MITSUBISHI ELECTRIC
FACTORY AUTOMATION

MELFA

Industrial Robots

Consistent Quality –
Precise Control

Articulated-arm robots /// SCARA robots /// High-performance Controllers /// Programming software /// Simulation ///

MELFA Industrial Robots

Robots from € 1.65/hr

Calculated on the basis of their average service life, around 6–7 years in typical applications, Mitsubishi robots have a surprisingly low total cost of ownership at around € 1.65/h per hour for both purchasing and operation.

More than 30,000 applications

Modern automation technology from Mitsubishi Electric is helping to power technological progress and business success all over the world. Since 1978, Mitsubishi's small industrial robots have been installed in over 30,000 applications in a huge diversity of fields.

Intelligent design

The high performance of Mitsubishi's robots is the result of market-leading technology combined with intelligent, carefully-planned design. For example, locating pneumatic and wiring extensions directly in the robot body reduces wiring complexity and costs.

The robots have hollow shaft motors and transmissions for maximum rigidity.

The high-precision Harmonic Drive transmission helps to provide exceptional repeatability performance.

Suitable for high-precision component placement with repeatability performance of ±0.005 mm and a cycle period of just 0.28 s.

The World's first twin-arm SCARA robot with parallel structure for maximum precision.

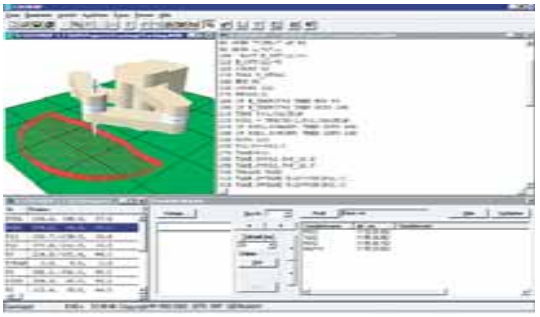
All the gripper hands of the articulated-arm robots conform to the ISO 9409-1 standard.

Internally-routed cables and hoses prevent snagging on peripheral equipment.

The sensorless crash detection feature reliably detects and prevents unexpected collisions.

Soft compliance control mode improves the quality of assembly and joining processes.

A very compact design takes up minimum space for applications in cramped quarters.

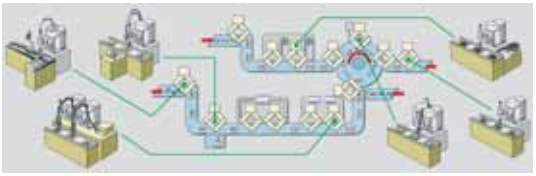


Simple programming

A powerful range of robots needs an equally powerful and user-friendly programming interface. Mitsubishi's COSIROP and COSIMIR packages are powerful programming and simulation software tools tailored precisely for the needs of your robots.

Compact and economical

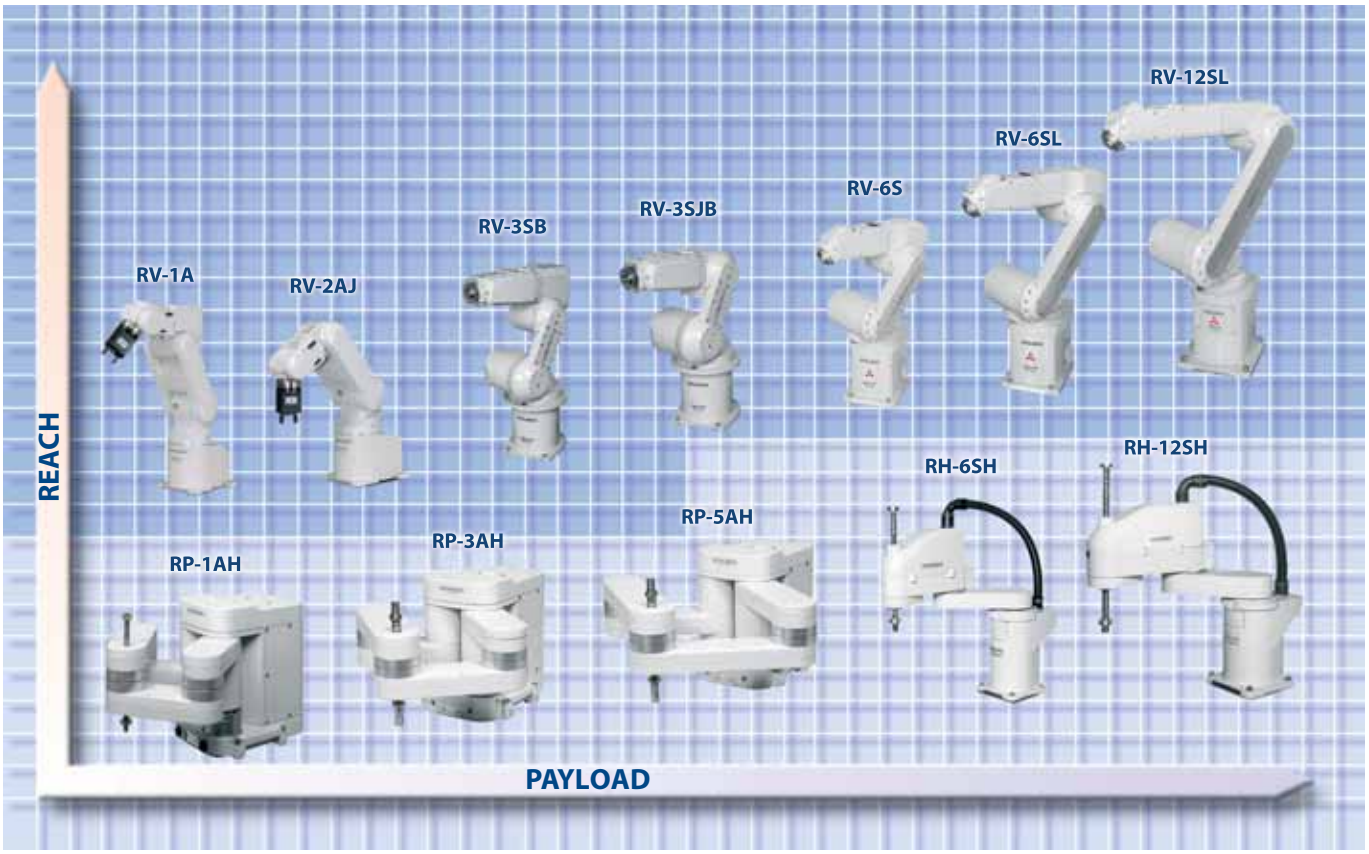
A small installation footprint and outstanding reliability are all key factors for many applications.



Network capabilities

Network connections like Ethernet and CC-Link make it easy to integrate Mitsubishi robot controllers in to larger systems, providing users with access to every step of the process.

A Complete Range



The MELFA range includes a robot for every application, with a wide selection of versions and power ratings.

Powerful robots for different applications.

Comprehensive range

The MELFA range of robots includes a great diversity of types, models and versions. The articulated-arm RV-A and RV-S lines include everything from high-performance compact models with 1kg payloads to powerful models that can handle up to 12 kg

For high-precision positioning tasks Mitsubishi offers the RP-AH and RH-SH ranges of SCARA robots with cycle periods of less than 1s and positioning accuracy as precise as 5 µm.

The right solution for every application

The MELFA robots are designed from the ground up to cater to the needs of virtually all industrial applications, providing the flexibility you need to reconfigure your production facilities fast.

MELFA robots have models which have capabilities such as:

- SCARA or articulated-arm construction
- 4 to 6 degrees of freedom (axes)
- Handling payloads from 1 kg to 12 kg
- Working reaches from 150 mm to 1,385 mm

The Powerful Compact Class

Handling critical liquids in a laboratory application

Trouble-free handling

An electrical gripper or up to two pneumatic grippers can be installed to handle components and workpieces. Pneumatic hoses are pre-installed in the RV-As robot arm to facilitate connection of the grippers.

If you need to enlarge the robot workspace, whilst maintaining compact dimensions, you can also install these robots on a linear axis, just like many of the other models.

RV-2AJ/-1A Facts and Figures

Degrees of freedom (axes):

RV-2AJ	5
RV-1A	6

Max. payload:

RV-2AJ	2 kg
RV-1A	1 kg

Gripper flange reach:

RV-2AJ	482 mm
RV-1A	490 mm

Repeatability:

RV-2AJ	±0.02 mm
RV-1A	±0.02 mm

Max. speed:

RV-2AJ	2,100 mm/s
RV-1A	2,200 mm/s

Controller:

RV-2AJ	CR1
RV-1A	CR1

The movement axes of the RV-1A robot

Small, compact and powerful

The compact design and flexible reach of these 5 and 6 DOF (degrees of freedom) robots makes them a popular choice. They are ideal for applications where a small, compact robot needs to be installed directly next to or even in the system it is serving. The RV-A robots are particularly good at handling, placing and removing small parts. Other applications include quality control and handling samples in medical and other laboratories.

The RV-2AJ at work in typically cramped quarters

Fast and Economical

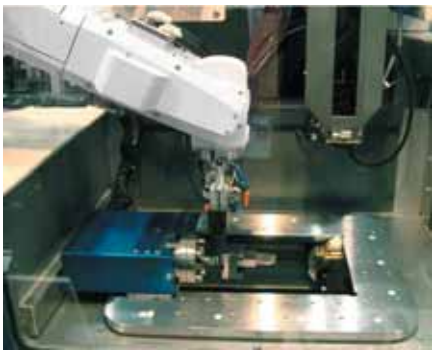
Ideal for operation in tough environments like metal-cutting tools

The movement axes of the RV-3SB

Easy integration

The RV-3S series robots are designed for easy integration in existing work cells. For example, 32 integrated inputs and outputs permit direct interaction with sensors and actuators, reducing cycle periods and making system configuration simpler and easier.

Good communication with other automation components is naturally essential for full work cell integration. The RV-3S series supports connection via the three main industry standard networks: Ethernet, Profibus/DP and CC-Link.



The RV-3SB at work in an EDM machine

The RV-3S can also control up to 8 additional axes for easy integration in to work cells where movement is restricted or where the processing points are far apart. Additionally two of these axes can be interpolated, providing greater flexibility to program the robots movement to avoid obstacles. The other six axes can be used for other purposes – for example to install the robot on a linear axis so that it can traverse between two processing points.

High protection rating

The RV-3S gives users more flexibility for planning their automation solutions. For example, the high IP65 ingress protection rating makes it possible to install the robot not just next to the machine or workstation but actually within the machine itself. This is particularly useful in metal-cutting applications where the robot may be exposed to fluids and cutting oils.

RV-3SB/-3SJB Facts and Figures

Degrees of freedom (axes):

RV-3SB	6
RV-3SJB	5

Max. payload:

RV-3SB	3.5 (3) kg
RV-3SJB	3.5 (3) kg

Gripper flange reach:

RV-3SB	727 mm
RV-3SJB	726 mm

Repeatability:

RV-3SB	±0.02 mm
RV-3SBJ	±0.02 mm

Max. speed:

RV-3SB	5,500 mm/s
RV-3SJB	5,300 mm/s

Controller:

RV-3SB	CR2B
RV-3SJB	CR2B

More Power and Reach

Heavy payloads of up to 12 kg can be handled with ease

The movement axes of the RV-12SL

An RV-S robot in action

Engineered for performance

Handling payloads of up to 12 kg, over a maximum working reach of 1,385 mm the RV-S series provides outstanding precision and repeatability (±0.05 mm). It is the ideal choice for handling workpieces in industrial manufacturing applications and for daisy-chaining plant components. Equipped with the latest technology that drastically reduces cycle periods: These new robots can complete the "12 inch test" in less than a second!

Multi-functional controllers

RV-S robots are driven by the CR2B or CR3 multi-tasking controllers. The ability to connect to any image processing system, options for controlling up to 8 additional axes and high-speed Ethernet connections are just a few of the impressive highlights of these powerful robot controllers. Other features include conveyor belt tracking, sensorless crash detection and many other functions for optimising cycle times.

RV-6S/-6SL/-12SL Facts and Figures

Degrees of freedom (axes):

6

Max. payload:

RV-6S/RV-6SL	6 (5) kg
RV-12SL	12 (10) kg

Gripper flange reach:

RV-6S	781 mm
RV-6SL	987 mm
RV-12SL	1,482 mm

Repeatability:

RV-6S/RV-6SL	±0.02 mm
RV-12SL	±0.05 mm

Max. speed:

RV-6S	9,300 mm/s
RV-6SL	8,500 mm/s
RV-12SL	9,500 mm/s

Controller:

RV-6S/RV-6SL	CR2B
RV-12SL	CR3

Intelligent Design

Mass production of similar products like CD-ROMs on a production line

The movement axes of an RH-SH robot

These two SCARA models of the RH-SH series are powerful robots designed specially for palletising and assembly tasks.

The robots are fitted with newly-developed servo motors and step-down transmissions that enable operation at high speeds with optimum acceleration and braking performance. For example, the RH-12SH achieves speeds that are 18 % faster than comparable robots, giving users an easy, flexible, high speed solution.

An RH-6SH in a palletising application

Intelligent self-monitoring

The sensorless crash detection system helps to preventing accidental damage, for example caused by contact between the vertical ball screw axis and peripherals during teaching operations. When the function is activated any contact immediately stops the robot motion automatically.

Optimised design

The solenoid valves for controlling the gripper hands are installed on the back of arm 2. This optimised design minimises tangling and catching of the gripper supply lines and the surrounding components.

In addition, pneumatic hoses and sensor cables are routed inside the robot arm for easier connection of grippers and sensors.

RH-6SH/-12SH Facts and Figures

Degrees of freedom (axes):

4

Max. payload:

RH-6SH	6 (2) kg
RH-12SH	12 (4) kg

Reichweite Arm:

RH-6SH	550 mm
RH-12SH	850 mm

Gripper flange reach:

RH-6SH	±0.02 mm
RH-12SH	±0,025 mm

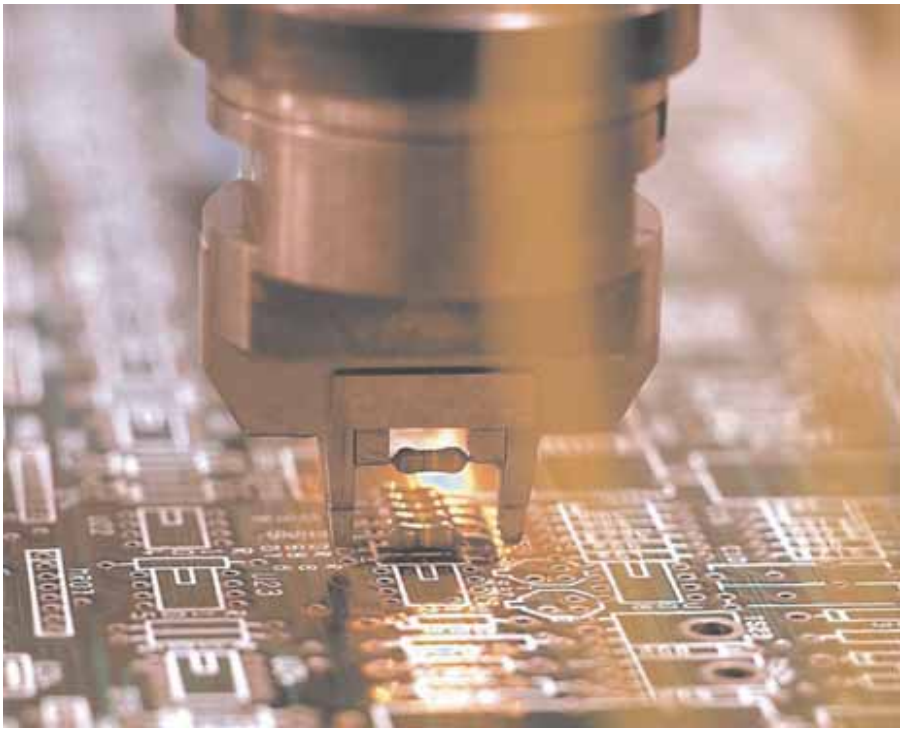
Max. speed:

RH-6SH	7,782 mm/s
RH-12SH	11,221 mm/s

Controller:

CR2B

Superfast, Superprecise



Fast "pick & place" applications – are a major application area for Mitsubishi robots

For applications requiring larger payloads or reaches users can select the RP-3AH and RP-5AH models, which can handle up to 3 kg and 5 kg and have reaches of 335 and 453 mm, respectively.

