 20 m
   Flexible 10, 15 or 20 m

10. J1 axis movement range modification
11. J2 axis movement range modification

Specifications

- Tube for pneumatic grippers (1 to 4 tubes)
- Hand curl tube
- Hand input cable
- Hand output cable
- Solenoid valve set (sink/source type)
- Internal wiring and tubing set for grippers
- External wiring and tubing box
- Machine cable (standard)
- Machine cable (replacement)
- J1 axis movement range modification
- J2 axis movement range modification

---

**Image Descriptions**

1. Solenoid valve set (sink/source type) with dedicated hand output cable for 1 to 4 valves.
2. Hand output cable used when solenoid valves are provided by the customer.
3. Hand input cable for gripper sensor signal input.
4. Hand curl tube for pneumatic grippers (1 to 4 tubes).
5. Hand tube (for RH-3FRHR series) for pneumatic grippers (2 tubes).
6. Internal wiring and tubing set for grippers, allowing air tubes and signal cables to run from the second arm to the shaft tip.
7. External wiring and tubing box for taking air tubes and signal wires out from the back end of the second arm.
8. Machine cable options: standard fixed 5 m, replacement fixed 2, 10, 15 or 20 m, flexible 10, 15 or 20 m.
9. J1 and J2 axis movement range modifications.

---

**Table of Options**

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Solenoid valve set</td>
<td>(sink/source type)</td>
</tr>
<tr>
<td>2</td>
<td>Hand output cable</td>
<td>Used when solenoid valves are provided by the customer</td>
</tr>
<tr>
<td>3</td>
<td>Hand input cable</td>
<td>For gripper sensor signal input</td>
</tr>
<tr>
<td>4</td>
<td>Hand curl tube</td>
<td>Tube for pneumatic grippers (1 to 4 tubes)</td>
</tr>
<tr>
<td>5</td>
<td>Hand tube (for RH-3FRHR series)</td>
<td>Tube for pneumatic grippers (2 tubes)</td>
</tr>
<tr>
<td>6</td>
<td>Internal wiring and tubing set for grippers</td>
<td>An air tube and cable set used to run air tubes and gripper input signal cables from inside the second arm to the shaft tip</td>
</tr>
<tr>
<td>7</td>
<td>External wiring and tubing box</td>
<td>A useful option for taking air tubes and signal wires out from the back end of the second arm or running gripper wiring and/or tubing outside the robot</td>
</tr>
<tr>
<td>8</td>
<td>Machine cable (standard)</td>
<td>Fixed 5 m</td>
</tr>
<tr>
<td>9</td>
<td>Machine cable (replacement)</td>
<td>Fixed 2, 10, 15 or 20 m, Flexible 10, 15 or 20 m</td>
</tr>
<tr>
<td>10</td>
<td>J1 axis movement range modification</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>J2 axis movement range modification</td>
<td></td>
</tr>
</tbody>
</table>

**Image Numbers**

- Image 1: Solenoid valve set (sink/source type) with dedicated hand output cable for 1 to 4 valves.
- Image 2: Hand output cable used when solenoid valves are provided by the customer.
- Image 3: Hand input cable for gripper sensor signal input.
- Image 4: Hand curl tube for pneumatic grippers (1 to 4 tubes).
- Image 5: Hand tube (for RH-3FRHR series) for pneumatic grippers (2 tubes).
- Image 6: Internal wiring and tubing set for grippers, allowing air tubes and signal cables to run from the second arm to the shaft tip.
- Image 7: External wiring and tubing box for taking air tubes and signal wires out from the back end of the second arm.
- Image 8: Machine cable options: standard fixed 5 m, replacement fixed 2, 10, 15 or 20 m, flexible 10, 15 or 20 m.
- Image 9: J1 and J2 axis movement range modifications.
- Image 10: Additional options for various configurations and specifications.
## OPTIONS

### RH-FR Main Options

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Type</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>①</td>
<td>Solenoid valve set</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1F-VD01-01 (Sink)</td>
<td>RH</td>
<td>1 to 4 valves with solenoid valve cable.</td>
</tr>
<tr>
<td></td>
<td>1F-VD02-01 (Sink)</td>
<td>RH</td>
<td>1 to 4 valves with solenoid valve cable.</td>
</tr>
<tr>
<td></td>
<td>1S-VD04-06 (Sink)</td>
<td>RH</td>
<td>4 valves with solenoid valve cable.</td>
</tr>
<tr>
<td></td>
<td>1S-VD04WE-06 (Source)</td>
<td>RH</td>
<td>4 valves with solenoid valve cable.</td>
</tr>
<tr>
<td>②</td>
<td>Hand output cable</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1F-GR06-01</td>
<td>RH</td>
<td>For 4-valve systems; robot connector on one end, unterminated on the other, with drip-proof grommet. Total length 1,050 mm, straight CBL.</td>
</tr>
<tr>
<td></td>
<td>1S-GR06S-02</td>
<td>RH</td>
<td>Straight cable for 4-valve systems; robot connector on one end, unterminated on the other. Total length: 450 mm.</td>
</tr>
<tr>
<td>③</td>
<td>Hand input cable</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1F-HC35-01</td>
<td>RH</td>
<td>8-point type, with a robot connector on one side and un terminated on the other, equipped with a splash-proof grommet. Total length: 1600 mm (including 350 mm curved section).</td>
</tr>
<tr>
<td></td>
<td>1F-HC35-02</td>
<td>RH</td>
<td>8-point type, with a robot connector on one side and un terminated on the other, equipped with a splash-proof grommet. Total length: 1210 mm.</td>
</tr>
<tr>
<td>④</td>
<td>Hand curl tube</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1E-ST0408C-300</td>
<td>RH</td>
<td>For 4-ø4-valve systems; total length: 1000 mm (including 300 mm curved section).</td>
</tr>
<tr>
<td></td>
<td>1N-ST0408C-01</td>
<td>RH</td>
<td>For 1- to 4-ø6-valve systems; total length: 630 mm (including 250 mm curved section).</td>
</tr>
<tr>
<td>⑤</td>
<td>Hand tube</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1S-ST0304S</td>
<td>RH</td>
<td>3 mm dia. for 2 tubes (customer-usable length: 400 mm).</td>
</tr>
<tr>
<td>⑥</td>
<td>Internal wiring and tubing set for grippers</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1F-HS60-01</td>
<td>RH</td>
<td>Internal wiring and tubing set for the tip axis (8 gripper inputs + two 6 mm dia. tubes). For 350 mm Z-axis stroke.</td>
</tr>
<tr>
<td></td>
<td>1F-HS60-02</td>
<td>RH</td>
<td>Internal wiring and tubing set for the tip axis (8 gripper inputs + two 6 mm dia. tubes). For 450 mm Z-axis stroke.</td>
</tr>
<tr>
<td></td>
<td>1F-HS60WS-01</td>
<td>RH</td>
<td>Internal wiring and tubing set for the tip axis (8 gripper inputs + four 4 mm dia. tubes). For 200 mm Z-axis stroke.</td>
</tr>
<tr>
<td></td>
<td>1F-HS60WS-02</td>
<td>RH</td>
<td>Internal wiring and tubing set for the tip axis (8 gripper inputs + four 4 mm dia. tubes). For 340 mm Z-axis stroke.</td>
</tr>
<tr>
<td>⑦</td>
<td>External user wiring and tubing box</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1F-UT06X-01</td>
<td>RH</td>
<td>External outlet box for user wiring (gripper input/output, gripper tubes).</td>
</tr>
<tr>
<td></td>
<td>1F-UT08X-01</td>
<td>RH</td>
<td>External outlet box for user wiring (gripper input/output, gripper tubes).</td>
</tr>
<tr>
<td>⑧</td>
<td>Machine cable (replacement) (fixed)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1F-UCBL41</td>
<td>RH</td>
<td>Replacement type, 2, 10, 15 or 20 m</td>
</tr>
<tr>
<td></td>
<td>1F-UCBL41</td>
<td>RH</td>
<td>Replacement type, 10, 15 or 20 m</td>
</tr>
<tr>
<td>⑨</td>
<td>J1 axis movement range modification</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1F-DH02</td>
<td>RH</td>
<td>Stopper for changing the range, installed by customer. (Standard)</td>
</tr>
<tr>
<td></td>
<td>1F-DH01</td>
<td>RH</td>
<td>Stopper for changing the range, installed by customer.</td>
</tr>
<tr>
<td></td>
<td>1S-DH06J1</td>
<td>RH</td>
<td>Stopper for changing the range, installed by customer.</td>
</tr>
<tr>
<td></td>
<td>1S-DH11J2</td>
<td>RH</td>
<td>Stopper for changing the range, installed by customer.</td>
</tr>
<tr>
<td></td>
<td>1S-DH65J2</td>
<td>RH</td>
<td>Stopper for changing the range, installed by customer.</td>
</tr>
</tbody>
</table>
R Type Controller

System Configuration

Function expansion card (MELFA SmartPlus)
- Enables all A-type functions
- Enables all A and B-type functions
- Selects and enables one function from A-type functions
- Selects and enables one function from A and B-type functions

Calibration assistance function
- Assists with positional calibration with peripheral devices using 2D vision sensors
- Provides a way to improve positioning accuracy by using automatically correcting the vision sensor coordinates
- Provides a way to improve positioning accuracy by using vision sensor to automatically correct the robot and workpiece coordinates
- Uses vision sensors to adjust the relative locations of multiple robots. Provides a way to improve positioning accuracy during coordinated operation
- Compensates thermal expansion of robot arm, and improves position accuracy
- Function for highly accurate coordination (interpolation) with additional axis (straight coaxial)
- Function for managing robot status by tracking operation status
- Automates 3D vision sensor parameter adjustment work, and improves measurement and recognition performance using AI technology
### Option Configurations (Controllers)

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Model</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Simple teaching box (7, 15 m)</td>
<td>R32TB (***)</td>
<td>7 m: Standard; 15 m: Special (model name includes &quot;-15&quot;)</td>
</tr>
<tr>
<td>2</td>
<td>High-performance teaching box (7, 15 m)</td>
<td>R56TB (***)</td>
<td>7 m: Standard; 15 m: Special (model name includes &quot;-15&quot;)</td>
</tr>
<tr>
<td>3</td>
<td>Teaching box conversion cable (32 x 32)</td>
<td>2F-33CON03M</td>
<td>Conversion cable for connecting the CR800 controller to the R32TB/R56TB. Cable length: 3 m</td>
</tr>
<tr>
<td>4</td>
<td>Encoder distribution unit</td>
<td>2F-YZ581</td>
<td>Unit used for connecting multiple controllers to one rotary encoder when using the tracking function (for 4 robots)</td>
</tr>
<tr>
<td>5</td>
<td>Controller protection box</td>
<td>CR800-MB</td>
<td>Houses a controller and provides protection against dust and water. (IP54)</td>
</tr>
<tr>
<td>6</td>
<td>Computer support software mini version</td>
<td>3F-15C-WINE</td>
<td>Simplified version (CD-ROM), (RT ToolBox3 mini)</td>
</tr>
<tr>
<td>7</td>
<td>Computer support software Pro version</td>
<td>3F-16C-WINE</td>
<td>Professional version (DVD-ROM), (RT ToolBox3 Pro)</td>
</tr>
</tbody>
</table>

### Option Configurations (Functions)

<table>
<thead>
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<th>No.</th>
<th>Name</th>
<th>Model</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Force sensor set</td>
<td>4F-FS002H-W200</td>
<td>Set of devices required for force control functionality, including force sensors, interface unit and support software</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4F-FS002H-W1000</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>MELFA 3D Vision</td>
<td>4F-3DVS2-PKG1</td>
<td>Set of devices required for 3D vision sensor functionality, including 3D camera head and control unit (applicable machines: RV-FR series)</td>
</tr>
<tr>
<td></td>
<td>Additional camera head</td>
<td>4F-3DVS2-OPT1</td>
<td>For field-of-view expansion option</td>
</tr>
<tr>
<td></td>
<td>Field-of-view expansion option</td>
<td>2F-3DVS2-OPT2</td>
<td>Expands the field of view by approx. 20° to 28°</td>
</tr>
<tr>
<td>3</td>
<td>Safety option</td>
<td>4F-SF002-01</td>
<td>Devices required by the safety functions</td>
</tr>
</tbody>
</table>

### Option Configurations (Software Expansion Functions)

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Model</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MELFA Smart Plus Card Pack</td>
<td>2F-DQS10</td>
<td>Enables all A-type functions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2F-DQS20</td>
<td>Enables all A and B-type functions</td>
</tr>
<tr>
<td>2</td>
<td>MELFA Smart Plus Card</td>
<td>2F-DQS11</td>
<td>Selects and enables one function from A-type functions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2F-DQS21</td>
<td>Selects and enables one function from A and B-type functions</td>
</tr>
</tbody>
</table>

### Software Options

<table>
<thead>
<tr>
<th>Classification</th>
<th>Name</th>
<th>Type</th>
<th>Function outline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intelligent function</td>
<td>Calibration assistance function</td>
<td>A</td>
<td>Assists with positional calibration with peripheral devices using 2D vision sensors</td>
</tr>
<tr>
<td></td>
<td>Automatic calibration function</td>
<td></td>
<td>Provides a way to improve positioning accuracy by using automatically correcting the vision sensor coordinates</td>
</tr>
<tr>
<td></td>
<td>Workpiece coordinate calibration function</td>
<td></td>
<td>Provides a way to improve positioning accuracy by using vision sensor to automatically correct the robot and workpiece coordinates</td>
</tr>
<tr>
<td></td>
<td>Robot-to-robot relative calibration function</td>
<td></td>
<td>Uses vision sensors to adjust the relative locations of multiple robots. Provides a way to improve positioning accuracy during coordinated operation</td>
</tr>
<tr>
<td></td>
<td>Robot mechanism temperature compensation function</td>
<td>A</td>
<td>Compensates thermal expansion of robot arm, and improves position accuracy</td>
</tr>
<tr>
<td></td>
<td>Coordinated control for additional axis</td>
<td>A</td>
<td>Function for highly accurate coordination (interpolation) with additional axis (straight coaxial)</td>
</tr>
<tr>
<td></td>
<td>Preventive maintenance function</td>
<td>A</td>
<td>Function for managing robot status by tracking operation status</td>
</tr>
<tr>
<td>AI function</td>
<td>MELFA 3D Vision expansion function</td>
<td>B</td>
<td>Automates 3D vision sensor parameter adjustment work, and improves measurement and recognition performance using AI technology</td>
</tr>
</tbody>
</table>
Q Type Controller

System Configuration

- **GOT**
- **Ethernet**
- **Vision system**
- **Robot CPU unit**
- **Robot controller**
- **Machine cable**
- **Teaching box (option)**
- **Safety options**
- **Function expansion card (MELFA SmartPlus)**
- **Machine cable**
- **Teaching box conversion cable**
- **USB cable**
- **SSCNETIII/H cable**
- **NC**
- **Servo**
- **Robot controller**
- **Robot CPU unit**
- **Teaching box (option)**
- **Safety options**
- **Function expansion card (MELFA SmartPlus)**
- **Machine cable**
- **Teaching box conversion cable**
- **USB cable**
- **SSCNETIII/H cable**
- **NC**
- **Servo**
- **Robot controller**
- **Robot CPU unit**
- **Teaching box (option)**
- **Safety options**
- **Function expansion card (MELFA SmartPlus)**
- **Machine cable**
- **Teaching box conversion cable**
- **USB cable**
- **SSCNETIII/H cable**
- **NC**
- **Servo**
- **Robot controller**

**<Software options>**

- RT ToolBox3 mini
- RT ToolBox3
- RT ToolBox3 Pro
- Controller protection box

**<Feature options>**

- Force sensor set
- MELFA-3D Vision
OPTIONS (Q Type Controller)

### Option Configurations (Controllers)

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Model</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Simple teaching box (7, 15 m)</td>
<td>R32TB (***)</td>
<td>7 m: Standard; 15 m: Special (model name includes &quot;15&quot;)</td>
</tr>
<tr>
<td>2</td>
<td>High-performance teaching box (7, 15 m)</td>
<td>R56TB (***)</td>
<td>7 m: Standard; 15 m: Special (model name includes &quot;15&quot;)</td>
</tr>
<tr>
<td>3</td>
<td>Teaching box conversion cable (33–&gt;33)</td>
<td>2F-33CON03M</td>
<td>Conversion cable for connecting the CR800 controller to the R33TB/R67TB. Cable length: 3 m</td>
</tr>
<tr>
<td>4</td>
<td>Controller protection box</td>
<td>CR800-MB</td>
<td>Houses a controller and provides protection against dust and water. (IP54)</td>
</tr>
<tr>
<td>5</td>
<td>Computer support software mini version</td>
<td>3F-15C-WINE</td>
<td>Simplified version (CD-ROM); (RT ToolBox3 mini)</td>
</tr>
<tr>
<td>6</td>
<td>Computer support software Pro version</td>
<td>3F-16C-WINE</td>
<td>Professional version (DVD-ROM); (RT ToolBox3 Pro)</td>
</tr>
</tbody>
</table>

### Option Configurations (Functions)

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Model</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Force sensor set</td>
<td>4F-FS002H-W200</td>
<td>Set of devices required for force control functionality, including force sensors, interface unit and support software</td>
</tr>
<tr>
<td>2</td>
<td>MELFA-3D Vision</td>
<td>4F-3DV52-PKG1</td>
<td>Set of devices required for 3D vision sensor functionality, including 3D camera head and control unit (applicable machines: RV-FR series)</td>
</tr>
<tr>
<td></td>
<td>Additional camera head</td>
<td>4F-3DV52-OPT1</td>
<td>For field-of-view expansion option</td>
</tr>
<tr>
<td></td>
<td>Field-of-view expansion option</td>
<td>2F-3DV52-OPT2</td>
<td>Expands the field of view by approx. 20° to 28°</td>
</tr>
<tr>
<td>3</td>
<td>Safety option</td>
<td>4F-SF002-01</td>
<td>Devices required by the safety functions</td>
</tr>
</tbody>
</table>