Boosting efficiency in production

The RP robots' small size and high precision make them perfect for micro-handling applications – for example micro-assembly, placement and soldering of SMD components on to circuit boards for many of today's electronic consumer good, such as mobile phones. These robots are much more versatile than traditional inflexible automated assembly machines, providing a significant boost to production efficiency.

The movement axes of the RP-AH series

Precise operation in restricted space

Precision in cramped quarters

The RP-1AH is in its element in all applications where components need to be handled quickly and with precision. With an installation footprint of just 200 x 160 mm it has a reach of 236 mm and can place parts, at speed, with a precision of ±0.005 mm.

This makes it one of the ultimate "pick & place" solutions available.

RP-1AH/-3AH/-5AH Facts and Figures

Degrees of freedom (axes):

4

Max. payload:

RP-1AH	1 kg
RP-3AH	3 kg
RP-5AH	5 kg

Gripper flange reach:

RP-1AH	±0.005 mm
RP-3AH	±0.008 mm
RP-5AH	±0.01 mm

Max. speed:

RP-1AH	800 mm/s
RP-3AH	960 mm/s
RP-5AH	960 mm/s

Controller:

CR1

Programming made Easy

Using Mitsubishi robots is easy

Programming a Mitsubishi robot arm is a lot easier than most people imagine. The programming language of the teach pendent is a simple sentence like structure with commands such a MOV being used to program the robot to move.

Alternatively, users can also benefit from our advanced programming and simulation software packages Cosirop and Cosimir. These two packages can allow a robot application to be built and simulated even before any hardware has been purchased.

Easy programming on the spot

COSIROP – from professionals for experts

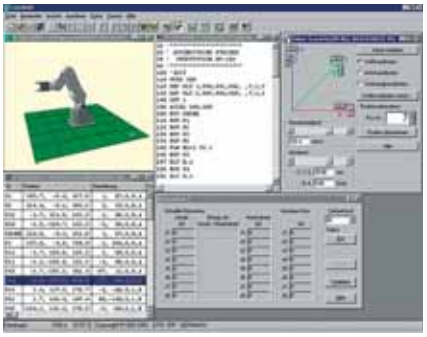
A powerful robot programming language needs an equally powerful programming environment.

COSIROP is the programming environment for all Mitsubishi robots. It allows you to create robot programs in minutes using the MELFA BASIC IV or MOVEMASTER COMMAND robot programming languages. After testing and optimising your program you can then transfer the program to the actual robot with a couple of mouse clicks, via an efficient direct network or serial link between the PC and the robot.

Display of a working range

Monitoring and visualisation

While the programs are being executed you can monitor and visualise the robots movement with the help of COSIROP's comprehensive control and diagnostics functions. The real-time axis speeds and motor currents are clearly displayed, together with the statuses of all the inputs and outputs of the robot. Live monitoring fully supports all the programs executed by the controller enabling you to track down program errors quickly and reliably.



Online position definition and motor current monitoring

COSIROP also provides tools for program archiving and for backing up the robot's parameters and settings.

Many functions – for your benefit

- Online "teach-in" function for robot positions
- Position display on a 3-D representation of the robot
- Syntax checking
- I/O monitor
- Variable monitor
- Online command execution
- Error diagnostics
- Position editor
- Project management

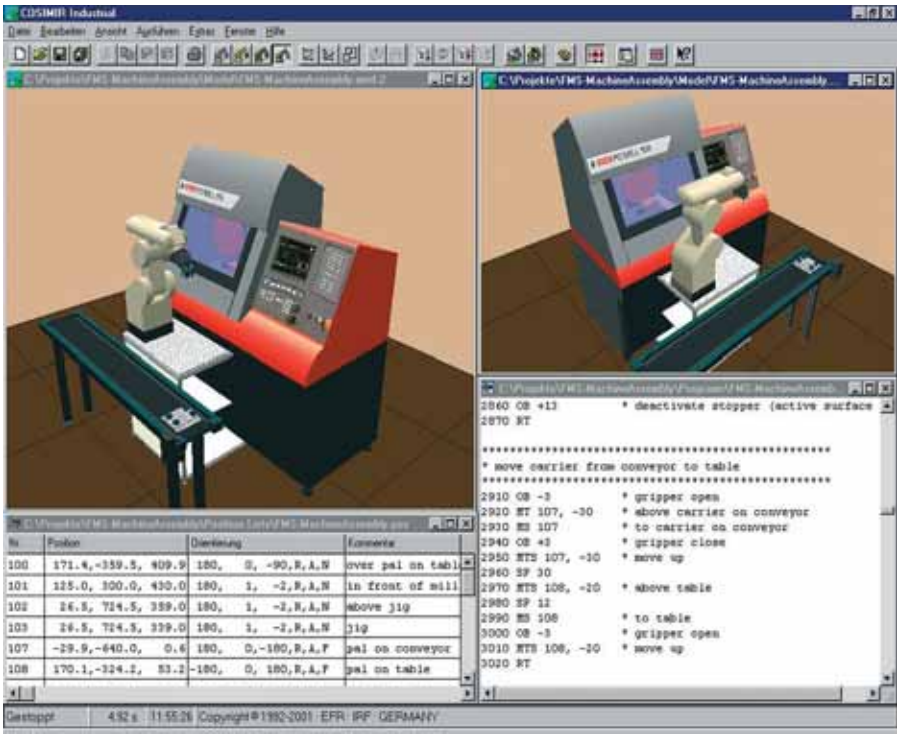
Fast and Easy Simulation

The COSIMIR® 3-D robot simulation system can simulate entire work cells, i.e. systems including both the robot itself and its interaction with its environment.

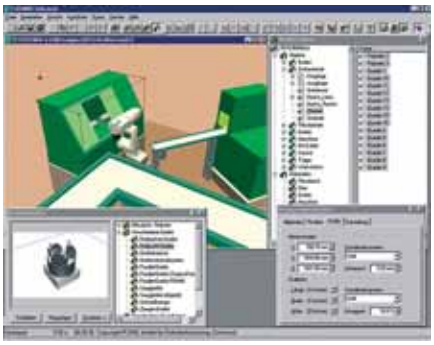
In addition to the entire range of Mitsubishi robots COSIMIR® also supports a broad spectrum of automation equipment including material flow control systems, and a variety of sensors and actuators and so on – these are typical automation components you would use to create production systems to meet the needs of your application.

Powerful tools

This set of powerful software tools helps you throughout the planning, programming and test phases of your project. "Reachability" checks in the early planning stages help you to select the most suitable robot systems for the task. You can move the robots and other work cell components around in the simulation at will, making it easy to optimise the layout of your system.



COSIMIR® industrial simulation software



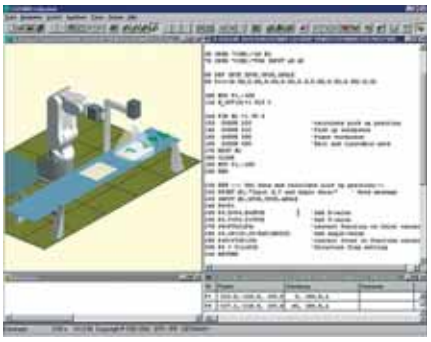
The Model Explorer simplifies object management

Authentic simulation environment

COSIMIR® uses the native robot languages (MELFA BASIC IV or MOVEMASTER COMMAND) to program the robots within the simulation environment. This means that no additional conversion or processing steps are required when you transfer the resulting programs to real robots. In addition, this enables you to use familiar robot programming languages and all your existing know-how and skills when you are working with the simulation. The comprehensive online help system is always available when you need support, for example, with the formulation of the necessary programming syntax. After creating your robot programs you can test them directly in the simulation environment, eliminating the need to remove the actual work cell from the production process for testing.

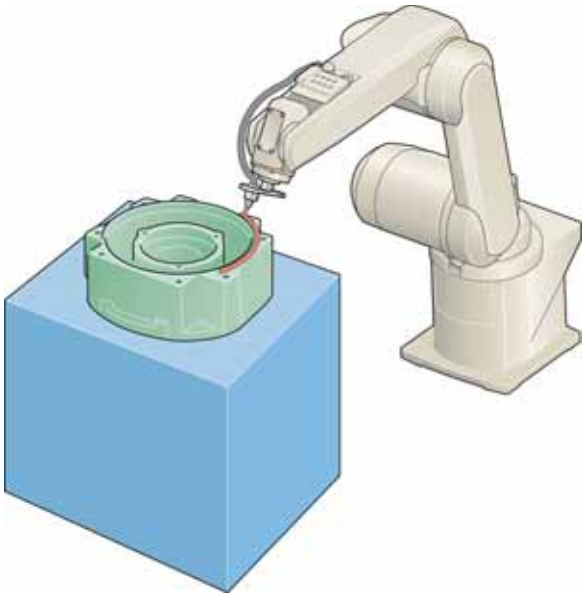
Saving costs

The COSIMIR® and COSIROP packages are powerful tools for achieving maximum efficiency and cost-effectiveness in the configuration and operation of robot-supported automation solutions. They allow you to plan and operate your systems with a very high degree of confidence, even before any hardware is purchased.



Program execution monitoring in the simulation

Innovation in Movement



Sealing a workpiece

For years, Mitsubishi robots have been demonstrating the power and productivity of their innovative technology in thousands of demanding applications.

These robots are now in service in virtually all branches of the motor industry and its suppliers, and also in medical, education and training applications. With their powerful controllers they provide cost-effective, reliable and easily-installable solutions for everything from simple tool and component handling tasks to complex applications in which the entire system is controlled by the robot.

Precise operation in restricted space

Mitsubishi's compact, 5-Joint closed link robot is the only one of its kind in the world. It has an installation footprint no larger than an A5 sheet of paper and repeatability of ±0.005 mm. This accuracy, combined with a cycle period of just 0.28 s, makes it suitable for use in precise component placement applications.

Small and compact

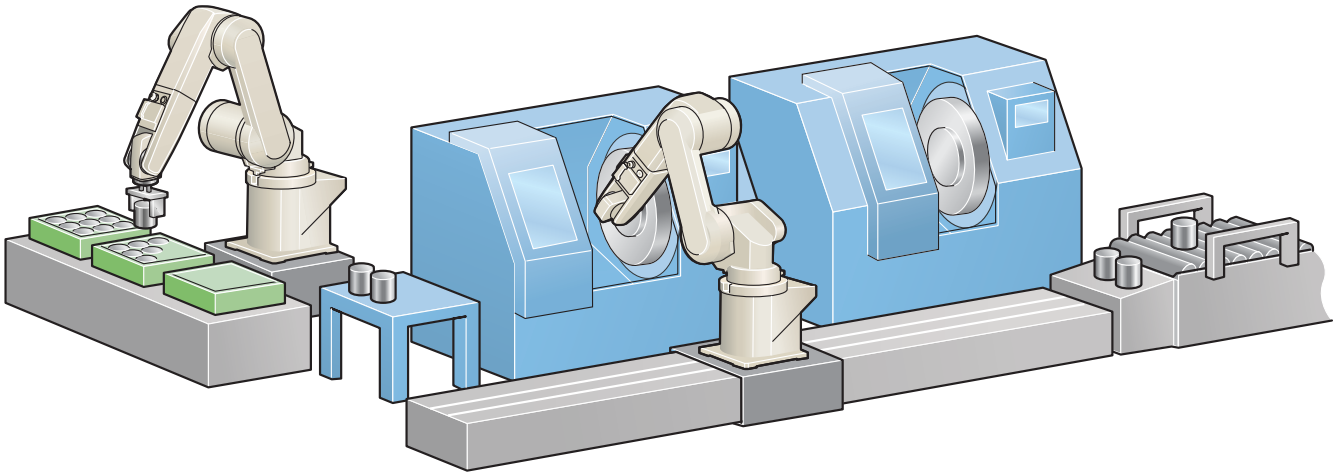
MELFA robot controllers are equally small and compact. With dimensions close to those of a standard PC they can be installed in the most cramped environments without taking up valuable production space. Their multitasking operating system and the powerful MELFA BASIC programming language make it easy to use them to control other system components. For example, the language instruction set also includes simple commands for the integration of cameras for object identification.

Strength and accuracy

The individual joints and axes of the robots are powered by high-precision AC servo motors coupled with play-free Harmonic Drive gears. Absolute position encoders are fitted to every motor, saving time by enabling the robot to start work as soon as it is powered up.

Applications in limited space

Precision and Flexibility



Machining/providing

Versatility

Mitsubishi robots are fitted with a standard robot gripper flange so you can attach any ISO 9404-1 compatible grippers. Cables and hoses are routed internally where they cannot snag on peripherals. The sensorless collision detection system enables the robot to respond to unforeseen collisions. The robots also feature Compliance Control for gentle and responsive handling to improve performance in assembly processes.

■ Fast Configuration

The initial setup of a new Mitsubishi robot system only takes around 5 minutes. The easy-to-understand programming language and powerful, user-friendly software tools make programming and operation child's play.

■ Universal Expansion Options

A comprehensive range of options and expansion cards can be added to adapt your robot to the precise requirements of your environment and application. These include robot grippers, interface cards for connection to a wide range of networks, I/O expansion modules and much more besides.

The ideal trainer

Festo Didactic, one of the world's leading suppliers of training applications, has already been using Mitsubishi robots in its training systems for years. Thousands of students and trainees have already learned to appreciate the capabilities of Mitsubishi robots on these systems.

Mitsubishi robot in a training application

Small robots. Big solutions.

Modern automation technology from Mitsubishi Electric is one of the driving forces behind technical progress and commercial success all over the world. Although MELFA robots can be used in individual machines and "island solutions" they really develop their full versatility as components in integrated systems.

Maximum reliability is always the top priority for our robots, no matter whether they are used in simple handling operations or the highly-complex applications of car manufacturers and their high-tech suppliers. Whatever the job, you can always depend on the reliability of Mitsubishi robots.

Other typical applications for these robots include manipulation of components and tools, quality control, placement and installation of small and miniature parts and handling tasks in medical and laboratory environments.

Compact and High Functional

The compact, modular robot controller is an integral part of the robot system. It contains the CPU and the power electronics for powering and controlling the robot.

Small and compact

At Mitsubishi Electric "switchgear cabinets" are relics of the past – everything is now packed into a single compact controller. Depending on the robot model either the CR1 controller with a footprint no larger than an A4 sheet of paper or the CR2/CR3 controller is used. The powerful control performance is the same in both the smaller and larger versions; the only difference between the two is in the power output stages. No matter which controller you use you always work with the same programming language – MELFA BASIC IV – and have the same options at your disposal.

This transparent compatibility pays off when you need to use different robot types or models when the needs of your application change.

■ Numbercrunching power

A 64-bit RISC processor with DSP provides ample power for 3-D circular and linear interpolation, and for multi-tasking with up to 32 programs running in parallel.

■ Gentle joining

The standard "compliance control" function guarantees gentle positioning. This function can be activated and deactivated as required, making it possible to optimise demanding joining and assembly processes, saving wear and tear on both components and robots.

■ Sensorless collision monitoring

Potential collision situations are identified reliably without an additional sensor, preventing damage to both workpieces and peripherals.

■ Digital inputs and outputs

In their standard configurations the CR1 has 16 digital inputs and 16 digital outputs, the CR2/CR3 32 digital inputs and 32 digital outputs. Optional remote I/O boxes make it possible to increase this to up to 256 inputs and 256 outputs for complex applications.

■ Large program memory

The controller can store up to 88 independent programs, all of which can call each other, for example when different program sequences are needed for different products.

CR1, CR2B and CR3 Facts and Figures

Control mode:
PTP and CP

Processor:
64 Bit RISC + DSP

Control functions:
Axial, linear and 3-D circular interpolation; palletising functions, interrupt control and multitasking

Max. number of programs:
88

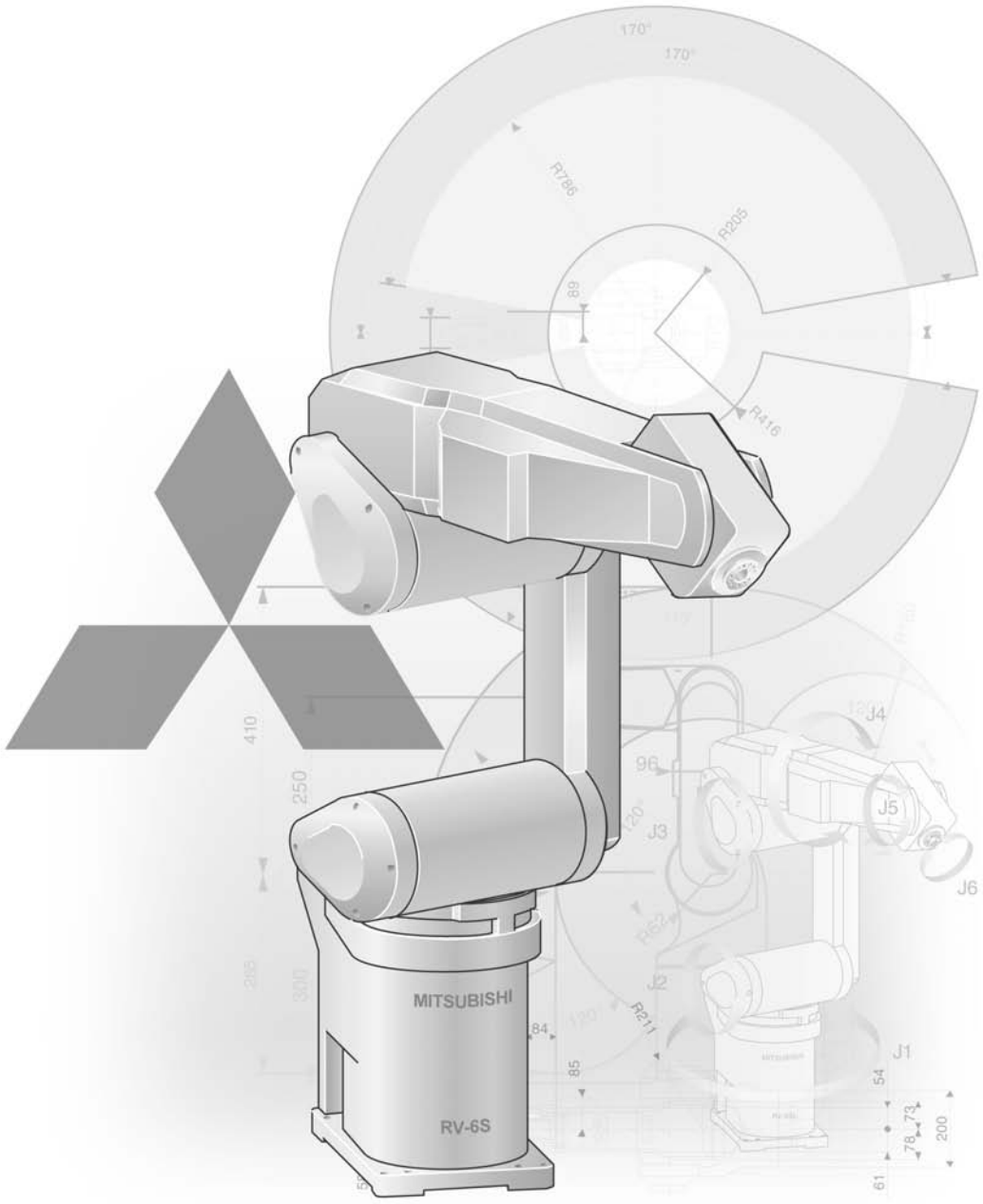
Max. number of program steps:
5,000 per programm

Max. number of teaching points:
2,500 per programm

Internal I/Os:

CR1	16 I/16 O, max. 240 I / 240 O
CR2B, CR3	32 I/32 O, max. 256 I / 256 O

Safety functions:
EMERGENCY OFF and door contact switch (CR2B, CR3)



Technical Information Section

Further Publications within the Industrial Automation Range

Technical Catalogues

MELSERVO and Motion Controller Technical Catalogue

Product catalogue for servo motors and servo amplifiers of the MR-J series and Motion Controller with SSCNET connection

PLC and HMI Technical Catalogue

Product catalogues for programmable logic controllers, operator terminals and accessories for the MELSEC PLC series

Networks Technical Catalogue

Product catalogue for Master and Slave modules as well as accessories for the use of programmable logic controllers in open and MELSEC networks

Further service supplies

This technical catalogue is designed to give an overview of the extensive range of FX Family of MELSEC PLCs. If you cannot find the information you require in this catalogue, there are a number of ways you can get further details on configuration and technical issues, pricing and availability.

For technical issues visit the www.mitsubishi-automation.com website.

Our website provides a simple and fast way of accessing further technical data and up to the minute details on our products and services. Manuals and catalogues are available in several different languages and can be downloaded for free.

For technical, configuration, pricing and availability issues contact our distributors and partners.

Mitsubishi partners and distributors are only too happy to help answer your technical questions or help with configuration building. For a list of Mitsubishi partners please see the back of this catalogue or alternatively take a look at the "contact us" section of our website.

About this technical catalogue

This catalogue is a guide to the range of products available. For detailed configuration rules, system building, installation and configuration the associated product manuals must be read. You must satisfy yourself that any system you design with the products in this catalogue is fit for purpose, meets your requires and conforms to the product configuration rules as defined in the product manuals.

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MELFA Industrial Robot Systems

1 Robots

2 Controller

3 Accessories

4 Programming Language

5 Software

MELFA - Industrial Robot Systems

For many years Mitsubishi Electric's innovative and powerful robots have been delivering reliable performance in thousands of applications. These robots are now used throughout the motor industry by both car manufacturers and their suppliers, and in a wide variety of medical and training applications.

Broad Range of Products

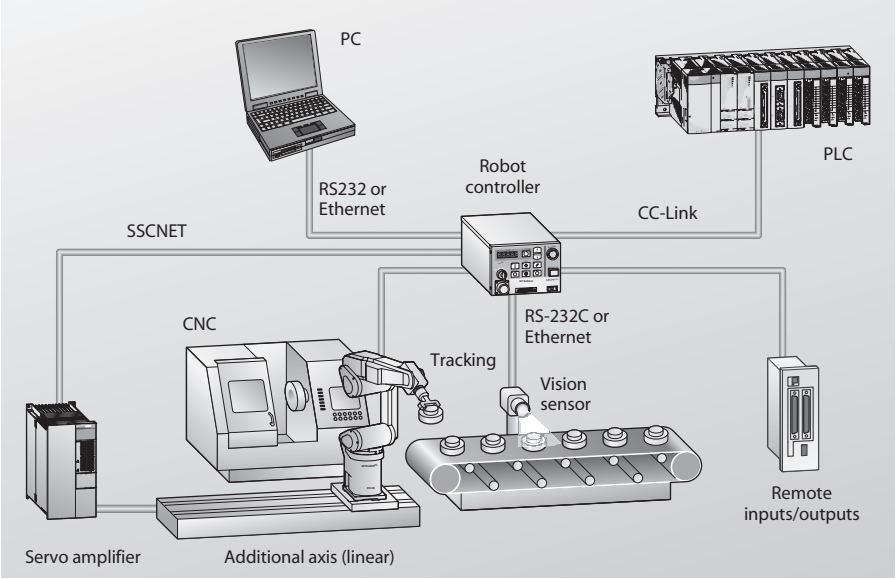
The MELFA family includes a wide selection of models in many different versions. The articulated-arm robots of the RV-A and RV-S series range from the high-performance compact class with a 1kg payload capacity to powerful models that can handle up to 12 kg. Mitsubishi's line of SCARA robots in the RP-AH and RH-SH series are designed for high-precision positioning tasks and feature cycle periods of less than 1 s with positioning accuracy up to 5 µm

Small and Compact

Mitsubishi's robot controllers are small and compact. With a footprint no larger than a PC they can be installed even in the most cramped quarters without taking up valuable production space. Their multitasking operating system and powerful MELFA BASIC programming language make it easy to develop programs to control your production systems. For example, MELFA BASIC includes instructions that make it easy to integrate a camera in the system for object identification.

Power and Precision

The robots are fitted with modern hollow shaft motors and transmissions designed for maximum drive train rigidity.
High-precision AC servo motors and play-free harmonic drive transmissions ensure outstanding precision.



Example of a robot system configuration

Versatility for Countless Applications

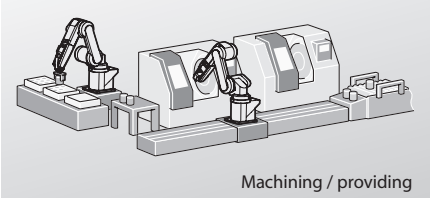
The robots are fitted with a standard robot gripper flange so you can attach any ISO 9404-1 compatible grippers. Cables and hoses are routed internally where they cannot snag on peripherals. The sensorless collision detection system enables the robot to respond to unforeseen collisions. The robots also feature Compliance Control for gentle and responsive handling to improve performance in assembly processes.

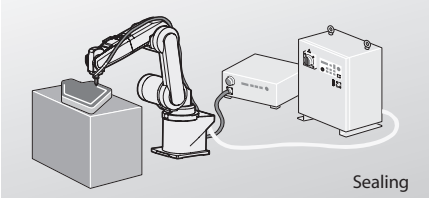
Fast Configuration

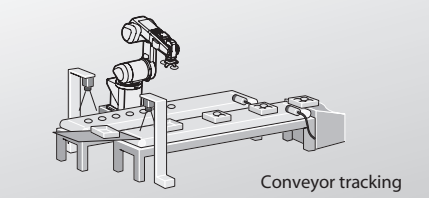
The initial setup of a new Mitsubishi robot system only takes around 5 minutes.
The easy-to-understand programming language and powerful, user-friendly software tools make programming and operation child's play.

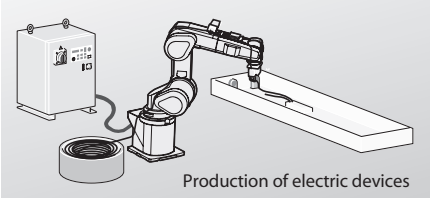
Universal Expansion Options

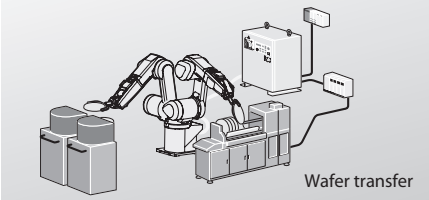
A comprehensive range of options and expansion cards can be added to adapt your robot to the precise requirements of your environment and application. These include robot grippers, interface cards for connection to a wide range of networks, I/O expansion modules and much more besides.

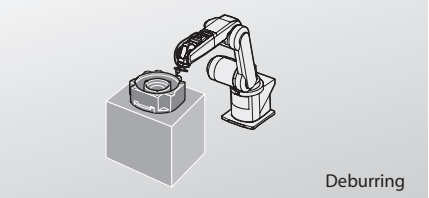

Machining / providing


Sealing


Conveyor tracking


Production of electric devices


Wafer transfer


Deburring

Optional Network Capabilities

Ethernet

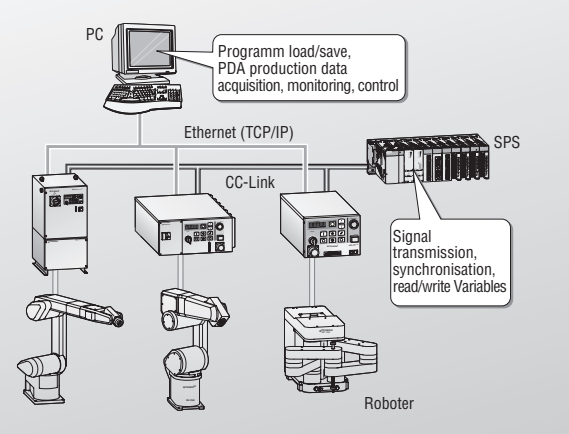
The Ethernet expansion card uses the standard TCP/IP protocol for high-speed communications between the robot controller and PCs or sensors. You can configure the card in master or slave mode as required by your application. One of the most attractive features of this communications option is the ability to control the robot in real time, so that the robot's movements can respond instantaneously to sensor data.

CC-Link

This option provides a large number of virtual I/Os, for example for communication between several robots or connection of a PLC via a simple twisted-pair line.

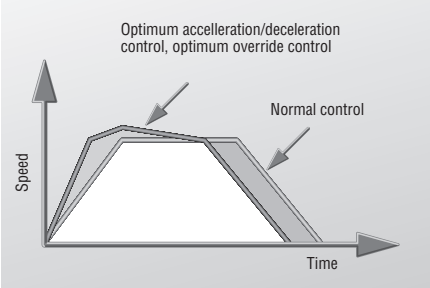
Profibus/DP

The Profibus/DP network is particularly well suited for time-critical applications. A wealth of distributed I/O solutions are also available for this network.

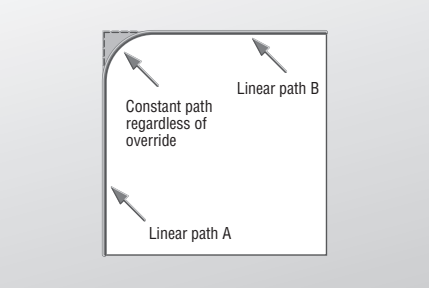


Possible network connection configuration

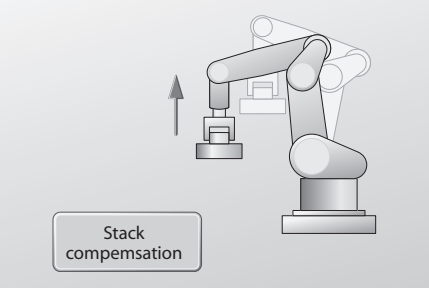
Practical Functions for all Applications



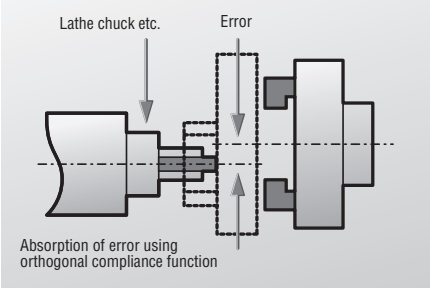
Automatic acceleration and braking ramp optimisation for faster cycle times



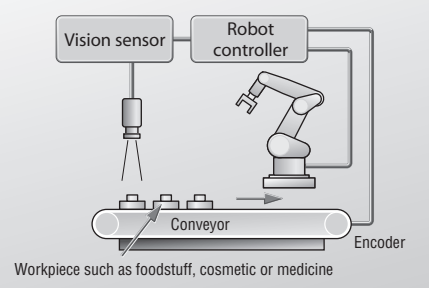
Continous path function for faster cycle times



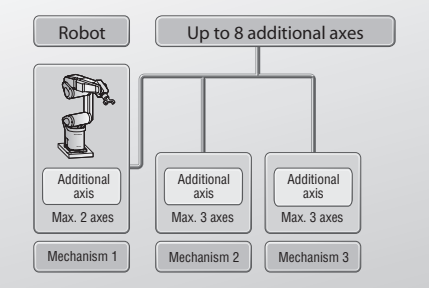
Gravity compensation for greater positioning and palletising precision



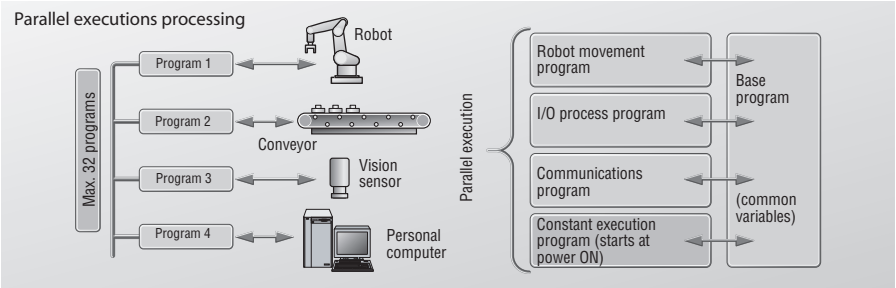
Orthogonal compliance control function for interactive response to opposing forces



Object tracking function for faster cycle times



Control functions for up to 8 additional axes



Multitasking function for parallel execution of multiple tasks

■ Overview Articulated Arm Robots

Large Range of Robot Models Makes Selection Easy

Mitsubishi produces a comprehensive range of robot models to cater to the full spectrum of modern needs. All Mitsubishi robots are powerful, fast and compact – that goes almost without saying. The product range includes the almost universal articulated-arm robots with 5 or 6 degrees of freedom and SCARA robots for assembly and palletising tasks. There is also a line of special high-precision robots for very fast and exact handling tasks.