### Option Configurations (Software Expansion Functions)

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Model</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MELFA Smart Plus Card Pack</td>
<td>3F-DQ510</td>
<td>Enables all A-type functions</td>
</tr>
<tr>
<td></td>
<td>MELFA Smart Plus Card</td>
<td>2F-DQ520</td>
<td>Enables all A and B-type functions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2F-DQ511</td>
<td>Selects and enables one function from A-type functions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3F-DQ521</td>
<td>Selects and enables one function from A and B-type functions</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Classification</th>
<th>Name</th>
<th>Type</th>
<th>Function outline</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Calibration assistance function</td>
<td>A</td>
<td>Assists with positional calibration with peripheral devices using 2D vision sensors</td>
</tr>
<tr>
<td></td>
<td>Automatic calibration function</td>
<td>A</td>
<td>Provides a way to improve positioning accuracy by using automatically correcting the vision sensor coordinates</td>
</tr>
<tr>
<td></td>
<td>Workpiece coordinate calibration function</td>
<td>A</td>
<td>Provides a way to improve positioning accuracy by using vision sensor to automatically correct the robot and workpiece coordinates</td>
</tr>
<tr>
<td></td>
<td>Robot-to-robot relative calibration function</td>
<td>A</td>
<td>Uses vision sensors to adjust the relative locations of multiple robots. Provides a way to improve positioning accuracy during coordinated operation</td>
</tr>
<tr>
<td></td>
<td>Robot mechanism temperature compensation function</td>
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<td>Compensates thermal expansion of robot arm, and improves position accuracy</td>
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<td>Function for highly accurate coordination (interpolation) with additional axis (straight coaxial)</td>
</tr>
<tr>
<td></td>
<td>Preventive maintenance function</td>
<td>A</td>
<td>Function for managing robot status by tracking operation status</td>
</tr>
<tr>
<td></td>
<td>MELFA 3D Vision expansion function</td>
<td>B</td>
<td>Automates 3D vision sensor parameter adjustment work, and improves measurement and recognition performance using AI technology</td>
</tr>
</tbody>
</table>
## OPTIONS (D Type Controller)

### Option Configurations (Controllers)

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
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</tr>
</thead>
<tbody>
<tr>
<td>①</td>
<td>Simple teaching box (7, 15 m)</td>
<td>R32TB (-***)</td>
<td>7 m: Standard; 15 m: Special (model name includes &quot;-15&quot;)</td>
</tr>
<tr>
<td>②</td>
<td>High-performance teaching box (7, 15 m)</td>
<td>R56E (-***)</td>
<td>7 m: Standard; 15 m: Special (model name includes &quot;-15&quot;)</td>
</tr>
<tr>
<td>③</td>
<td>Teaching box conversion cable (33-&gt;32)</td>
<td>2F-33CON03M</td>
<td>Conversion cable for connecting the CR800 controller to the R32TB/R56TB. Cable length: 3 m</td>
</tr>
<tr>
<td>④</td>
<td>Parallel input/output unit (sink type)</td>
<td>2A-RZ381</td>
<td>32 outputs/32 inputs</td>
</tr>
<tr>
<td>⑤</td>
<td>External input/output cable (5, 15 m)</td>
<td>2A-CBL**</td>
<td>CBL05: 5 m; CBL15: 15 m, one end unterminated. For 2A-RZ361/371</td>
</tr>
<tr>
<td>⑥</td>
<td>Parallel input/output interface (sink type)</td>
<td>2D-TZ368</td>
<td>32 outputs/32 inputs</td>
</tr>
<tr>
<td>⑦</td>
<td>Encoder distribution unit</td>
<td>2F-YZS81</td>
<td>Unit used for connecting multiple controllers to one rotary encoder when using the tracking function (for 4 robots)</td>
</tr>
<tr>
<td>⑧</td>
<td>Controller protection box</td>
<td>CR800-MB</td>
<td>Houses a controller and provides protection against dust and water. (IP54)</td>
</tr>
<tr>
<td>⑨</td>
<td>Computer support software mini version</td>
<td>3F-15C-WINE</td>
<td>Simplified version (CD-ROM), (RT ToolBox3 mini)</td>
</tr>
<tr>
<td>⑩</td>
<td>Computer support software</td>
<td>3F-14C-WINE</td>
<td>With simulation function (CD-ROM), (RT ToolBox3)</td>
</tr>
<tr>
<td>⑪</td>
<td>Computer support software Pro version</td>
<td>3F-16D-WINE</td>
<td>Professional version (DVD-ROM), (RT ToolBox3 Pro)</td>
</tr>
<tr>
<td>⑫</td>
<td>SD memory card</td>
<td>2F-2GB8SD</td>
<td>2 GB, logging</td>
</tr>
<tr>
<td>⑬</td>
<td>CC-Link interface</td>
<td>2D-TZ576</td>
<td>CC-Link intelligent device station Ver. 2.0, for 1–4 stations</td>
</tr>
<tr>
<td>⑭</td>
<td>Network base card (EtherCAT/IP interface)</td>
<td>2D-TZ535</td>
<td>Communications interface for installation in an HMS Anybus-CompactCom module.</td>
</tr>
<tr>
<td>⑮</td>
<td>Network base card (PROFINET interface)</td>
<td>2D-TZ535-PN</td>
<td>Communications interface for installation in an HMS Anybus-CompactCom module.</td>
</tr>
<tr>
<td>⑯</td>
<td>Network base card (CC-Link/IE Field interface)</td>
<td>2F-DQ335</td>
<td>Communications interface for installation in an HMS Anybus-CompactCom module.</td>
</tr>
<tr>
<td>⑰</td>
<td>Network base card (EtherCAT interface)</td>
<td>2F-DQ35-EC</td>
<td>Communications interface for installation in an HMS Anybus-CompactCom module.</td>
</tr>
</tbody>
</table>

### Option Configurations (Functions)

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<tr>
<th>No.</th>
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<td>Force sensor set</td>
<td>4F-FS002H-W200</td>
<td>Set of devices required for force control functionality, including force sensors, interface unit and support software</td>
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<tr>
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<td>4F-FS002H-W1000</td>
<td></td>
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<tr>
<td>②</td>
<td>MELFA-3D Vision</td>
<td>4F-JDVS2-PKG1</td>
<td>Set of devices required for 3D vision sensor functionality, including 3D camera head and control unit (applicable machines: RV-FR series)</td>
</tr>
<tr>
<td>③</td>
<td>Additional camera head</td>
<td>4F-JDVS2-OPT1</td>
<td>For field-of-view expansion option</td>
</tr>
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<td></td>
<td>Field-of-view option expansion option</td>
<td>2F-JDVS2-OPT2</td>
<td>Expands the field of view by approx. 20° to 28°</td>
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### Classifi- cation

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</table>
OPTIONS

Solenoid valve set

When grippers or various other tools are mounted on the end of the arm, this solenoid valve option is used to control those tools. Fitted with features such as manifolds, couplings and connectors to facilitate mounting on the robot body. The solenoid valve attachment shapes differ depending on the robot. Note the attachment shape before using.

Internal wiring and tubing set for grippers

An air tube and cable set used to run input signal cables from inside the second arm to the shaft tip. An air tube and gripper input signal cable set. Includes grease (for applying to the upper part of the shaft), silicon rubber and cable ties.

Hand output cable

Useful for using solenoid valves other than the optional solenoid valve set. One end can be connected to the gripper output signal connector in the robot. The other end is unterminated (bare cable).

Hand input cable

Used when the air gripper is designed by the customer. Used to convey gripper open/close confirmation signals and grip confirmation signals to the controller. One end can be connected to the gripper input signal connector on the top of the robot body. The other end is connected to a sensor in the gripper designed by the customer.

Hand curl tube

Curl tube for air gripper.

Machine cable (replacement)

Used for replacement of the standard machine cable (5 m) included to extend the distance between robot controller and the robot main unit and connect it. There are 2 types of cables: fixed and flexible. Both type consists of motor signal cable and motor power cable.
Simple teaching box

**R32TB**
- **External dimensions**: 195 (W) × 292 (H) × 106 (D) mm
- **Weight**: Approx. 0.9 kg (body only, excluding cables)
- **Display**: LCD type: 24 characters x 8 rows, backlight
- **Display languages**: Japanese, English

Used for creating, editing and managing programs, to teach operating positions and for jogging. Fitted with a 3-position enabling switch to ensure safe use. When multiple robots are used, the connections can be switched to a single teaching box. The connections can be switched when the power is shut off.

Parallel input/output unit

**Input**
- **Model**: DC input
- **No. of input**: 32
- **Isolation method**: Photocoupler isolation
- **Rated input voltage**: 12 V DC, 24 V DC
- **Rated input current**: Approx. 3 mA, Approx. 7 mA

**Output**
- **Model**: Transistor output
- **No. of outputs**: 32
- **Isolation method**: Photocoupler isolation
- **Rated load voltage**: 12/24 V DC
- **Maximum load current**: 0.1 A/output

Used when external input/outputs are added. Connector cables for external devices are not included. External input/output cables (for parallel input/output units) are available as options. Both sink and source types are available.

Parallel input/output interface

**Input**
- **Model**: DC input
- **No. of input**: 32
- **Isolation method**: Photocoupler isolation
- **Rated input voltage**: 12 V DC, 24 V DC
- **Rated input current**: Approx. 3 mA, Approx. 7 mA

**Output**
- **Model**: Transistor output
- **No. of outputs**: 32
- **Isolation method**: Photocoupler isolation
- **Rated load voltage**: 12/24 V DC
- **Maximum load current**: 0.1 A/output

Installing this option on the controller allows external input/output to be used. Connector cables for external devices are not included. External input/output cables (for parallel input/output interfaces) are available as options. The input/output specifications are the same as for PLC interfaces. Both sink and source types are available.

External input/output cables (for parallel input/output units)

<table>
<thead>
<tr>
<th>Cable size x No. of cores</th>
<th>AWG#28 x 25P (50 cores)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total length:</td>
<td>5 or 15 m</td>
</tr>
</tbody>
</table>

This is a dedicated cable for connecting external peripheral devices to parallel input/output unit connectors. One end is matched to the parallel input/output unit and the other end is unterminated. Input/output signals from peripheral devices should be connected via the unterminated end of the cable. One cable supports 16 inputs and 16 outputs. If a parallel input/output unit is installed, 32 inputs and 32 outputs are connected per unit, so two cables must be added.