RV-2AJ, RV-1A

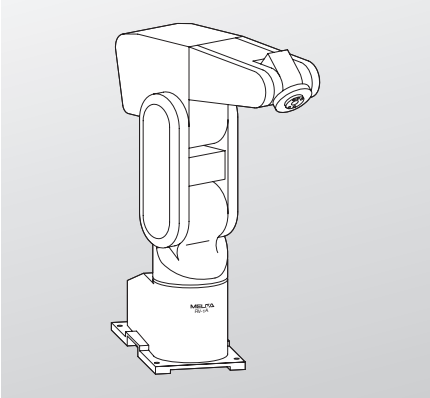
The powerful robots of the compact class are ideal for handling and component placement applications in cramped quarters. These robots are also well suited for handling tasks at machines, for example automated laboratory equipment etc.

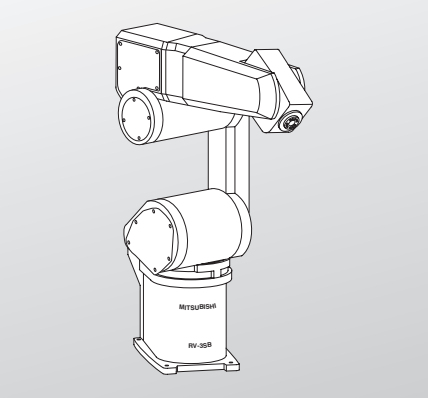
RV-3SJB, RV-3SB

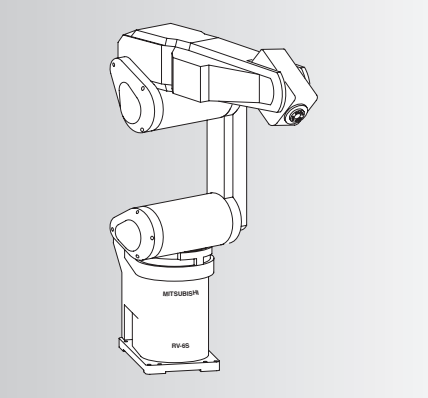
The RV-3S deliver robots outstanding performance at or even in machines. The entire robot has an IP 65 protection rating for reliable operation even under the most extreme conditions.

RV-6S, RV-6SL, RV-12S, RV-12SL

The RV-6S and RV-12S are the high-performance robots in Mitsubishi's S series. Available in both 6 kg and 12 kg payload versions and with standard or long-reach arms, the robots of this series are ideal for handling workpieces in industrial manufacturing processes and for daisy-chaining production stations.







Model		RV-2AJ	RV-1A	RV-3SJB	RV-3SB	RV-6S	RV-6SL	RV-12S	RV-12SL
Degrees of freedom		5	6	5	6	6			
Type		Standard							
Installation posture		Installation on floor or ceiling possible		Installation on floor, wall or ceiling possible		Installation on floor, wall or ceiling possible			
Max. composite speed [mm/s]		2100	2200	5300	5500	9300	8500	9600	9500
Payload [kg]	maximum	2.0	1.5	3.5		6		12	
	nominal	1.5	1.0	3		5		10	
Position repeatability [mm]		±0.02		±0.02		±0.02		±0.05	
Weight [kg]		17	19	33	37	58	60	93	98
Reach without hand [mm]		410	418	641	642	696	902	1086	1385
Catalogue reference page		8		10		12			

■ Overview SCARA Robots

The robots described in this section are SCARA robots, which have 4 degrees of freedom. Whilst the RH-SH series has the typical SCARA design, the closed-loop arm of the RP-AH series puts it in a special class of its own.

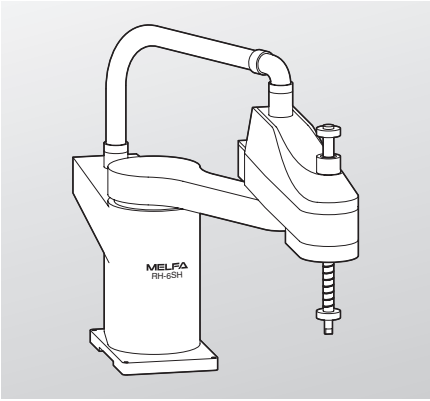
The kinematic advantages of this design enable the robot to perform positioning tasks with precision of up to 5 µm.

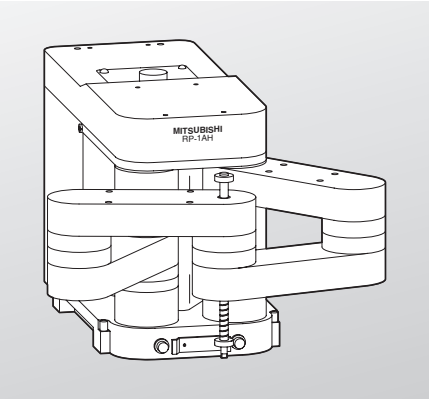
RH-6SH, RH-12SH

SCARA robots are designed for tasks like sorting, palletising and workpiece placement. Depending on the application they can achieve cycle times of less than 1 second.

RP-1AH, RP-3AH, RP-5AH

Their compact dimensions and high precision predestine the RP robots for micro-handling applications like micro-assembly, component placement and soldering SMD circuit boards.

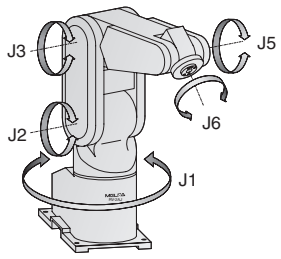




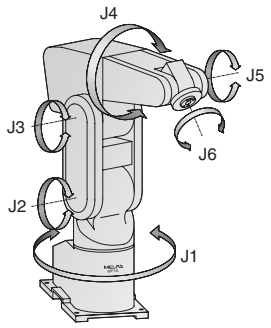
Model		RH-6SH	RH-12SH
Degrees of freedom		4	
Installation posture		Floor mounting	
Payload [kg]	maximum	6	12
	nominal	2	2
Max. reach (arm 1 + 2) [mm]		550	850
Max. composite speed [mm/s]		7782 (J1, J2, J4) 6003 (J1, J2)	11221 (J1, J2, J4) 6612 (J1, J2)
Repeatability	X, Y direction [mm]	±0.02	±0.025
	J3 (Z) direction [mm]	±0.01	
	J4 direction (θ axis) [degree]	±0.02	±0.03
Weight [kg]		21	45
Reference page		15	

Model		RP-1AH	RP-3AH	RP-5AH
Degrees of freedom		4		
Installation posture		Floor mounting		
Payload [kg]	maximum	1.0	3.0	5.0
	nominal	0.5	1.0	2.0
Rectangular operating range (width x depth) [mm]		150 × 105 (DIN A6)	210 × 148 (DIN A5)	207 × 210 (DIN A4)
Repeatability	X, Y direction [mm]	±0.005	±0.008	±0.01
	Z direction [mm]	±0.01		
	wrist roll direction [degree]	±0.02		
Weight [kg]		12	24	25
Reference page		17		

■ Industrial Robots RV-2AJ and RV-1A



RV-2AJ



RV-1A

The Articulated Arm Robots RV-2AJ, RV-1A

High-tech arms and robot controllers are among the outstanding features of the RV-2AJ and RV-1A, which have 5 and 6 degrees of freedom, respectively. High-precision AC servo motors make the drive system almost completely maintenance-free.

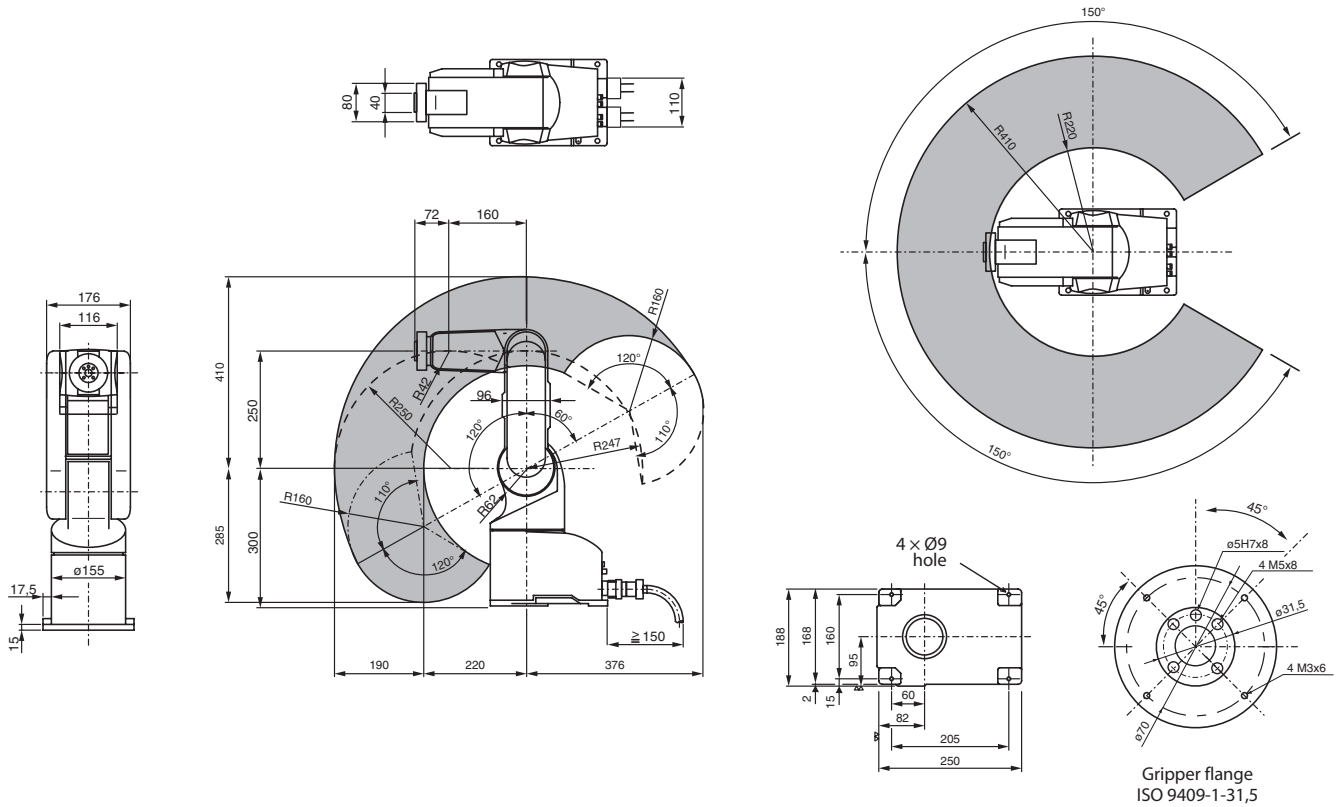
Highlights:

- Slim design allows operation in cramped quarters
- Additional axes can be added
- Multitasking operating system

Characteristics/Functions			Specification	
			RV-2AJ	RV-1A
Degrees of freedom (no. of axes)			5	6
Installation posture			Floor or ceiling mounting possible	
Structure			Vertical multiple-joint type	
Drive system			AC servo (J1, J2, J3 and J5-axies: with brake; J4 and J6 axes: without brake)	
Position detection method			Absolute encoder	
Operating range	waist (J1)	degree	300 (-150 to +150)	
	shoulder (J2)		180 (-60 to +120)	
	elbow (J3)		230 (-110 to +120)	95 (+60 to +155)
	wrist twist (J4)		—	320 (-160 to +160)
	wrist pitch (J5)		180 (-90 to +90)	
	wrist roll (J6)		400 (-200 to +200)	
Maximum speed	waist (J1)	degree/s	180	
	shoulder (J2)		90	
	elbow (J3)		135	
	wrist twist (J4)		—	180
	wrist pitch (J5)		180	
	wrist roll (J6)		210	
Maximum composite speed		mm/s	2200	2100
Payload capacity	rated	kg	1.5	1
	maximum		2	1.5
Position repeatability		mm	±0.02	
Ambient temperature		°C	0 to 40	
Weight		kg	17	19
Tolerable moment	wrist twist (J4)	Nm	—	1.44
	wrist pitch (J5)		2.16	1.44
	wrist roll (J6)		1.10	0.73
Tolerable inertia	wrist twist (J4)	kgm²	—	2.16×10^{-2}
	wrist pitch (J5)		3.24×10^{-2}	2.16×10^{-2}
	wrist roll (J6)		8.43×10^{-3}	5.62×10^{-3}
Arm reachable radius (to the center point of the J5 axis)		mm	410	418
Tool wiring			4 input signal lines (connections in robot gripper area), 4 output signal lines (connections in base area), power line for motor-powered robot grippers (connection in robot gripper area)	
Tool pneumatic pipes			Ø4 × 4 (from the base level to the gripper hand area)	
Supply pneumatic pressure		MPa (bar)	0.5 ± 10 % (5 ± 10 %)	
Gripper flange			ISO 9409-1-31.5	
Protection rating			IP 30	
Robot controller			CR1	
Order information		Art. no.	129861	134211

■ Robot Arms RV-2AJ and RV-1A

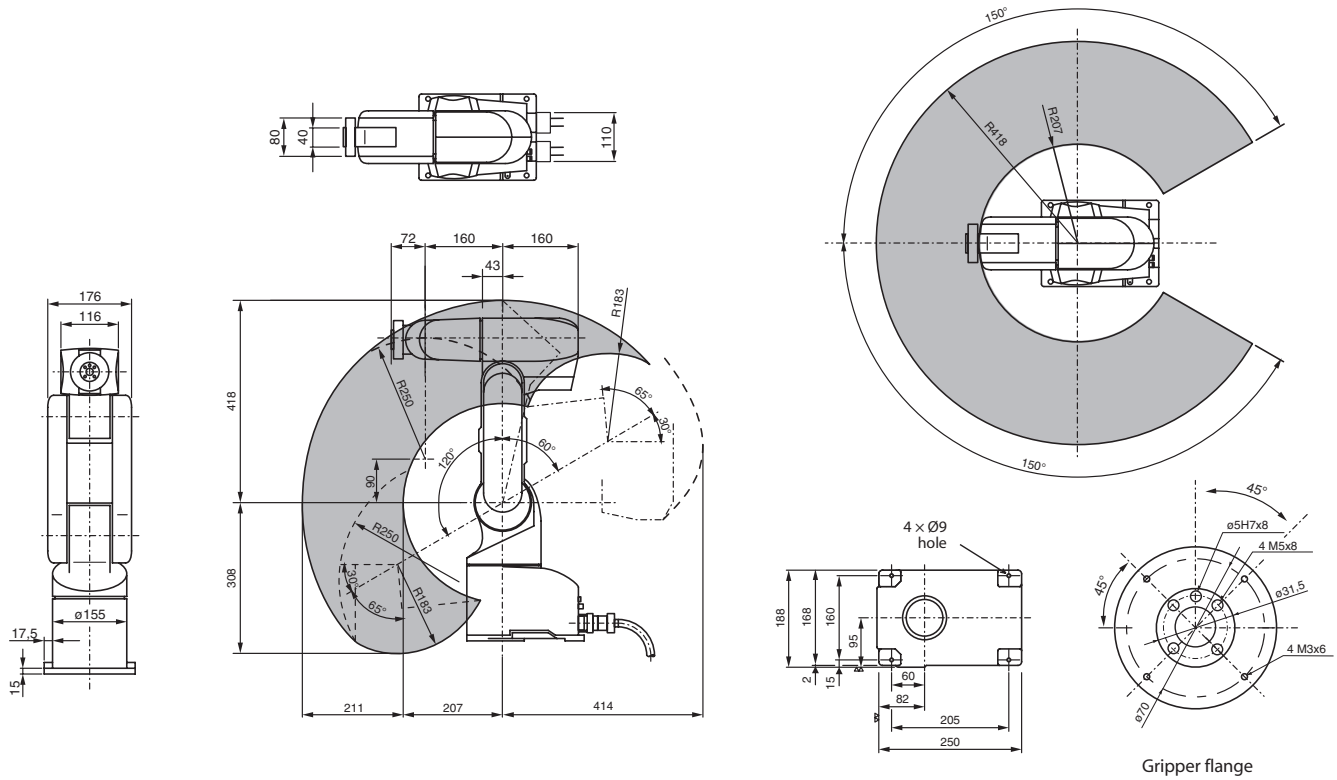
RV-2AJ



Gripper flange
ISO 9409-1-31,5

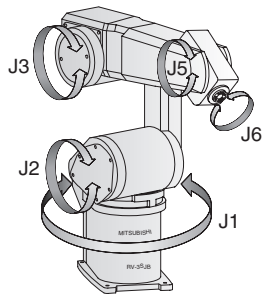
RV-1A

Dimensions: mm

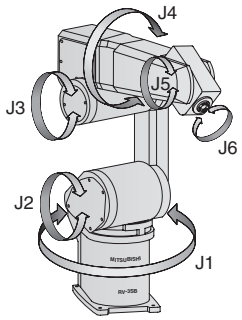


Gripper flange
ISO 9409-1-31,5

■ Industrial Robots RV-3SJB and RV-3SB



RV-3SJB



RV-3SB

The Articulated Arm Robots RV-3SJB, RV-3SB

The RV-3S robots are specially designed for handling tasks with payloads of up to 3.5kg. They are encapsulated with an IP 65 ingress protection rating for operation in extreme environments.

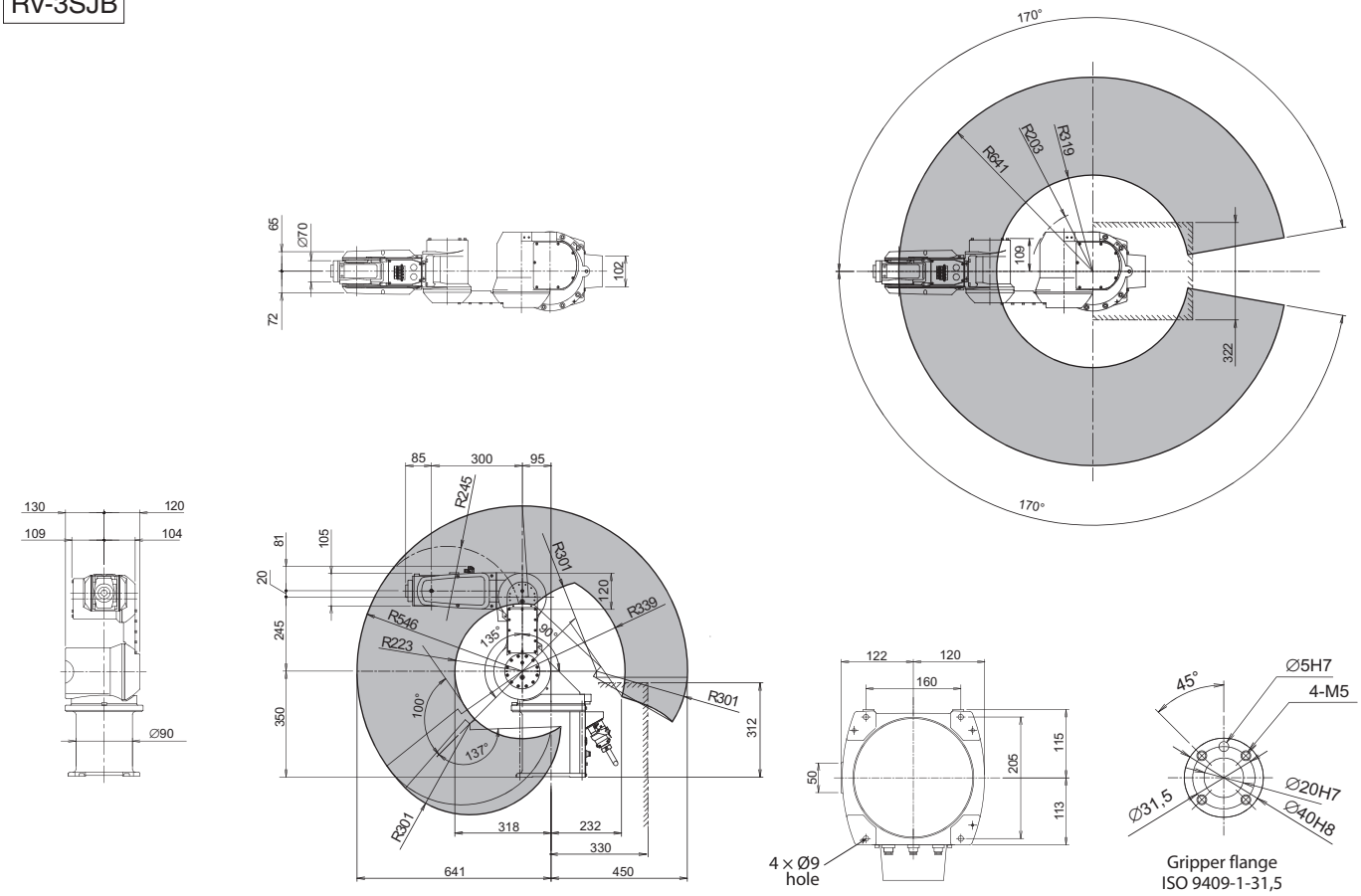
Highlights:

- Compliance Control function to compensate for workpiece tolerances
- Conveyor belt tracking
- Sensorless collision detection
- Encapsulated design with IP65 rating
- Adaptive speed optimisation

Characteristics/Functions			Specifiactions	
			RV-3SJB	RV-3SB
Degrees of freedom (no. of axes)			5	6
Machine class			Standard (oil mist)	
Installation posture			Floor, wall or ceiling mounting possible (wall mounting with limitations in the J1 axis)	
Structure			Vertical multiple-joint type	
Drive system			AC servo (all axes with brakes)	
Position detection method			Absolute encoder	
Operating range	waist (J1)	degree	340 (-170 to +170)	
	shoulder (J2)		225 (-90 to +135)	
	elbow (J3)		237 (-100 to +137)	191 (-20 to +171)
	wrist twist (J4)		—	320 (-160 to +160)
	wrist pitch (J5)		240 (-120 to +120)	
	wrist roll (J6)		720 (-360 to +360)	
Maximum speed	waist (J1)	degree/s	250	
	shoulder (J2)		187	
	elbow (J3)		250	
	wrist twist (J4)		—	412
	wrist pitch (J5)		412	
	wrist roll (J6)		660	
Maximum composite speed		mm/s	5300	5500
Payload capacity	rated	kg	3	
	maximum		3.5	
Position repeatability		mm	± 0.02	
Ambient temperature		°C	0 to 40	
Weight		kg	33	37
Tolerable moment	wrist twist (J4)	Nm	—	5.83
	wrist pitch (J5)		5.83	
	wrist roll (J6)		3.9	
Tolerable inertiat	wrist twist (J4)	kgm²	—	0.137
	wrist pitch (J5)		0.137	
	wrist roll (J6)		0.047	
Arm reachable radius (to the center point of the J5 axis)		mm	641	642
Tool wiring			8 inputs/8 outputs 8 spare wires 0.2 mm² (shielded)	
Tool pneumatic pipes			Primary: Ø6 × 2 (base to forearm section) Secondary: Ø4 × 8 (optional)	
Supply pneumatic pressure		MPa (bar)	0.5 ± 10 % (5 ± 10 %)	
Gripper flange			ISO 9409-1-31,5	
Protection rating			IP 65	
Robot controller			CR2B	
Order information		Art. no.	163527	163526

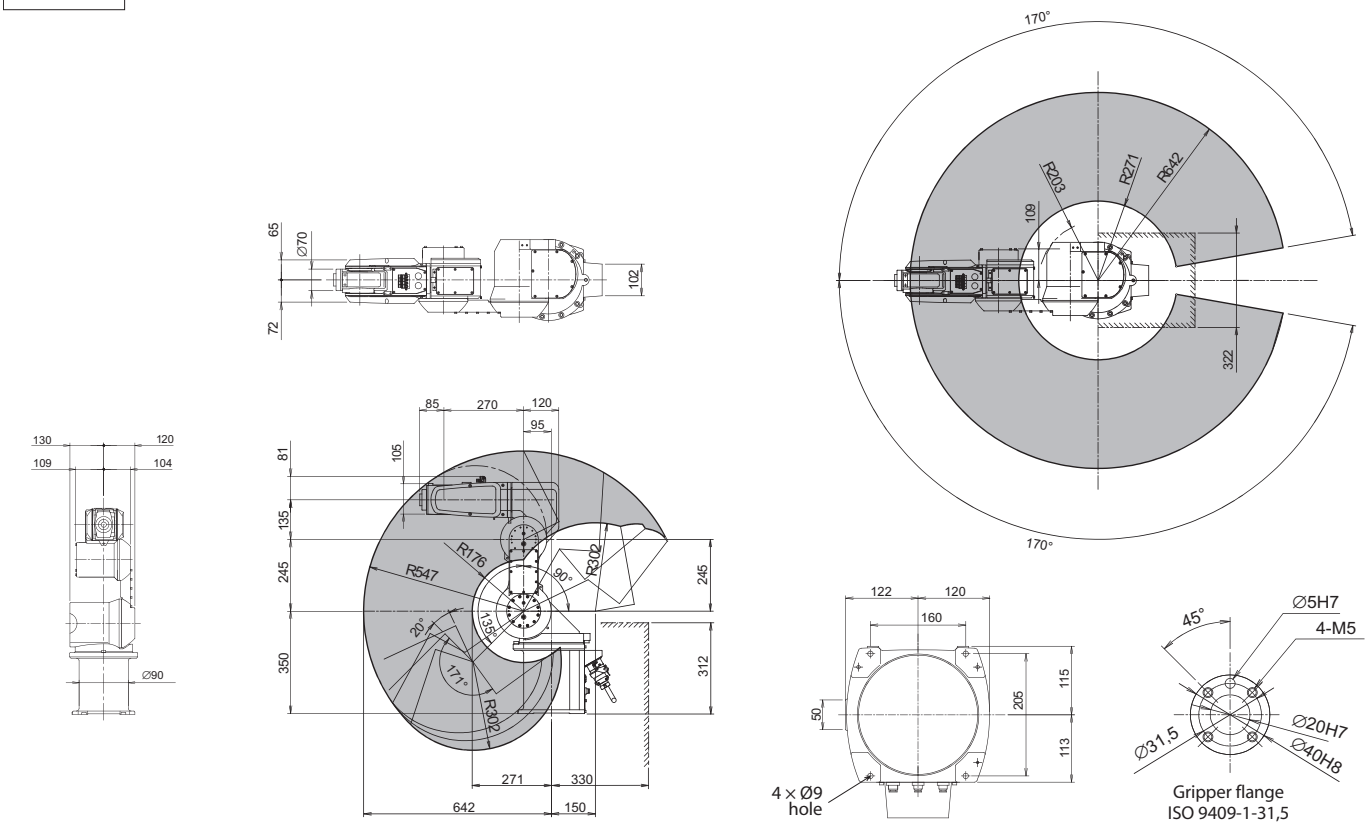
■ Robot Arms RV-3SJB and RV-3SB

RV-3SJB

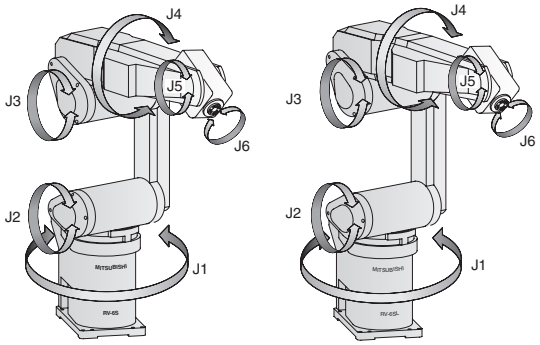


RV-3SB

Dimensions: mm



■ Industrial Robots RV-6S, RV-6SL, RV-12S and RV-12SL



RV-6S RV-6SL

The Articulated Arm Robots RV-6S(L) and RV- 12S(L)

Combining high speeds with maximum handling payloads of 6 kg and 12 kg, these robots are an ideal choice for virtually any application.

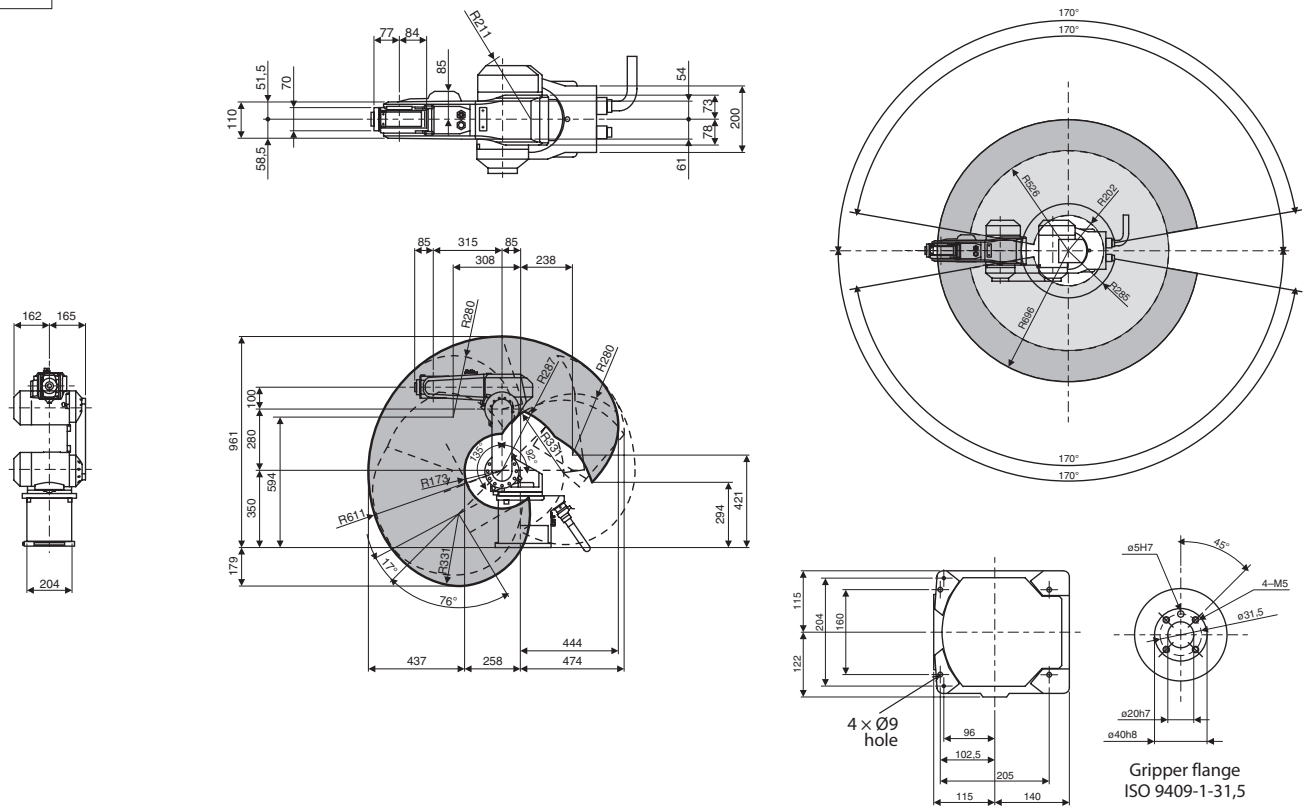
Highlights:

- Sensorless collision detection
- Conveyor belt tracking
- Compliance Control function to compensate for workpiece tolerances