External input/output cables (for parallel input/output interfaces)

<table>
<thead>
<tr>
<th>Cable size x No. of cores</th>
<th>AWG#28 x 20P (40 cores)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total length:</td>
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</tr>
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</table>

This is a dedicated cable for connecting external peripheral devices to parallel input/output interface connectors. One end is matched to the parallel input/output interface and the other end is unterminated. Input/output signals from peripheral devices should be connected via the unterminated end of the cable. One cable supports 16 inputs and 16 outputs. If a parallel input/output interface is installed, 32 inputs and 32 outputs are connected per unit, so two cables must be added.

High-performance teaching box

**R56TB**
- **External dimensions**: 252 (W) × 240 (H) × 114 (D) mm
- **Weight**: Approx. 1.3 kg (body only, excluding cables)
- **Interface**: USB port (1)
- **Display**: 6.5-inch TFT (640 × 480)
  Color touch-screen, backlight
- **Display languages**: Japanese, English

High-performance teaching box with improved monitor function in addition to the R32TB function.

Parallel input/output unit

**Input**
- **Model**: DC input
- **No. of input**: 32
- **Isolation method**: Photocoupler isolation
- **Rated input voltage**: 12 V DC, 24 V DC
- **Rated input current**: Approx. 3 mA, Approx. 7 mA

**Output**
- **Model**: Transistor output
- **No. of outputs**: 32
- **Isolation method**: Photocoupler isolation
- **Rated load voltage**: 12/24 V DC
- **Maximum load current**: 0.1 A/output

Installing this option on the controller allows external input/output to be used. Connector cables for external devices are not included. External input/output cables (for parallel input/output interfaces) are available as options. The input/output specifications are the same as for PLC interfaces. Both sink and source types are available.

Options

**Simple teaching box**

- **R32TB**
  - **External dimensions**: 195 (W) × 292 (H) × 106 (D) mm
  - **Weight**: Approx. 0.9 kg (body only, excluding cables)
  - **Display**: LCD type: 24 characters x 8 rows, backlight
  - **Display languages**: Japanese, English

**Parallel input/output unit**

- **Input**
  - **Model**: DC input
  - **No. of input**: 32
  - **Isolation method**: Photocoupler isolation
  - **Rated input voltage**: 12 V DC, 24 V DC
  - **Rated input current**: Approx. 3 mA, Approx. 7 mA

- **Output**
  - **Model**: Transistor output
  - **No. of outputs**: 32
  - **Isolation method**: Photocoupler isolation
  - **Rated load voltage**: 12/24 V DC
  - **Maximum load current**: 0.1 A/output

**Parallel input/output interface**

- **Input**
  - **Model**: DC input
  - **No. of input**: 32
  - **Isolation method**: Photocoupler isolation
  - **Rated input voltage**: 12 V DC, 24 V DC
  - **Rated input current**: Approx. 3 mA, Approx. 7 mA

- **Output**
  - **Model**: Transistor output
  - **No. of outputs**: 32
  - **Isolation method**: Photocoupler isolation
  - **Rated load voltage**: 12/24 V DC
  - **Maximum load current**: 0.1 A/output

**External input/output cables (for parallel input/output units)**

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## OPTIONS

### CC Link Interface

<table>
<thead>
<tr>
<th>Communication functions</th>
<th>Bit/word data transfer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Station type</td>
<td>Intelligent device station</td>
</tr>
<tr>
<td>Support station</td>
<td>Local station (no master station function)</td>
</tr>
<tr>
<td>CC-Link-compatible version</td>
<td>Ver.2, allows extended cyclic configuration</td>
</tr>
<tr>
<td>No. of isolated stations</td>
<td>Isolation of 1, 2, 3 or 4 stations can be configured</td>
</tr>
</tbody>
</table>

The CC-Link interface option augments CC-Link functionality by allowing cyclic transmission of word data as well as bit data to the robot controller.

### EtherNet/IP-compatible network base card

<table>
<thead>
<tr>
<th>Installation module</th>
<th>AB6514</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmission specifications</td>
<td>10BASE-T/100BASE-TX</td>
</tr>
<tr>
<td>No. of inputs</td>
<td>Max. 2,048</td>
</tr>
<tr>
<td>No. of outputs</td>
<td>Max. 2,048</td>
</tr>
</tbody>
</table>

EtherNet/IP communication can be achieved by having the customer install an HMS Anybus-CompactCom module (order code: AB6514) in the network base card (2D-TZ535).

### EtherCAT-compatible network base card

<table>
<thead>
<tr>
<th>Installation module</th>
<th>AB6707</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmission specification</td>
<td>100Mbps (100BASE-TX)</td>
</tr>
<tr>
<td>No. of inputs</td>
<td>Bit device: Max. 256 points</td>
</tr>
<tr>
<td>No. of outputs</td>
<td>Word device: Max. 128 points</td>
</tr>
</tbody>
</table>

EtherCAT communication can be achieved by having the customer mount an Anybus-CompactCom module (order code: AB6707) on the network base card (2F-DQ535-EC).

### CC-LinkIE Field-compatible network base card

<table>
<thead>
<tr>
<th>Installation module</th>
<th>AB6709</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmission specifications</td>
<td>1Gbps (1000BASE-T)</td>
</tr>
<tr>
<td>No. of inputs</td>
<td>Max. 2,048</td>
</tr>
<tr>
<td>No. of outputs</td>
<td>Max. 2,048</td>
</tr>
</tbody>
</table>

CC-Link IE Field communication can be achieved by having the customer install an HMS Anybus-CompactCom module (order code: AB6709) in the network base card (2F-DQ535).

### PROFINET-compatible network base card

<table>
<thead>
<tr>
<th>Installation module</th>
<th>AB6489-B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmission specifications</td>
<td>100BASE-TX</td>
</tr>
<tr>
<td>No. of inputs</td>
<td>Max. 2,040</td>
</tr>
<tr>
<td>No. of outputs</td>
<td>Max. 2,040</td>
</tr>
</tbody>
</table>

PROFINET I/O communication can be achieved by having the customer install an HMS Anybus-CompactCom module (order code: AB6489-B) in the network base card (2D-TZ535-PN).

### Safety option

Allows people to approach and enter the work area without stopping the robot.

<table>
<thead>
<tr>
<th>Safety expansion unit</th>
<th>Input signal</th>
<th>8 systems (duplicated)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Output signal</td>
<td>4 systems (duplicated)</td>
</tr>
<tr>
<td>External dimensions</td>
<td>115 x 168 x 190mm</td>
<td></td>
</tr>
<tr>
<td>Applicable robot controller</td>
<td>CR800-R/G/D</td>
<td></td>
</tr>
</tbody>
</table>

### Controller protection box

Houses a controller and provides protection against dust and water. (IP54)
The new R56TB teaching box delivers enhanced robot operations. Outfitted with monitoring functions on par with PC support software, it has become even easier to use to edit programs, set parameters, and display I/O status. The touch panel GUI allows easy programming and monitoring, and switches arranged around the panel ensure efficient robot operations. The teaching box is also equipped with a USB memory interface for backing up controller data without the use of a PC.

An upgraded teaching box model to R32TB. In addition to “training” the robot, its LCD display and monitoring functions can be effectively used for debugging tasks.

### Specifications/Functions

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>External dimensions</td>
<td>252mm (W) × 240mm (H) × 114mm (D)</td>
</tr>
<tr>
<td>Body color</td>
<td>Dark gray</td>
</tr>
<tr>
<td>Weight</td>
<td>1.3kg (main unit only, excluding cable)</td>
</tr>
<tr>
<td>Connection method</td>
<td>Connection with controller using a dedicated connector</td>
</tr>
<tr>
<td>Interface</td>
<td>1 USB port</td>
</tr>
<tr>
<td>Display</td>
<td>6.5&quot; TFT color LCD display; 4 status indicator LEDs</td>
</tr>
<tr>
<td>Operation panel</td>
<td>Touch panel, emergency stop button, enabling switch (3 positions), 18 button, wheel, 30 operation keys</td>
</tr>
<tr>
<td>Display languages</td>
<td>Japanese, English</td>
</tr>
</tbody>
</table>

### Features

#### Improved display performance

- Adopts a VGA (640×480) full-color touch panel for user-friendly screen layouts.
- Visual menu screens ensure easy operations.

#### Functions on par with PC software

- Program editing screens use a large layout (6.5") to display programs in an easy-to-understand fashion.
- Programs can be written and parameter names entered easily using the keyboard screen.
- Text can also be entered using a stylus pen.
- Program debugging time can be shortened via screen operations, such as the I/O monitor screen, which was not available with R32TB.

#### USB connection interface

By connecting USB memory, controller data may be backed up without the need to have a PC on site. Program information, parameter information, system information, and other such data may be backed up, as with a PC.

#### Enhanced user-friendliness

The teaching box can be held with one gripper by gripping the grip handle, and the enable switch operated with a finger on the same gripper. The other gripper can be used to operate the touch panel and buttons. The right and left grippers may be interchanged.

#### User-defined screen functions

Monitor screens may be individually created to suit each user’s debugging task. Debugging time is shortened by being able to easily display the screen to monitor.

#### Operations panel

The robot operations screen provides the same functions as the robot controller panel, and may be used to activate such automated operations as servo on/off, startup, shutdown, reset, and program selection.
Assembly/processing tasks are performed in the same manner as a human being, while sensing the force that is applied to the gripper. Tasks requiring subtle adjustment and detection of force can be performed.

---

### Force Sensor Set

Model 4F-FS002H-W200/1000

**Improved production stability**

Parts can be inserted/attached without damage, while adjusting for displacement absorptions caused by parts variations and subtle external forces. Work stability is improved by position latching and retry processing at times of work failure. Furthermore, quality can be managed using log data, and the causes of work errors can be analyzed.

**Realization of complex assembly and processing tasks**

Parts can be inserted/attached without damage, while adjusting for subtle external forces. Action direction and pushing force can be changed by detecting the contact force, and interrupt processing can be performed using trigger conditions that combine position information and force information.

**Easy control**

Programs can be easily created using dedicated robot language. Based on representative examples of application programs, work programs can be easily created in response to each customer’s required task.

**Product features**

<table>
<thead>
<tr>
<th>Item</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Force control</td>
<td>Function for controlling robots while applying a specified force</td>
</tr>
<tr>
<td>Stiffness control</td>
<td>Function for controlling the stiffness of robot appendages</td>
</tr>
<tr>
<td>Gain changes</td>
<td>Function for changing control characteristics while the robot is running</td>
</tr>
<tr>
<td>Execution of interrupts</td>
<td>Interrupts can be executed (EO triggers) under trigger conditions combining position and force information.</td>
</tr>
<tr>
<td>Data latch</td>
<td>Function for acquiring force sensor and robot positions while contact made</td>
</tr>
<tr>
<td>Synchronous data</td>
<td>Function for displaying force sensor data and maintaining maximum values</td>
</tr>
<tr>
<td>Start/stop trigger</td>
<td>Allows logging start/stop commands to be specified in robot programs</td>
</tr>
<tr>
<td>FTP transmission</td>
<td>Function for transferring acquired log files to the FIP server</td>
</tr>
<tr>
<td>Force sense control</td>
<td>Enables/disables force sensor control and sets control conditions while jogging.</td>
</tr>
<tr>
<td>Force sensor monitor</td>
<td>Displays sensor data and the force sensor control status.</td>
</tr>
<tr>
<td>Teaching position</td>
<td>Function for searching for the contact position.</td>
</tr>
<tr>
<td>Parameter setting screen</td>
<td>Parameter setting screen dedicated for the force sensor function. (For R965VR07TB)</td>
</tr>
</tbody>
</table>

**System Configuration**

![Diagram](image)

**Product Configuration**

<table>
<thead>
<tr>
<th>Item</th>
<th>Qty.</th>
<th>Name</th>
<th>Qty.</th>
</tr>
</thead>
<tbody>
<tr>
<td>① Force sensor</td>
<td>Qty.1</td>
<td>Force sensor</td>
<td></td>
</tr>
<tr>
<td>② Force sensor interface unit</td>
<td>Qty.1</td>
<td>Force sensor interface unit (2F-DQ561)</td>
<td></td>
</tr>
<tr>
<td>③ Sensor adapter (*1)</td>
<td>Qty.1</td>
<td>Sensor adapter</td>
<td></td>
</tr>
<tr>
<td>④ Adapter cable</td>
<td>Qty.1</td>
<td>Adapter cable</td>
<td></td>
</tr>
<tr>
<td>⑤ Force control power supply</td>
<td>Qty.1</td>
<td>24V DC power supply</td>
<td></td>
</tr>
<tr>
<td>⑥ Force sensor interface unit</td>
<td>Qty.1</td>
<td>24V DC power supply cable</td>
<td></td>
</tr>
<tr>
<td>⑦ Serial cable between the unit and sensor</td>
<td>Qty.1</td>
<td>Serial cable between the unit and sensor</td>
<td></td>
</tr>
</tbody>
</table>

---

### Force Sensor Specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
<th>Specification Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated load</td>
<td>4F-FS002H-W200</td>
<td>4F-FS002H-W1000</td>
</tr>
<tr>
<td>Max. static load</td>
<td>Fx, Fy, Fz</td>
<td>N       200 1000</td>
</tr>
<tr>
<td></td>
<td>Mx, My, Mz</td>
<td>Nm      4 30</td>
</tr>
<tr>
<td>Breaking load</td>
<td>Fx, Fy, Fz</td>
<td>N       0.3</td>
</tr>
<tr>
<td></td>
<td>Mx, My, Mz</td>
<td>Nm      0.03</td>
</tr>
<tr>
<td>Consumption current</td>
<td>mA</td>
<td>200</td>
</tr>
<tr>
<td>Weight (sensor unit)</td>
<td>g</td>
<td>360</td>
</tr>
<tr>
<td></td>
<td>580</td>
<td></td>
</tr>
<tr>
<td>External dimensions</td>
<td>mm</td>
<td>±80×32.5</td>
</tr>
<tr>
<td></td>
<td>±60×40</td>
<td></td>
</tr>
<tr>
<td>Protective structure</td>
<td>–</td>
<td>IP50</td>
</tr>
</tbody>
</table>

### Force Sense Interface Unit Specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
<th>Specification Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface</td>
<td>RS-422</td>
<td>ch</td>
</tr>
<tr>
<td></td>
<td>SSCNET II/H</td>
<td>ch</td>
</tr>
<tr>
<td>Power supply</td>
<td>Vdc</td>
<td>24±5%</td>
</tr>
<tr>
<td></td>
<td>W</td>
<td>25</td>
</tr>
<tr>
<td>External dimensions</td>
<td>mm</td>
<td>225(W)×111(D)×48(H)</td>
</tr>
<tr>
<td>Weight (robot controller)</td>
<td>kg</td>
<td>Approx. 0.8</td>
</tr>
<tr>
<td>Construction</td>
<td>–</td>
<td>IP20 (Panel installation, open type)</td>
</tr>
</tbody>
</table>

### Sensor mounting adapter (for 4F-FS002H-W1000)

<table>
<thead>
<tr>
<th>Name of product</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor mounting adapter (for RV-2/4/7FR)</td>
<td>1F-FSLGSET-01</td>
</tr>
<tr>
<td>Sensor mounting adapter (for RV-13/20FR)</td>
<td>1F-FSLGSET-02</td>
</tr>
</tbody>
</table>

*1 Not included in 4F-FS002H-W1000. An adapter needs to be selected from the chart at right and purchased separately in accordance with your robot model.
MELFA-3D Vision 2.0 Model 4F-3DVS2-PKG3

This compact 3D vision sensor for small robots delivers high-speed, high-accuracy measurements. It is an optimum replacement for a parts feeder, and performs high-speed picking owing to its unique model-less recognition processing.

**Compact and lightweight**
The compact and lightweight body (camera head: 146x87x137 mm, approx. 0.9kg) is ideal for fixed installations and eye-in-gripper configurations.

**High-speed, high-accuracy measurement**
High-accuracy measurement is realized by a high-speed recognition of 0.2 seconds at the quickest (model-less recognition) and a minimum measuring error of approx. 0.3mm.

**As a replacement for a parts feeder**
One of two types of recognition methods may be selected:
- Model-less recognition: The position of a workpiece is recognized without registering its model.
- Model matching recognition: Workpiece pose is recognized using a 3D-CAD model.

Compared to a parts feeder, the 3D vision sensor is less expensive and has a smaller footprint (when handling multiple parts). Rety operations can reduce frequent stoppages.

**Connection compatibility befitting a robot manufacturer**
Direct connection is possible via LAN, which is equipped on the controller as a standard feature, and sensor settings and operation checks can be made easily using a PC. The PC, however, is not needed while the sensor is operating. The sensor can calibrate the coordinates of the robot and vision sensor as a standard feature, and realize easy control by using dedicated commands that have been added to MELFA-BASIC.

**Product specifications**

### Item Specifications

<table>
<thead>
<tr>
<th>Measurement method (*1)</th>
<th>Triangulation method (Pattern light projection type)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement time</td>
<td>Approx. 1.3 to 1.8 seconds</td>
</tr>
<tr>
<td>Recognition method</td>
<td>Model-less: Workpiece registration-free method (6 degrees of freedom: XYZABC) / Model matching: 3D-CAD utilizing method (6 degrees of freedom: XYZABC)</td>
</tr>
<tr>
<td>Processing time (*2)</td>
<td>Model-less: Approx. 1.7 to 3.2 seconds / During measurement: Model matching: Approx. 1.2 to 3.2 seconds</td>
</tr>
<tr>
<td>Measurement efficient points (*3)</td>
<td>Approx. 30,000 to 60,000 points</td>
</tr>
<tr>
<td>Measurement viewing angle (*3)</td>
<td>Approx. 15 to 30 degrees (standard field-of-view) / Approx. 20 to 38 degrees (extended option field-of-view)</td>
</tr>
<tr>
<td>Workpiece distance (*4)</td>
<td>500 to 1500 mm</td>
</tr>
<tr>
<td>Measuring error (*3)</td>
<td>0.3 mm or more</td>
</tr>
<tr>
<td>External dimensions (*5)</td>
<td>Camera head section (Minimum size: For registration to reduces 3-step variable) 146 (W) x 87 (H) x 137 (D) mm</td>
</tr>
<tr>
<td>Weight</td>
<td>Approx. 0.9 kg (Camera head part)</td>
</tr>
</tbody>
</table>

### General specifications

- Ambient temperature: 5 to 40°C (Camera head section: 0 to 40°C)
- Ambient humidity: 45 to 95%RH, with no condensation
- Usage atmosphere: With no corrosive gas

### Power supply

- 24V DC

---

**Options**

1. The following workpieces cannot be measured.
   - Transparent objects and mirror face objects
   - High-gloss objects, black objects, or deep color objects
   - Workpiece size (Reference values)
     - Model-less: Short side = 1/2 of the viewing field size to Long side = 1/3 of the viewing field size
     - Model matching: Short side = 1/10 of the viewing field size to Long side = 1/3 of the viewing field size

2. The workpiece size depends on the conditions of the workpiece distance, sensor parameters, and the shape and surface of the workpiece. The reference values are based on Mitsubishi test conditions. For details, refer to instruction manuals.