Characteristics/Functions			Specifiactions			
			RV-6S	RV-6SL	RV-12S	RV-12SL
Degrees of freedom (no. of axes)			6	6 (long arm)	6	6 (long arm)
Machine class			Standard			
Installation posture			Floor, wall or ceiling mounting possible (wall mounting with limitations in the J1 axis)			
Structure			Vertical multiple-joint type			
Drive system			AC servo (all axes with brakes)			
Position detection method			Absolute encoder			
Operating range	waist (J1)	degree	340 (-1170 to +170)			
	shoulder (J2)		227 (-92 to +135)		230 (-100 to +130)	
	elbow (J3)		285 (-107 to +166)	295 (-129 to +166)	290 (-130 to +160)	
	wrist twist (J4)		320 (-160 to +160)			
	wrist pitch (J5)		240 (-120 to +120)			
	wrist roll (J6)		720 (-360 to +360) (expandable)			
Maximum speed	waist (J1)	degree/s	401	250	276	230
	shoulder (J2)		321	267	230	172
	elbow (J3)		401	267	267	200
	wrist twist (J4)		352			
	wrist pitch (J5)		450		375	
	wrist roll (J6)		660			
Maximum composite speed		mm/s	9300	8500	9600	9500
Payload capacity	rated	kg	5		10	
	maximum		6		12	
Position repeatability		mm	±0.02		±0.05	
Ambient temperature		°C	0 to 40			
Weight		kg	58	60	93	98
Tolerable moment	wrist twist (J4)	Nm	12		19.3	
	wrist pitch (J5)		12		19.3	
	wrist roll (J6)		4,5		11	
Tolerable inertia	wrist twist (J4)	kgm²	0.29		0,4	
	wrist pitch (J5)		0.29		0.4	
	wrist roll (J6)		0.46		0.14	
Arm reachable radius (to the center point of the J5 axis)		mm	696	902	1086	1385
Tool wiring			8 inputs/8 outputs, 6 spare wires 0.1 mm² (shielded)			
Tool pneumatic pipes			Primary: Ø6 × 2 (base to fore arm section) secondary: Ø4 × 8		Primary: Ø6 × 2 (base to fore arm section) secondary: Ø4 × 8	
Supply pneumatic pressure		MPa (bar)	0.49 ± 10 % (4.9 ± 10 %)			
Gripper flange			ISO 9409-1-31,5		ISO 9409-1-40	
Protection rating			IP 54 (J1 to J3), IP 65 (J4 to J6)			
Robot controller			CR2B		CR3	
Order information		Art. no.	152466	152465	156734	152467

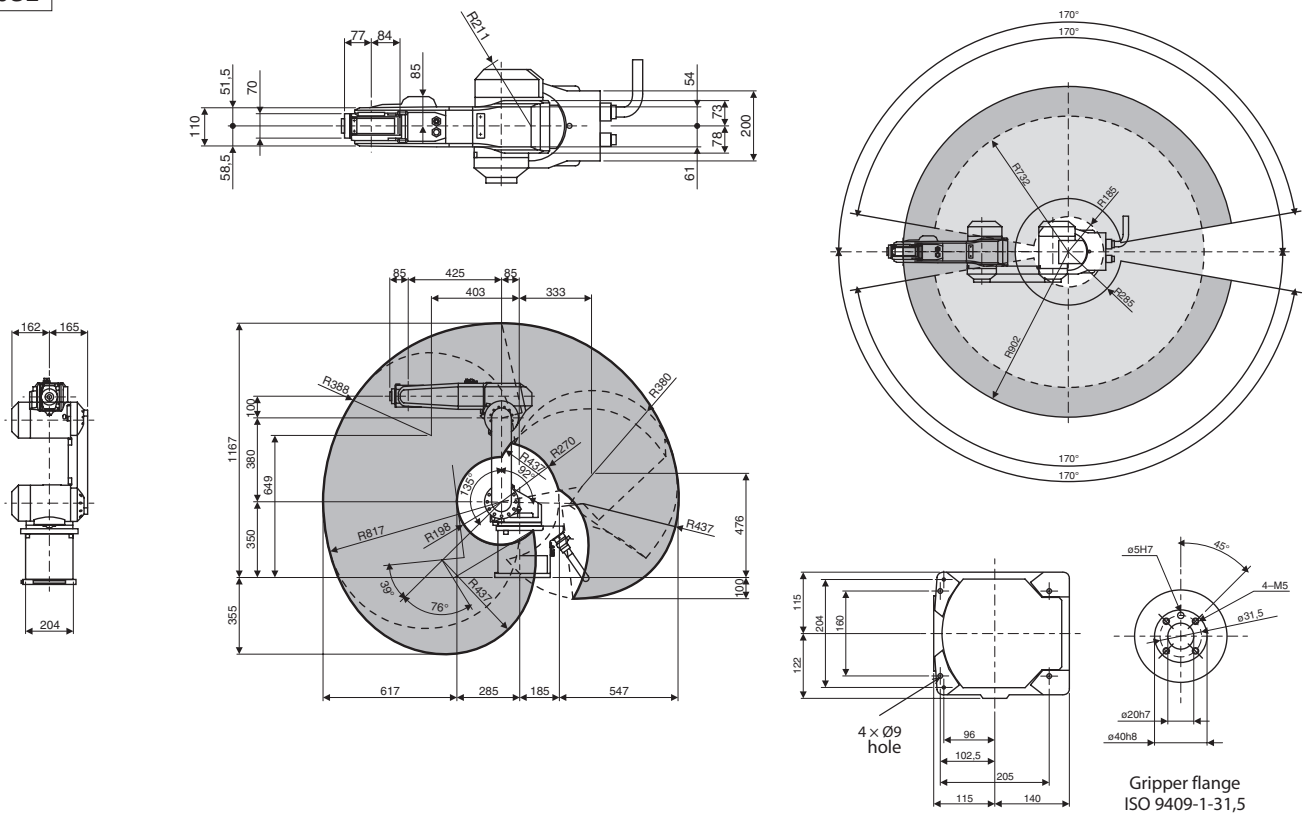
■ Robot Arms RV-6S and RV-6SL

RV-6S



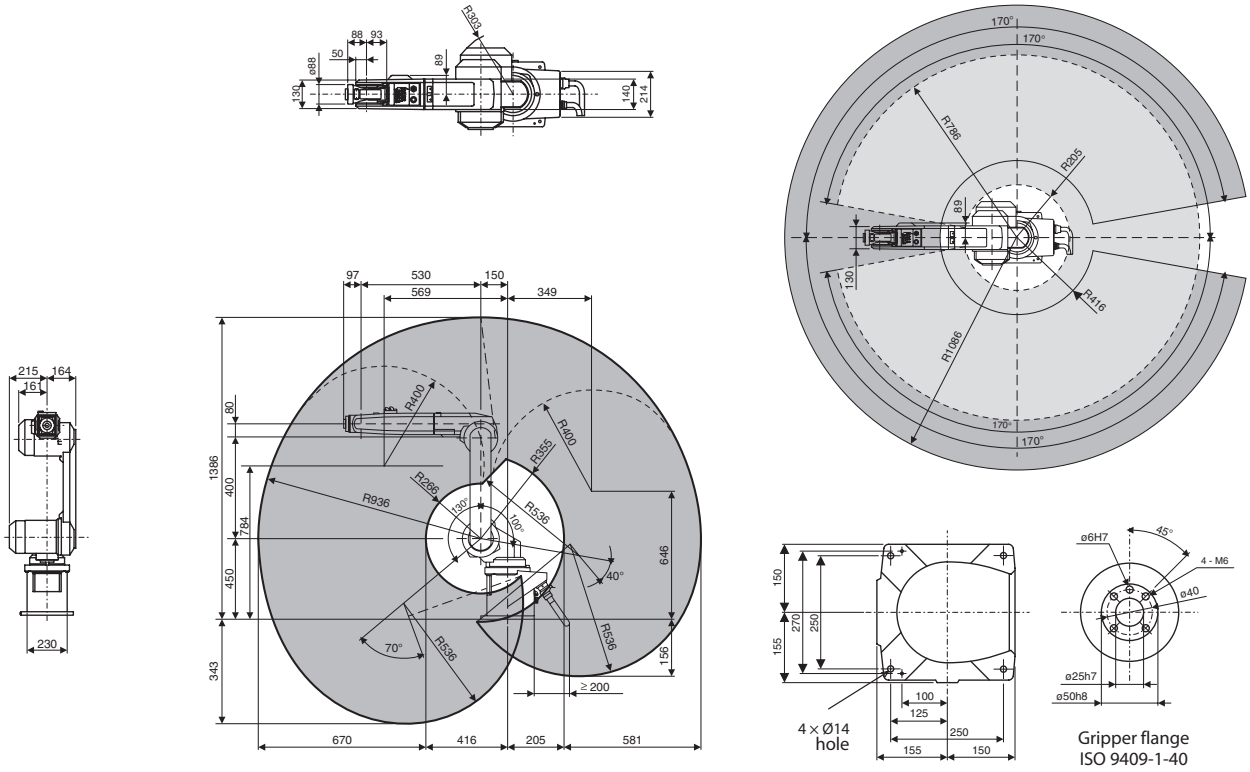
Dimensions: mm

RV-6SL



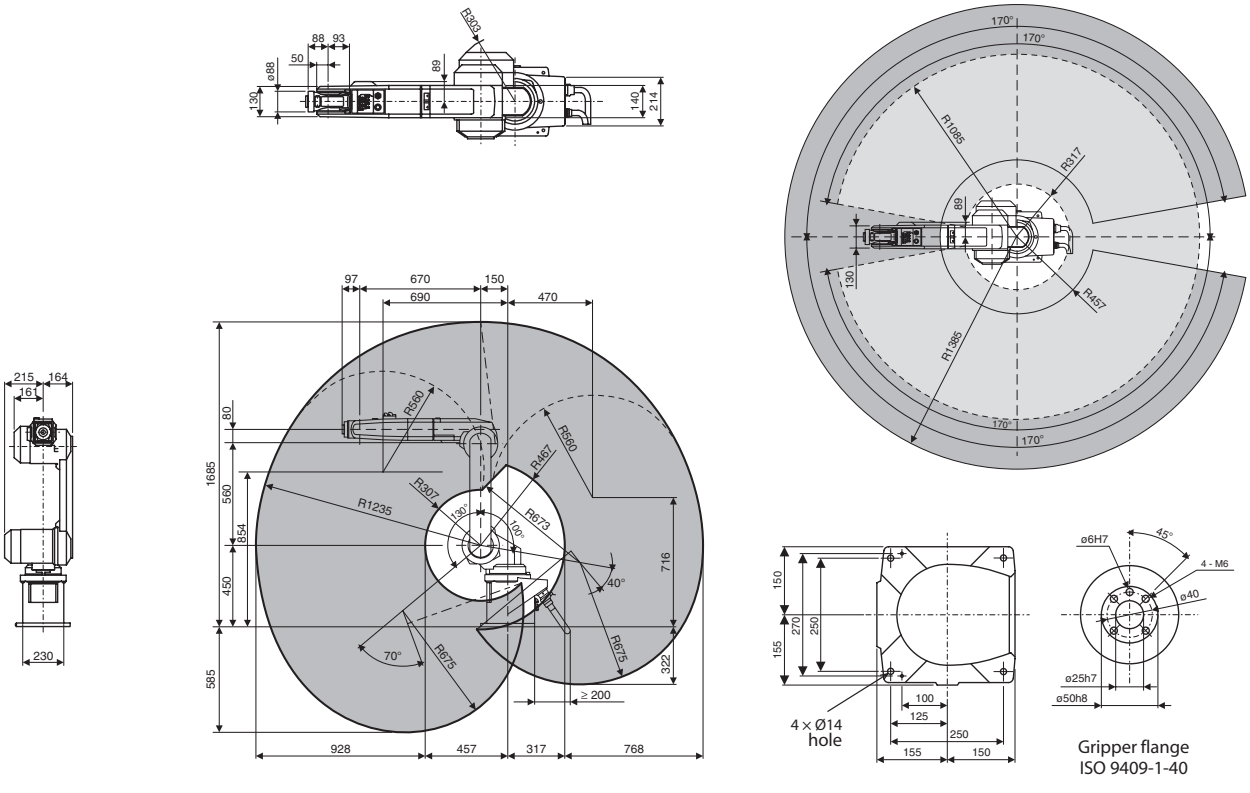
■ Robot Arms RV-12S and RV-12SL

RV-12S

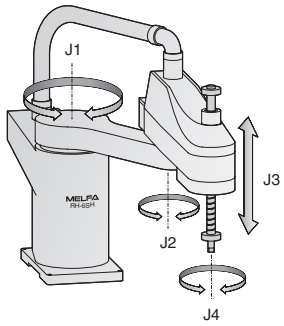


Dimensions: mm

RV-12SL



■ Industrial Robots RH-6SH and RH-12SH



The SCARA Robots RH-6SH and RH-12SH

Assembly, handling and palletising are the strengths of these 6 kg and 12 kg SCARA robots. A version with an 18 kg payload capacity is available for handling particularly heavy loads.

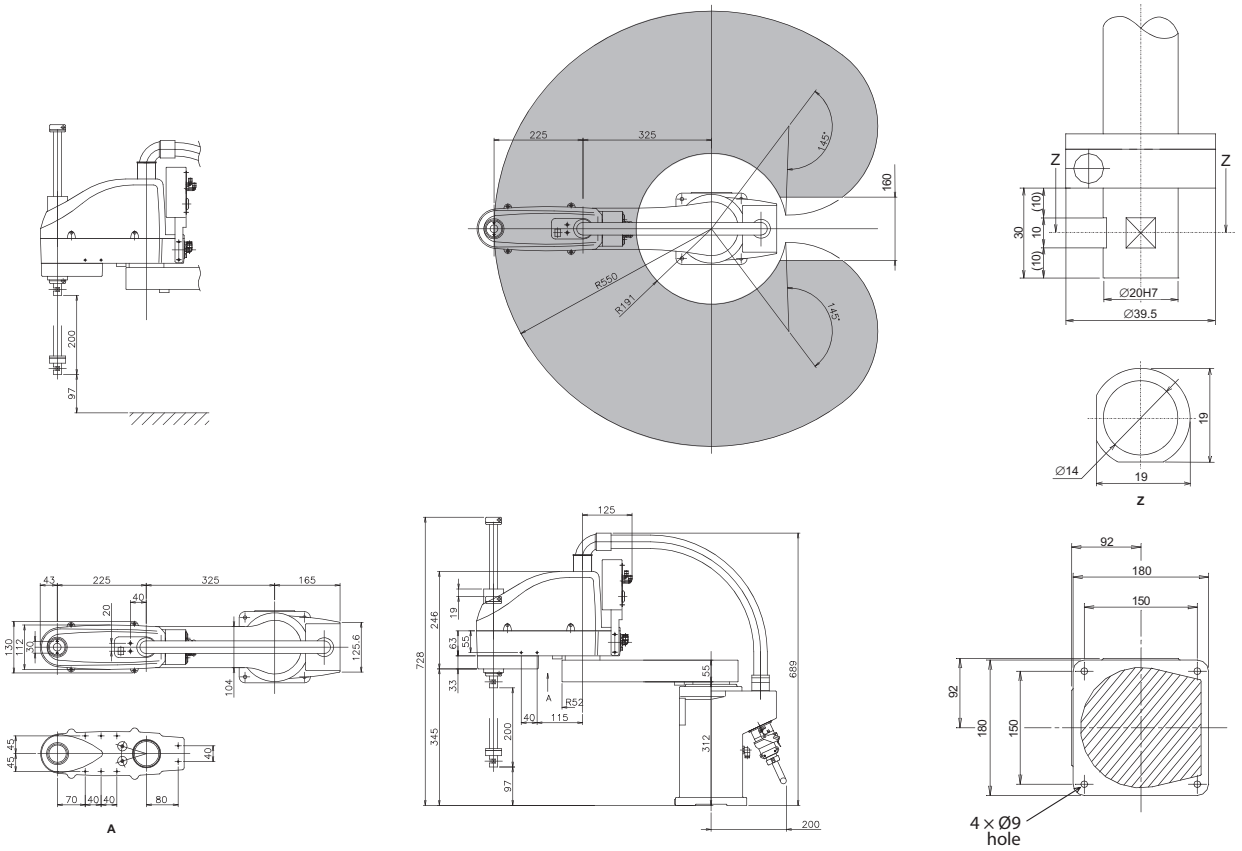
Highlights:

- Slim design
- 6/12 kg payload capacity
- Speeds up to 11,200mm/s with axis interpolation