3. Whether the measurement can be performed or not and the measurement accuracy depend on individual conditions. For details, please contact Mitsubishi.

4. For model-less picking, a 2D vision sensor may be required in addition to a 3D vision sensor.

**Products prepared by customers**

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal computer (3DV control IPC)</td>
<td>O/S: Windows 10 Professional/Enterprise (64bit)<strong>1</strong> CPU: Intel Core i7-7 (4 cores or more) RAM: 4GB or more / HDD: 100GB or more **1) (24GB) or more is required when using MELFA Smart Plus / Gigabit Ethernet portx1</td>
<td>1 unit</td>
</tr>
<tr>
<td>Personal computer (for setting)</td>
<td>RT ToolBox3 installed (can be used with 1)</td>
<td>1 unit</td>
</tr>
<tr>
<td>Switching hub</td>
<td>100BASE-T1 or later</td>
<td>1 unit</td>
</tr>
<tr>
<td>LAN cable</td>
<td>Category 5a or later</td>
<td>2 to 3 cables</td>
</tr>
<tr>
<td>24 VDC power supply</td>
<td>For camera head</td>
<td>1</td>
</tr>
</tbody>
</table>

**Precautions**

1. The following workpieces cannot be measured.
   - Transparent objects and mirror face objects
   - High-gloss objects, black objects, or deep color objects

2. The workpiece size depends on the conditions of the workpiece distance, sensor parameters, and the shape and surface of the workpiece. The reference values are based on Mitsubishi test conditions. For details, refer to instruction manuals.

3. Whether the measurement can be performed or not and the measurement accuracy depend on individual conditions. For details, please contact Mitsubishi.

4. For model-less picking, a 2D vision sensor may be required in addition to a 3D vision sensor.

5. The applicable model is the vertical, multiple-joint type RV-F Series.

**Component specifications**

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Camera head</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Mounting base set (Small, Medium, Large)</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Calibration jig</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>CD-ROM (MELFA-3D Vision software, instruction manual, setup guide, etc.)</td>
<td>1</td>
</tr>
</tbody>
</table>

---

*Required only when using AI function.*
Software for program creation and total engineering support.

This is PC software that supports all processes from system startup to debugging and operations, including programming and editing, verification of the scope of operations prior to introducing a robot, estimation of tact time, robot debugging prior to startup, and monitoring of robot conditions and malfunctions during operations.

### Windows® compatible
- Easy operations on Windows®
- Compatible with Windows® XP, Windows® Vista, Windows® 7, 8, 8.1, 10 (32-bit version 1.8 or later, 64-bit version 2.0 or later)

### Simulation functions
- Compatible with all models that connect to the CRN-500 Series, CRN-700 Series, CRN-750 Series, and CRN-800 Series controllers.
- Robot movements and tact times can be calculated using a PC (not available with the mini version).
- Robot movements, operational status, input signals, and servo conditions can be monitored.

### Program editing and debugging functions
Programs are created using MELFA-BASIC IV, V and VI. A multi-window format has been adopted for greater work efficiency and enhanced editing. Operations such as program step executions and breakpoint settings can be conveniently verified.

### 3D viewer
The 3D viewer allows easy verification of robot poses and movements, verification of the limit values of user-defined parameters, and virtual placements of peripheral devices by basic objects. It can also be used to check for interferences between the robot and peripheral devices. Distance measuring functions are also available on the screen.

### Full support, from programming to startup and maintenance
- Programs can be edited using MELFA-BASIC IV, V and VI and (varies depending on the model).
- Robot movements, operational status, input signals, and servo conditions can be monitored.

### Enhanced maintenance functions
- Equipped with a maintenance forecast function that notifies users of the robot’s greasing time and battery life, and an assistance function for position recovery in the event of trouble, the software is effective for preventive maintenance and for shortening recovery time.
- Data is managed by project, to allow collective backup of the entire system.

### Program execution status, variables, I/O signals, etc. can be monitored.

### Measurement of cycle times
Simulated operations can be saved to a video file (AVI format).

### Interference checks
Items that are to be subject to an interference check may be specified simply by clicking on it.

### Jog function
A robot displayed in SolidWorks® can be jogged, just as a teaching box can jog a robot.

### Maintenance functions
Maintenance functions include maintenance forecasts, position recovery support, parameter management, etc.

---

**<Example of a Pick & Place program>**

- **Move to erection point**
- **Move to workpiece position**
- **Workpiece extraction position**
- **Closed hand**
- **Wait 0.2 seconds**
- **Move above workpiece extraction position**
- **Wait for signal**
- **Move above workpiece placement position**
- **Open hand**

**Classification and Main functions**

- **Classification**
  - Movements
  - Input/output
  - Numerical operations
  - Additional functions

- **Main functions**
  - Joint, linear, and circular interpolation, optimal acceleration/deceleration control, collision detection, singular point passage control
  - Digital/analog signals, interrupt control
  - Arithmetical calculation, pose positioning, character strings, logic operations
  - Multi-tasking, tracking, vision sensor functions

---

*Windows® is registered trademark of Microsoft Corporation in the United States and other countries.*
RT ToolBox3 Pro

A 3D robot simulator that provides powerful support for system designs and preliminary layout examinations.

RT ToolBox3 Pro allows robot simulations to be run on SolidWorks® 3D CAD software. Programs can be created to match today's era of high-mix, low-volume production, such as for layout considerations prior to introducing robots, desktop program debugging, and generation of complex motion paths.

By linking an add-in tool to SolidWorks® 3D CAD software, robot simulation functions can be added on to SolidWorks® platform.

*1) SolidWorks® is a registered trademark of SolidWorks Corporation (USA).
*2) An add-in tool is a software program that adds certain functions to application software packages.

### Features

**Automatic robot program creation function**

By loading 3D CAD data (*3) of the relevant workpiece to SolidWorks® and setting processing conditions and areas, teaching position data and robot movement programs that are necessary to operate the robot can be generated automatically. Programs can be automatically created even for workpieces with complex shapes that require multiple teaching position data.

*3) Formats that can be loaded into SolidWorks®

![List of functions](image)

**Data loading from peripheral devices and making rearrangements**

Data of parts created with SolidWorks® can be loaded into the simulator. The loaded parts can be rearranged by numerical input.

**Installation of grippers**

Grippers designed and created with SolidWorks® can be installed on selected robots. An Auto Tool Changer (ATC) can also be specified for each gripper.

**Handling workpieces**

Workpieces can be handled without fail by simulating gripper signal control using a robot program.

**CAD links**

Work data for performing sealing operations and other such tasks that require many teaching steps can be easily created by selecting the processing area on the 3D CAD data. Since work data is created from 3D CAD data, even complex 3D curves can be generated, and the number of teaching steps can be significantly reduced.

**Offline teaching**

Robot poses can be "taught" on screen, in advance.

**Creation of robot programs (templates)**

Workflows can be created by combining offline teaching and CAD links, and converted to robot programs (MELFA BASIC IV, V format).

**Specifying robot programs**

Robot programs may be used as they are without modifications, and can be specified for each task slot.

**Simulation of robot operations**

Robot programs, including I/O signals, can be simulated. That is, the operations of the actual system can be reproduced as they are. The I/O signals of a robot controller may be simulated according to two methods: (1) by defining movements associated with I/O signals in a simple manner, or (2) by linking robot programs with GX Simulator2/3.

**Displaying robot trajectories**

The trajectories of robot operations can be displayed by locus lines in space.

**Interference checks**

Interferences between the robot and peripheral devices can be checked. Items that are to be subject to an interference check may be specified simply by clicking on it on screen. If an interference is detected, information about the interference (name of the part, the program line that was executed and the position of the robot when the interference occurred, etc.) may be stored in a log file.

**Saving videos**

Simulated operations can be saved to a video file (AVI format).

**Measurement of cycle times**

The cycle time of robot operations can be measured in a manner resembling a stopwatch. The cycle time of specified locations of a program can also be measured.

**Robot program debugging functions**

The following functions are provided for debugging robot programs.

- Stepped operation: Specified programs are executed one step at a time.
- Breakpoint: Breakpoints can be inserted in a specified program.
- Direct execution: Arbitrary robot commands are executed.

**Jog function**

A robot displayed in SolidWorks® can be jogged, just as a teaching box can jog a robot.

**Traveling axis**

A traveling axis can be installed in the robot, for examination of the operations of a system equipped with a traveling axis.

**Calibration**

The point sequence data of CAD coordinates created using CAD links is corrected into robot coordinate data, and the operations program and point sequence data are sent to the robot. In consideration of the frequent need for calibration onsite, the calibration tool is an application separate from SolidWorks®, designed to run efficiently on a laptop PC that does not have SolidWorks® software.
Multifunctional Electric Gripper Option

The multifunctional electric gripper option supports customer’s various applications with various functions, great lineup, and highly accurate gripping.

Highly advanced control impossible with air cylinders

Grip patterns can be set according to the grip target, such as soft workpieces and heavy workpieces, with the torque specification and grip speed setting.

Even when target workpieces are different in size, the optimal stroke can be specified with the operation position specification.

New applications will be available.

Components

<table>
<thead>
<tr>
<th>Name</th>
<th>Quantity</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Electric gripper</td>
<td>1</td>
<td>Select the model by the grip force and stroke.</td>
</tr>
<tr>
<td>2) Electric gripper control unit</td>
<td>1</td>
<td>Connected to the electric gripper.</td>
</tr>
<tr>
<td>gripper cable</td>
<td>1</td>
<td>Connects the electric gripper and control unit.</td>
</tr>
<tr>
<td>Robot cable</td>
<td>1</td>
<td>The cable type depends on the robot model.</td>
</tr>
</tbody>
</table>

Specifications of the electric gripper control unit

<table>
<thead>
<tr>
<th>Item</th>
<th>Specifications</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>External dimensions</td>
<td>60 (W) × 60 (D) × 40 (H)</td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>Approx. 200 g</td>
<td></td>
</tr>
<tr>
<td>Input power source</td>
<td>24 V DC ±10%, 1 A (max.)</td>
<td>Powered by the robot controller. (Customers need to prepare no power supplies.)</td>
</tr>
<tr>
<td>No. of teaching points</td>
<td>32 points</td>
<td>Position data for multiple-point position control</td>
</tr>
</tbody>
</table>

* Only one model of the electric gripper control unit is available for the electric grippers.

(1) To install the electric gripper to a mechanical interface, fabricate an attachment separately.

(2) The cable of the electric gripper is not designed to be resistant to bending.

Take cautions to prevent any stress from applying to the cable while the robot is operating.

For RV-2F

Component names and specifications are as follows.

Components

- Electric gripper: 4F-MEHGR-01
- Gripper cable: 4F-MEHGR-02
- Control unit for the electric gripper: 4F-MEHCU-01
- Electric gripper control unit installation stand: 4F-MEHCU-02
- Electric gripper installation flange: RH-20FH(M)(C)8535
- Force sensor: 1F-HA01S-01
- Relay cable: RV-F-SH02/SH-03
- Banding band/fixing plate: RV-2F series —SH02
- Standard (external wiring) specifications: RV-2F series
- External wiring unit for the forearm: RV-4F/7F/13F/20F series

Specifications Remarks

- 4F-MEHGR-01: When the gripper input signal and Ethernet signal are used together
- 1F-HA02S-01: When the gripper input signal and vision sensor signal are used together
- 1F-HA01S-01: When the force sensor signal and Ethernet signal are used together

External wiring sets (option) need to be connected to each of the forearm part and base part.

As required

Quantity Purchased at Remarks

Please contact your local representative or sales office.
## Configuration requirement of the multi-function electric gripper

### RV-2F series

<table>
<thead>
<tr>
<th>No.</th>
<th>Name: model</th>
<th>Quantity</th>
<th>Purchased at</th>
<th>Remarks</th>
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<tbody>
<tr>
<td>1</td>
<td>Electric gripper</td>
<td>1</td>
<td></td>
<td>Electric gripper used by customers</td>
</tr>
<tr>
<td>2</td>
<td>Control unit for the electric gripper: 4F-MEHCU-01</td>
<td>1</td>
<td>Mitsubishi Electric</td>
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<tr>
<td>3</td>
<td>Electric gripper installation flange</td>
<td>1</td>
<td>Fabricated by customers</td>
<td>Electric gripper used by customers</td>
</tr>
<tr>
<td>4</td>
<td>Robot</td>
<td>1</td>
<td>Mitsubishi Electric</td>
<td>Standard specifications</td>
</tr>
<tr>
<td>5</td>
<td>Bending band/fixing plate</td>
<td>As required</td>
<td>Fabricated by customers</td>
<td>For fixing a cable</td>
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</tbody>
</table>

### RV-4F/7F/20F series, external wiring specifications

<table>
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<tr>
<th>No.</th>
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<th>Quantity</th>
<th>Purchased at</th>
<th>Remarks</th>
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<tr>
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<td></td>
<td>Electric gripper used by customers</td>
</tr>
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<td>2</td>
<td>Control unit for the electric gripper: 4F-MEHCU-02</td>
<td>1</td>
<td>Mitsubishi Electric</td>
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</tr>
<tr>
<td>3</td>
<td>Adapter cable: 4F-MEHCBL-01</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Electric gripper installation flange</td>
<td>1</td>
<td>Fabricated by customers</td>
<td>For fixing the tip of the electric gripper</td>
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<tr>
<td>5</td>
<td>Electric gripper control unit installation stand</td>
<td>1</td>
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<td>For wiring from a forearm</td>
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### RH-3/6/12/20F series

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<th>Purchased at</th>
<th>Remarks</th>
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<td>1</td>
<td>Electric gripper</td>
<td>1</td>
<td></td>
<td>Electric gripper used by customers</td>
</tr>
<tr>
<td>2</td>
<td>Control unit for the electric gripper: 4F-MEHCU-02</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Relay cable</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>External wiring unit for the base</td>
<td>1</td>
<td>Mitsubishi Electric</td>
<td>Standard specifications, External wiring sets (option) need to be connected to each of the forearm part and base part.</td>
</tr>
<tr>
<td>5</td>
<td>External wiring unit for the forearm</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Robot, standard (external wiring) specifications</td>
<td>1</td>
<td></td>
<td>1F-HA01S-01: When the gripper input signal and Ethernet signal are used together 1F-HA02S-01: When the force sensor signal and Ethernet signal are used together</td>
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<tr>
<td>7</td>
<td>Wrist wiring internal-wiring specifications: RV-4F-5F</td>
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<td></td>
<td>RV-4F-5F: SH02-03</td>
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</table>

### RV-4F/7F/13F/20F series, piping internal wiring specifications

#### Specifications

<table>
<thead>
<tr>
<th>Accessory</th>
<th>Possible gripper configuration</th>
<th>External wiring set for the forearm</th>
<th>External wiring set for the base</th>
<th>Remarks</th>
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<tbody>
<tr>
<td>SH02</td>
<td>Electric gripper + gripper input signal + Vision sensor</td>
<td>–</td>
<td>1F-HA01S-01</td>
<td>An external wiring set for the base is enclosed with the internal wiring type robot.</td>
</tr>
<tr>
<td>SH03</td>
<td>Electric gripper + Vision sensor + Force sensor</td>
<td>–</td>
<td>1F-HA02S-01</td>
<td></td>
</tr>
</tbody>
</table>

![Diagram of gripper setup](image-url)
The AnyWire ASLINK wiring system can be incorporated in MELFA robots, to resolve gripper wiring problems. By connecting the AnyWire dedicated cable unit to the standard wiring of a conventional robot, all 256 I/O points of the robot gripper can be used without drawing external wiring to the robot arm.

By introducing AnyWire ASLINK...

**Before introduction**
- Increased weight
- Disconnection!

**External wiring multicore cable**

**After introduction**
- General-purpose cable can be used
- Reduced wiring work
- Reduced risk of disconnection

**Four-core cable**
- Large distribution with fewer wires
- Compact and lightweight
- High-performance gripper movements

**Issues:**
- Limited number of wires in multi-core cable
- Increased size due to relay box
- Increased weight
- Frequent stoppages due to disconnection

**MELFA × AnyWire ASLINK wiring/device calibration**

<table>
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<tr>
<th>No.</th>
<th>Device</th>
<th>Model</th>
<th>Quantity</th>
<th>Supplier</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Forearm external wiring set</td>
<td>1F-HB02S-01</td>
<td>1</td>
<td>Mitsubishi</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Base external wiring set</td>
<td>1F-HA02S-01</td>
<td>1</td>
<td>Mitsubishi</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>AnyWire ASLINK unit</td>
<td></td>
<td>n</td>
<td>AnyWire</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Forearm conversion adapter cable</td>
<td>BL2-RVAS</td>
<td>1</td>
<td>AnyWire</td>
<td>200mm fixed cable</td>
</tr>
<tr>
<td>5</td>
<td>Base conversion adapter cable</td>
<td>BL2-RVBS</td>
<td>1</td>
<td>AnyWire</td>
<td>200mm fixed cable</td>
</tr>
<tr>
<td>6</td>
<td>AnyWire ASLINK master unit</td>
<td>QJ51AW12AL</td>
<td>1</td>
<td>Mitsubishi</td>
<td>For Mitsubishi Electric PLCs</td>
</tr>
</tbody>
</table>

Of the external wiring set, the cable for:
1. gripper input signals (OP1, OP3) or
2. force sensors/electric grippers (OP2, OP4) may be used as conversion adapter cable (3) and (6), to be selected as required by the customer.

When using a vision sensor LAN with ASLINK, consult with an AnyWire service center in advance.

**Compatible models**
- RV-4F/7F/13F/20F Series (excluding -SH specifications)
- For other models, inquire with the service center.
Calculating the Inertia

A tolerable inertia is set in the mechanical interface for robot arm. If a load exceeding this inertia is mounted, the robot may vibrate or an overload alarm may occur when the robot moves. When selecting the robot, it must be considered whether the hand or load to be mounted on the arm is suitable. The method of calculating the load inertia is explained below.