Characteristics/Functions			Specifications	
			RH-6SH5520	RH-12SH8535
Degrees of freedom (no. of axes)			4	
Machine class			Standard	
Structure			SCARA	
Installation posture			Floor mounting	
Drive system			AC servo	
Position detection method			Absolute encoder	
Brake attachment			J1-, J2-, J4 axes: without brake, J3 axis: with brake	
Payload capacity (hand gripper included)	rated	kg	2	2
	maximum		6	12
Maximum reach	arm 1 + arm 2	mm	550	850
Operating range	J1	degree	254 (±127)	280 (±140)
	J2	degree	290 (±145)	306 (±153)
	J3 (Z)	mm	200 (97–297)	350 (-10–340)
	J4 (θ axis)	degree	720 (±360)	
Maximum speed	J1	degree/s	375	288
	J2	degree/s	612	412,5
	J3 (Z)	mm/s	1177	1300
	J4 (θ axis)	degree/s	2411	1500
Maximum composite speed		mm/s	7782 (J1, J2 and J4) 6003 (J1 and J2)	11221 (J1, J2 and J4) 6612 (J1 and J2)
Allowable wrist moment of inertia	rated	kgm^2	0.01	0.02
	maximum		0.04	0.1
Position repeatability	X, Y direction	mm	±0.02	±0.025
	J3 (Z direction)	mm	±0.01	
	J4 (θ axis)	degree	±0.02	±0.03
Ambient temperature		℃	0 to 40	
Weight		kg	21	45
Tool wiring			8 inputs/8 outputs 8 spare wires	
Tool pneumatic pipes			Ø6 × 2	
Supply pneumatic pressure		MPa (bar)	0.5 ± 10 % (5 ± 10 %)	
Protection rating			IP 20	
Robot controller			CR2B	
Order information		Art. no.	166053	166054

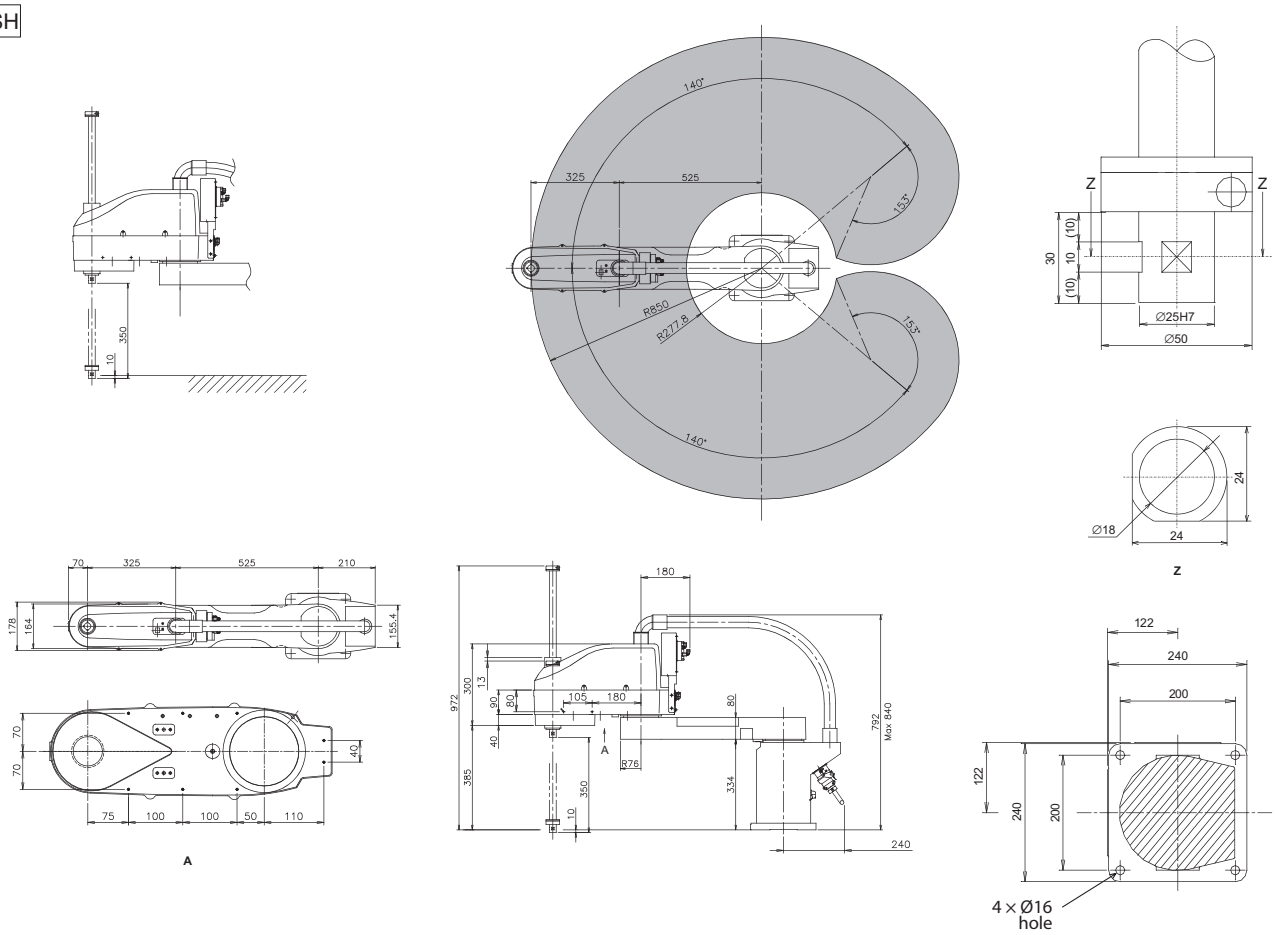
■ Robot Arms RH-6SH and RH-12SH

RH-6SH

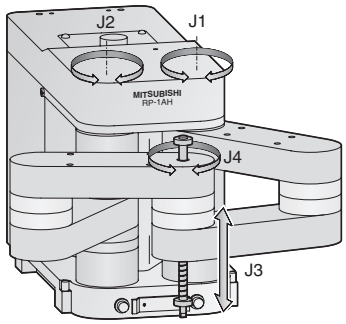


Dimensions: mm

RH-12SH



■ Industrial Robots RP-1AH, RP-3AH and RP-5AH



The SCARA Robots RP-1AH, RP-3AH and RP-5AH

The RP-1AH, RP-3AH and RP-5AH SCARA robots are in their element in all applications calling for fast and precise placement of components in limited space. The unique mechanical design of these robots gives them a significant edge for improved productivity and micro-handling quality.

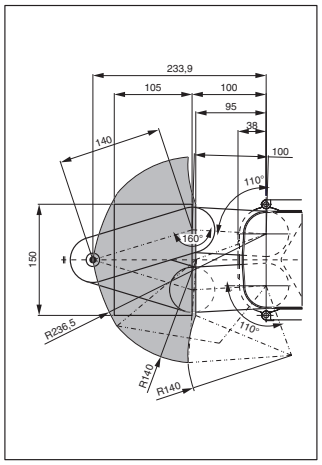
Highlights:

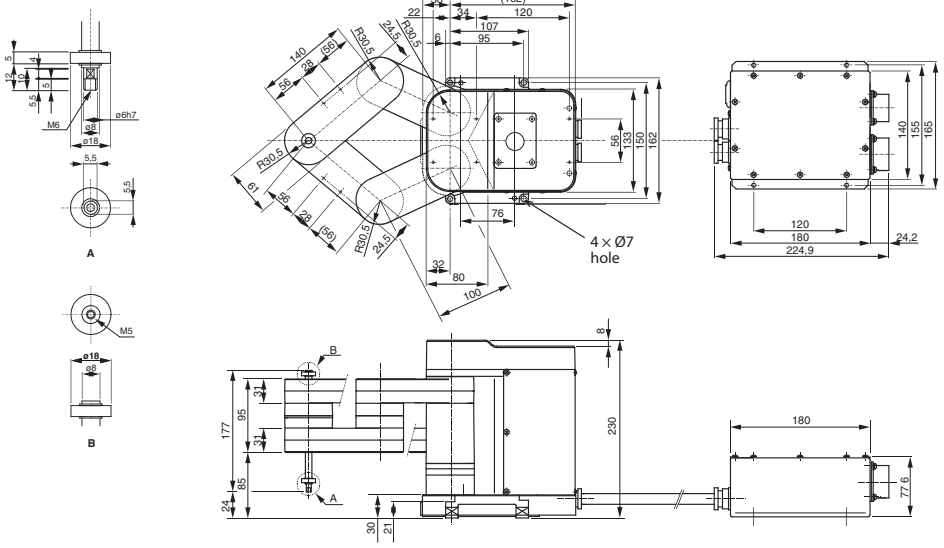
- Repeatability ±0.005 mm (RP-1AH)
- Footprint just 200 x 160 mm (RP-1AH)
- Pick & Place cycle time < 0.5 s

Characteristics/Function			Specifications		
			RP-1AH	RP-3AH	RP-5AH
Degrees of freedom (no. of axes)			4		
Installation posture			Floor mounting		
Drive system			AC servo		
Position detection method			Absolute encoder		
Brake attachment			All axes		
Max. load capacity	rated	kg	0.5	1.0	2.0
	maximum		1.0	3.0	5.0
Operating range	width × depth	mm	150 × 105 (DIN-A6)	210 × 148 (DIN-A5)	297 × 210 (DIN-A4)
	vertical	mm	30	50	
	twist	degree	±200		
Maximum speed	J1/J2	degree/s	480	432	
	J3	mm/s	800	960	
	J4	degree/s	3000	1330	
Inertial moment	wrist	kgm^2	3.10×10^{-4}	1.60×10^{-3}	3.20×10^{-3}
Position repeatability	X, Y direction	mm	±0.005	±0.008	±0.01
	Z direction	mm	±0.01		
	direction of the wrist twist	degree	±0.02	±0.03	
Ambient temperature		°C	0 to 40		
Weight		kg	12	24	25
Tool wiring			8 inputs/8 outputs		
Supply pneumatic pressure		MPa (bar)	0.5 ± 10 % (5 ± 10 %)		
Tool pneumatic pipes			—		
Robot controller			CR1		
Order information		Art. no.	134183	131626	131628

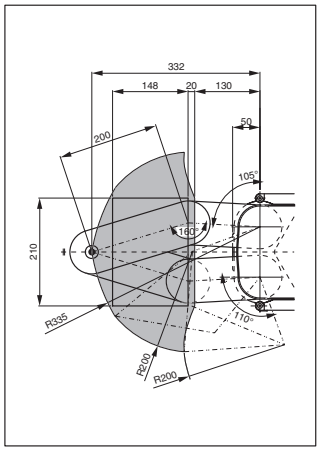
■ Robot Arms RP-1AH, RP-3AH and RP-5AH

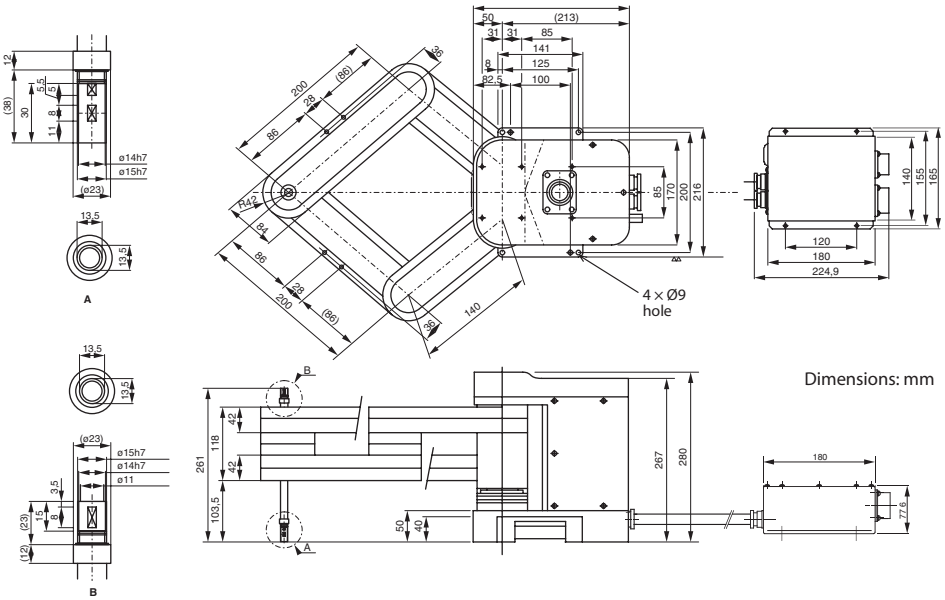
RP-1AH



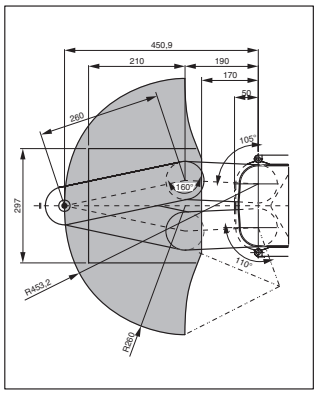


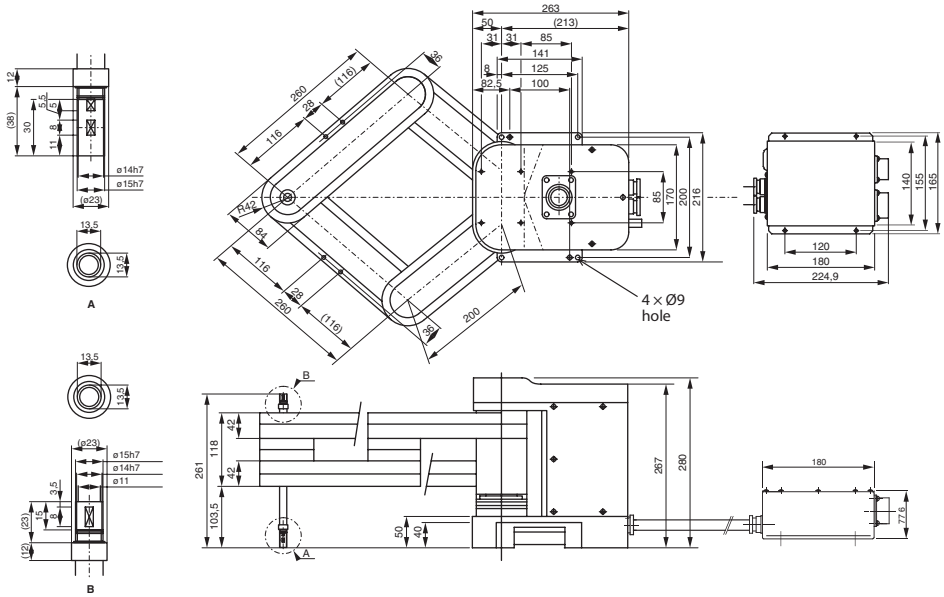
RP-3AH





RP-5AH





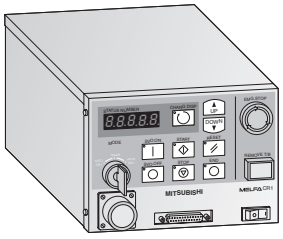
■ Controller Overview

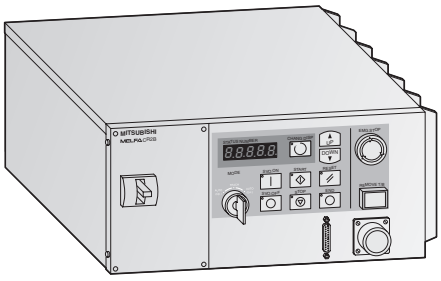
Powerful Controllers CR1, CR2B and CR3

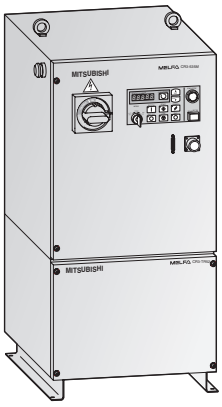
Which controller is used depends on the specific robot model. But the CR1, CR2B and CR3 are all programmed with exactly the same language, no matter which robot is connected to them. You can add special application functions by inserting expansion option cards in the slots in the controllers. For example, there are option cards for connecting the controllers to different networks and for controlling additional robot axes.

A teaching box for defining the robots' working positions can be connected to the controller's RS-422 port. The teaching box can also be used for testing the entire program sequence.

There is also an RS-232C port for connecting a personal computer. This makes it possible to develop programs with a powerful PC software package with a user-friendly interface, and to perform 3D simulations of complete work cells.







CR1-571

With a footprint no larger than a DIN A4 sheet of paper the CR1-571 can be used to control the following robots:

- RV-1A
- RV-2AJ
- RP-1AH/3AH/5AH

The controller comes with 16 general inputs and outputs that can be expanded up to a maximum of 240. It uses a single-phase, 180–253 V AC power supply.

CR2B-574

The CR2B controller is used with the following robots:

- RV-3SB/SJB
- RV-6S/6SL
- RH-6SH/12SH

This controller comes with 32 general inputs and outputs that can be expanded up to a maximum of 256. It uses a single-phase, 180–253 V AC power supply.