**Example 1  Horizontally articulated robot**

Calculate the total inertia around the J4 axis.

\[
I = I_z1 + I_z2 + W_1L_1^2 + W_2L_2^2
\]

- \( I_z1 \): Load inertia
- \( I_z2 \): Load inertia
- \( W_1 \): Each weight (kg)
- \( W_2 \): Each weight (kg)

**Example of calculation**

[Diagram of a horizontally articulated robot with hand and workpiece showing the calculation of inertia]

The total inertia around the J4 axis:

\[
I = 0.0068 + 0.0012 + 2.5 \times 0.05^2 + 1.5 \times 0.1^2
\]

\[
= 0.0068 + 0.0012 + 0.0625 + 0.0015
\]

\[
= 0.0708kg\cdot m^2
\]

The RH-6FRH tolerable inertia (rating) is 0.01 kg\cdot m\(^2\) so 0.0708 kg\cdot m\(^2\) exceeds the tolerable inertia. However, if the hand center of gravity is aligned with the J4 rotary axis, and the workpiece is grasped directly below the J4 axis, both \( L_1 \) and \( L_2 \) become zero (0), so the total inertia around J4 axis can be determined by the following formula:

\[
I = I_z1 + I_z2 = 0.0068 + 0.0012 = 0.008kg\cdot m^2 = 0.01kg\cdot m^2
\]

The total inertia around the J4 axis:

\[
I = 0.0068 + 0.0012 = 0.008kg\cdot m^2 < 0.01kg\cdot m^2
\]

This falls within the tolerable inertia.

Even if the total inertia is exceeded, consider changing the grasping method or changing the position.
Example 2 For vertically articulated robot

With the vertical articulated robot, the load moment for the wrist axis (J4 axis to J6 axis) and the load inertia for the wrist axis (J4 axis to J6 axis) must be reviewed. Consider the hand to be used and the posture of the workpiece, and calculate the load moment and load inertia applied on each of J4 axis to J6 axis. An example of the review is shown below.

Example for calculating load moment (For J5 axis with flange facing downward)

Assume the following conditions as shown on the right:
- Hand weight: \( W_1 \) (kg)
- Hand center of gravity position: \( L_1 \) (m)
- Workpiece weight: \( W_2 \) (kg)
- Workpiece center of gravity position: \( L_2 \) (m)

In this case, the load moment applied on the J5 axis is determined as follows.

\[
M = W_1 \times L_1 \times g + W_2 \times L_2 \times g
\]

Where, \( g \): gravitational acceleration (m/sec\(^2\)).

Confirm that this value \( M \) falls within the tolerable moment of the model to be selected.

Example of calculating load inertia (For J6 axis)

Assume the following conditions as shown on the right:
- Hand weight: \( W_1 \) (kg)
- Distance from the J6 axis center to the hand center of gravity position: \( L_1 \) (m)
- Workpiece weight: \( W_2 \) (kg)
- Workpiece center of gravity position: \( L_2 \) (m)

In this case, the load inertia applied on the J6 axis rotation is determined as follows.

The hand and workpiece shapes shall be square respectively, with dimensions of \( a_1 \times b_1 \) and \( a_2 \times b_2 \) respectively.

\( a \): Vertical length, \( b \): Horizontal length

Load inertia around the hand J6 axis (kg·m\(^2\)):

\[
I_1 = I_{z1} + W_1 \times L_1^2 = W_1 \times (a_1^2 + b_1^2)/12 + W_1 \times L_1^2
\]

Load inertia around the workpiece J6 axis (kg·m\(^2\)):

\[
I_2 = I_{z2} + W_2 \times L_2^2 = W_2 \times (a_2^2 + b_2^2)/12 + W_2 \times L_2^2
\]

Load inertia around the J6 axis (kg·m\(^2\)) based on the hand + workpiece:

\[
I = I_1 + I_2
\]

Confirm that this value falls within the tolerable inertia of the model to be selected.

Note) If the posture change other than in the downward direction is large, the load moment around J4 axis must also be confirmed.
Example for calculating load moment (For J5 axis with flange facing downward)

Hand weight: $W_1$ (kg)
Hand center of gravity position: $L_1$ (m)
Workpiece weight: $W_2$ (kg)
Workpiece center of gravity position: $L_2$ (m)

In this case, the load moment applied on the J5 axis is determined as follows.

\[
M = W_1 \times L_1 \times g + W_2 \times L_2 \times g
\]

Confirm that this value $M$ falls within the tolerable moment of the model to be selected.

Example of calculating load inertia (For J6 axis)

Assume the following conditions as shown on the right:
Hand weight: $W_1$ (kg)
Distance from the J6 axis center to the hand center of gravity position: $L_1$ (m)
Workpiece weight: $W_2$ (kg)
Workpiece center of gravity position: $L_2$ (m)

In this case, the load inertia applied on the J6 axis rotation is determined as follows.

- Load inertia around the hand J6 axis (kg·m²): $I_1 = I_{z1} + W_1 \times L_1^2 = W_1 \times (a_1^2 + b_1^2)/12 + W_1 \times L_1^2$
- Load inertia around the workpiece J6 axis (kg·m²): $I_2 = I_{z2} + W_2 \times L_2^2 = W_2 \times (a_2^2 + b_2^2)/12 + W_2 \times L_2^2$
- Load inertia around the J6 axis (kg·m²) based on the hand + workpiece: $I = I_1 + I_2$

Confirm that this value falls within the tolerable inertia of the model to be selected.

Note) If the posture change other than in the downward direction is large, the load moment around J4 axis must also be confirmed.
YOUR SOLUTION PARTNER

Mitsubishi Electric offers a wide range of automation equipment from PLCs and HMIs to CNC and EDM machines.

A NAME TO TRUST
Since its beginnings in 1870, some 45 companies use the Mitsubishi name, covering a spectrum of finance, commerce and industry.

The Mitsubishi brand name is recognized around the world as a symbol of premium quality.

Mitsubishi Electric Corporation is active in space development, transportation, semi-conductors, energy systems, communications and information processing, audio visual equipment and home electronics, building and energy management and automation systems, and has 237 factories and laboratories worldwide in over 121 countries.

This is why you can rely on Mitsubishi Electric automation solution - because we know first hand about the need for reliable, efficient, easy-to-use automation and control in our own factories.

As one of the world’s leading companies with a global turnover of over 4 trillion Yen (over $40 billion), employing over 100,000 people, Mitsubishi Electric has the resource and the commitment to deliver the ultimate in service and support as well as the best products.

* Not all products are available in all countries.
## American Offices

<table>
<thead>
<tr>
<th>Country</th>
<th>Address</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>Mitsubishi Electric Automation, Inc. 500 Corporate Woods Parkway, Vernon Hills, IL 60061, USA. Tel: +1-847-478-2100</td>
<td>+1-847-478-2100</td>
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## Brazil

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<tbody>
<tr>
<td>Brazil</td>
<td>Mitsubishi Electric do Brasil Comercio e Servicos Ltda. Rua Justa, 1750- Bloco-B- Sala 01, Jardim Santa Cecilia, CEP 06465-070, Banani - SP, Brasil</td>
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## Asia-Pacific Offices

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<tr>
<td>China</td>
<td>Mitsubishi Electric Automation (China) Ltd. No.1386 Hongqiao Road, Mitsubishi Electric Automation Center 3F Shanghai, China Tel: +86-21-2332-3030</td>
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<tr>
<td>Taiwan</td>
<td>Mitsubishi Electric Taiwan Co., Ltd. 10F, No.88, Sec.6, Chung-Shan N Rd, Taipei, Taiwan Tel: +886-2-2633-5430</td>
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<td>Singapore</td>
<td>Mitsubishi Electric Asia Pte. Ltd. 107 Alexandra Road #05-01/02, Mitsubishi Electric Building, Singapore Tel: +65-6470-2480</td>
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<tr>
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<td>MITSUBISHI ELECTRIC FACTORY AUTOMATION (THAILAND) CO., LTD. 99/19 and 20, 12 th Floor, 5V City Building, Office Tower 1, Rama 3 Road, Klong Bangpompong, Yannawa, Bangkok, 10120, Thailand Tel: +66-2682-6522</td>
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<tr>
<td>Korea</td>
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## European Offices

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<td>Germany</td>
<td>Mitsubishi Electric Europe B.V. German Branch Mitsubishi-Electric-Platz 1, 40882 Ratingen, Germany Tel: +49-2102-486-0</td>
<td>+49-2102-486-0</td>
</tr>
<tr>
<td>UK</td>
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<td>Italy</td>
<td>Mitsubishi Electric Europe B.V. Italian Branch VIALE COLLEONI 7-20041 Agrate Brianza (Milano), Italy Tel: +39-039-60331</td>
<td>+39-039-60331</td>
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<tr>
<td>Spain</td>
<td>Mitsubishi Electric Europe B.V. Spanish Branch Calle de Rabi 76-80-AC 4720, E-08190 Sant Cugat del Valles (Barcelona), Spain Tel: +34-935-65-3131</td>
<td>+34-935-65-3131</td>
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<tr>
<td>France</td>
<td>Mitsubishi Electric Europe B.V. French Branch 25, Boulevard des Bouquets, F-92741 Nanterre Cedex, France Tel: +33-1-5569-0569</td>
<td>+33-1-5569-0569</td>
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<tr>
<td>Czech Republic</td>
<td>Mitsubishi Electric Europe B.V. Czech Branch Avenue Business Park, Rádolka 714/113a, 158 00 Praha 5, Czech Republic Tel: +420-251-551-470</td>
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<td>Poland</td>
<td>Mitsubishi Electric Europe B.V. Polish Branch ul. Krakowska 53-32-083 Balice, Poland Tel: +48-12-630-47-00</td>
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<td>Ireland</td>
<td>Mitsubishi Electric Europe B.V. Irish Branch Westgate Business Park, Ballymount, IRL-Dublin 24 Tel: +353-1-1498603</td>
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<tr>
<td>Russia</td>
<td>Mitsubishi Electric Europe B.V. Russian Branch Moscow Office 52,状3, Kosmodamskaya nab., RU-115054, Moscow, Russia Tel: +7-495-721-2070</td>
<td>+7-495-721-2070</td>
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