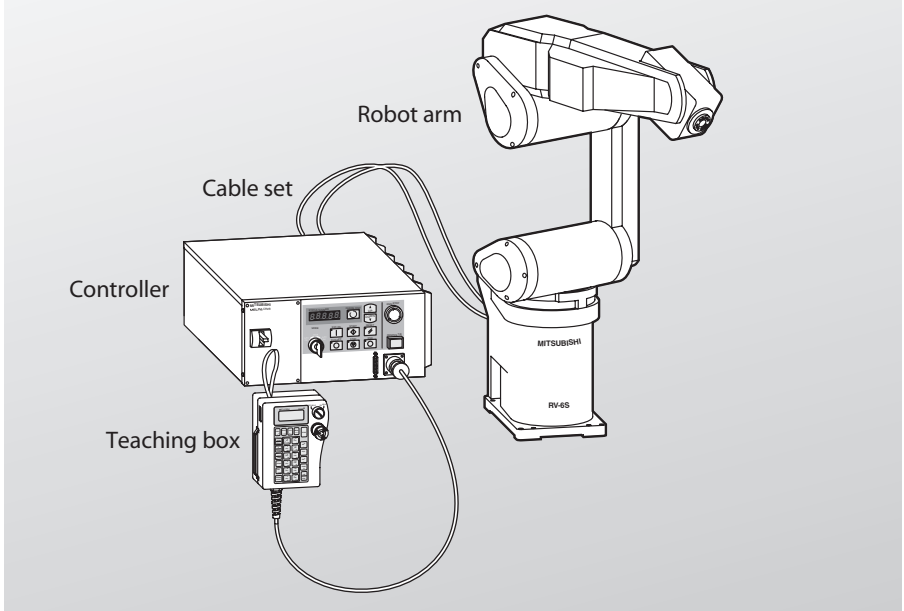
CR3-535M

The CR3-535M controller as special power stages with higher output capacity for use with the following robot:

- RV-12S/12SL

The programming language and options are the same as for the CR1 and CR2B controllers. The controller comes with 32 general inputs and outputs that can be expanded up to a maximum of 256. It uses a three-phase, 400 V AC power supply.

■ System Configuration



The illustration on the left shows the basic configuration of a robot system with the following components:

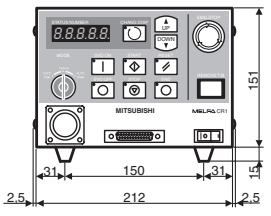
- RV-6S robot arm
- CR2B controller
- 5 m controller connection cable set
- R28TB teaching box

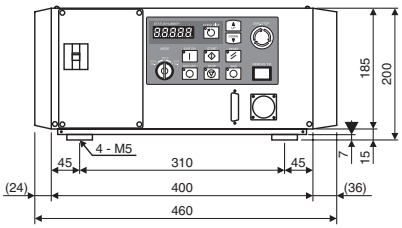
Mitsubishi Electric offers a wide range of optional accessories with which you can configure your robot system for the individual requirements of your application. An overview of the available options can be found on page 21 and there is a detailed list on page 30.

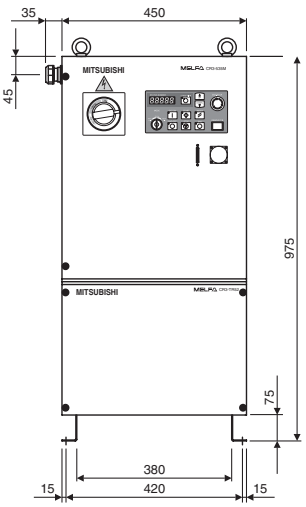
■ Controller Specifications

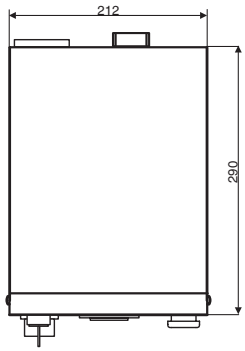
Characteristics/Functions		CR1-571	CR2B-574	CR3-535M
Number of controllable axes		6 robot axes + 2 interpolation axes + 6 independent axes		
Processor type (CPU)		Main CPU: 64 Bit RISC; servo CPU: DSP		
Memory capacity	number of teaching points and program steps	Max. 2500 position teaching points, max. 5000 steps		
	number of programs	88		
Programming languag		MELFA-BASIC IV or MOVEMASTER COMMAND	MELFA-BASIC IV	MELFA-BASIC IV
External inputs/outputs	general purpose I/Os	16 inputs and 16 outputs	32 inputs and 32 outputs	32 inputs and 32 outputs
	dedicated I/Os	User assigned from general purpose I/O	User assigned from general purpose I/O	User assigned from general purpose I/O
	hand open/close	8 inputs and 0 outputs (up to 4 output points can be added as an option)	8 inputs und 0 outputs (up to 8 output points can be added as an option)	8 inputs und 0 outputs (up to 8 output points can be added as an option)
	emergency stop I/Os	1	2 terminal blocks with screw terminals for the connection of a redundant EMERGENCY STOP switch	2 terminal blocks with screw terminals for the connection of a redundant EMERGENCY STOP switch
	door switch input	1	1	1
Interface	RS232C	1 interface for PC	1 interface for PC	1 interface for PC
	RS422	1 interface for teaching box	1 interface for teaching box	1 interface for teaching box
	slot dedicated for hand	1 interfacenkarte for pneumatic hand	1 interfacenkarte for pneumatic hand	1 interfacenkarte for pneumatic hand
	extension slot	For 3 expansion options (optional)	For 3 expansion options	For 3 expansion options
	memory expansion slot	—	1 memory option	1 memory option
	robot I/O link	1 channel (expansion to up to 240 inputs and 240 outputs possible)	1 channel (expansion to up to 256 inputs and 256 outputs possible)	1 channel (expansion to up to 256 inputs and 256 outputs possible)
Power supply		1-phase 90–132 V AC; 50/60 Hz; 0.7 kVA 1-phase 180–253 V AC; 50/60 Hz; 0.7 kVA	1-phase 90–132 V AC; 50/60 Hz; 1.0 kVA	3-phase 400 V AC; 50/60 Hz; 3.0 kVA;
Ambient temperature		0 to 40 °C		
Ambient humidity		45 to 85 % without condensation		
Grounding		Via seperate terminal; earth resistance ≤ 100 Ω		
Mounting		Self-contained floor type/closed structure	Self-contained floor type/closed structure, vertical	Self-contained floor type/closed structure
Dimensions (W x H x D)		212 mm x 166 mm x 290 mm	460 mm x 200 mm x 400 mm	450 mm x 975 mm x 380 mm
Weight		8 kg	20 kg	60 kg

■ Controller Dimensions

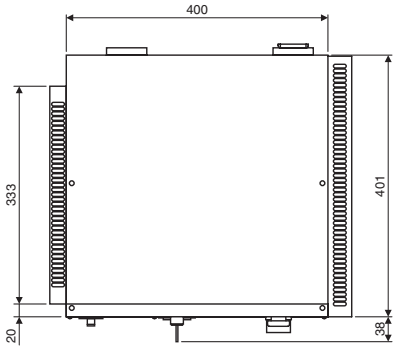




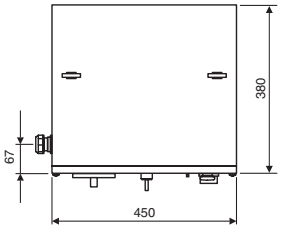




CR1-571



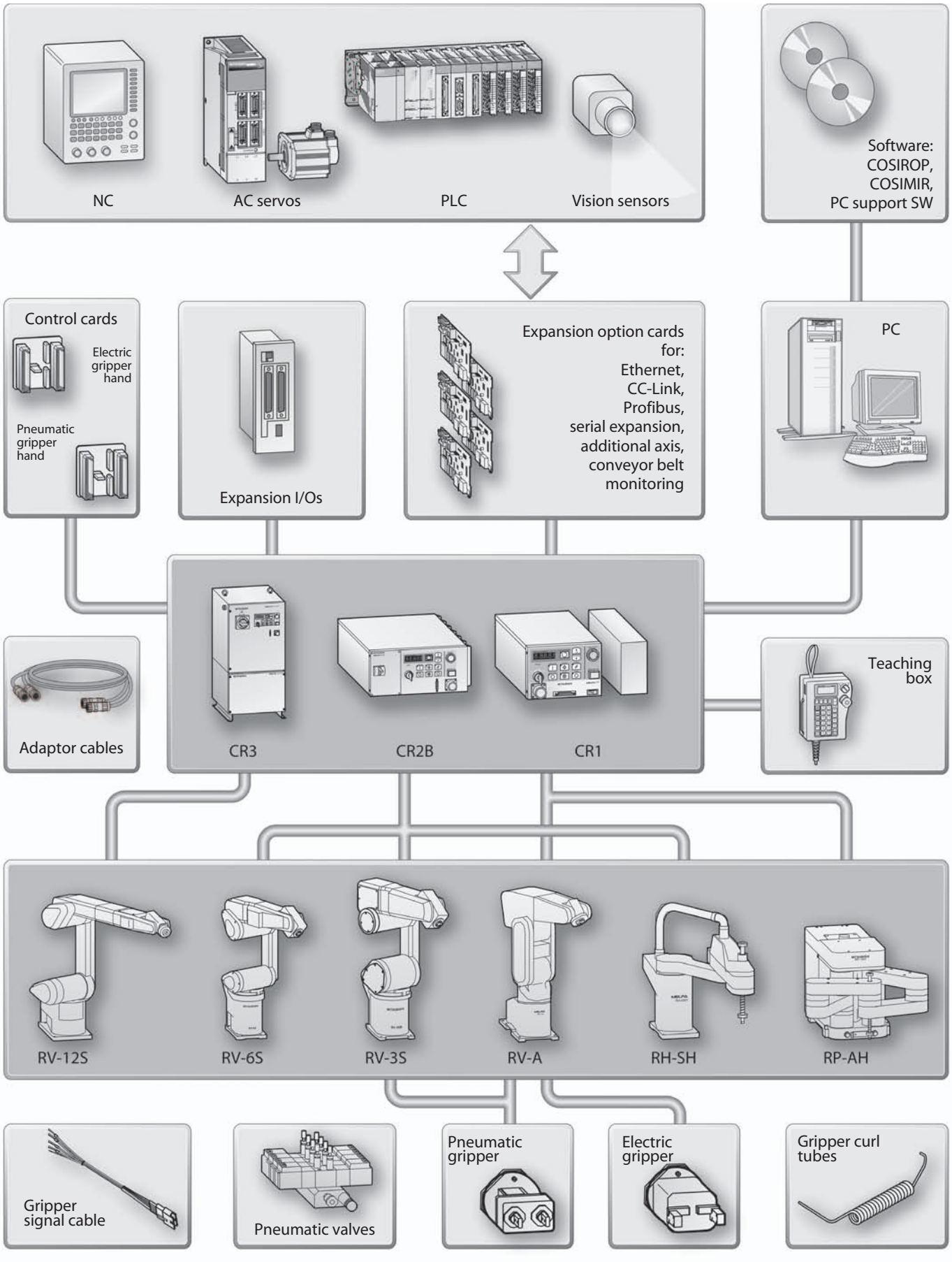
CR2B-574



CR3-535M

All dimensions in mm

■ System Components and Options



■ Teaching Box

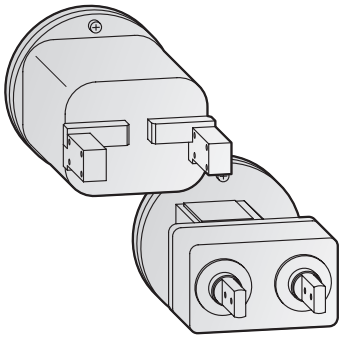
Operation and Programming

The teaching box is used for moving (JOG feed) the robot and for teaching (storing) positions. You can then switch the robot to test mode, step through the stored positions and modify them as required. This compact teaching box can also monitor I/O signals and variables. Safe teaching is ensured by a three-stage confirm button.

Specifications	R28TB
Application range	Position teaching, JOG feed, program control and editing
Dimensions (W x H x D)	153 mm x 203 mm x 70 mm
Body color	Light gray
Weight	Approx. 0.5 kg (without cable)
Connection cable length	7 m
Interface	RS422
Display method	LCD with 4 lines x 16 characters (with backlight illumination)
Operation section	28 keys
Protection rating	IP 65

Order information	Art. no.	
		124656

■ Hand Sets



Tools

The motor-powered gripper is ideal for laboratory tasks because it does not need a compressed air supply. The griping force is adjustable. This gripper has a service life of around 10 million gripping cycles at 50% gripping force.

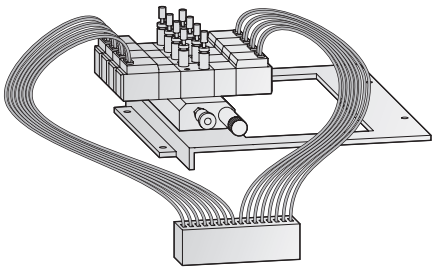
The electric gripper set consists of the gripper, a spiral cable and the control card.

The pneumatic gripper is available in a set consisting of the gripper, spiral pneumatic hose, interface, one-way valve and adapter. It has a service life of 10 million gripping cycles. The gripper is fitted with sensors that provide feedback information on the current gripper position.

Specifications	4A-HM01	4A-HP01E
Drive	DC servo motor	Oil-free compressed air
Grip force	4.9–68.6 N	—
Operating preassure range	—	0.4–7.0 bar
Operating temperatur range	0–40 °C	0–40 °C
Ambient humidity	45–85 %	—
Life	1 mio. gripper cycles (at 100 % load) 10 mio. gripper cycles (at 50 % load)	10 mio. gripper cycles
Operation confirmation sensors	None	Open edge and close edge
Weight	0.59 kg (includes the adapter)	0.45 kg (includes the adapter)

Order information	Art. no.		
		129874	129873

■ Solenoid Valve Sets



Solenoid Gripper Control Valve Sets

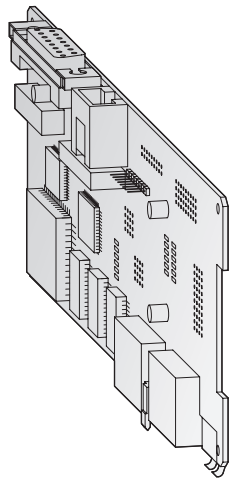
This option is used to control the gripper tool installed on the robot arm. The valve set comes with all the components required for installation, including the branch manifold, couplings and dampers. The valves are fitted with plug-in control cables for quick and easy wiring.

The solenoid valve sets are for use with oil-free compressed air.

Specifications	1A-VD0□E-RP				RV-E-1E-VD0□E	
	1	2	3	4	1	2
No. of valves	1	2	3	4	1	2
Range of use (robot type)	AH				A	
Valve function	Double solenoid				Double solenoid	
Operating method	Internal pilot method				Internal pilot method	
Effective sectional area (CV value)	1.5 mm				1.5 mm	
Operating preassure range	2–7 bar				2–7 bar	
Maximum preassure	10 bar				10 bar	
Response time	< 12 ms at 24 V DC				< 12 ms at 24 V DC	
Max. operating frequency	5 Hz				5 Hz	
Ambient temperature	-5 to +50 °C				-5 to +50 °C	
Coil rated voltage	24 V DC ± 10 %				24 V DC ± 10 %	
Order information Art. no.	129780	129781	129792	129793	47397	47398

Specifications	1S-VD0□E-01				1S-VD0□E-02				1S-VD0□ME-03				1S-VD0□ME-04			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
No. of valves	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Range of use (see page 30)	12S / 12SL				3S / 6S				12SH				6SH			
Valve function	Double solenoid				Double solenoid				Double solenoid				Double solenoid			
Operating method	Internal pilot method				Internal pilot method				Internal pilot method				Internal pilot method			
Effective sectional area (CV value)	0.64 mm				0.64 mm				0.64 mm				0.64 mm			
Operating preassure range	1–7 bar				1–7 bar				1–7 bar				1–7 bar			
Maximum preassure	10 bar				10 bar				10 bar				10 bar			
Response time	< 22 ms at 5 bar				< 22 ms at 5 bar				< 22 ms at 5 bar				< 22 ms at 5 bar			
Max. operating frequency	5 Hz				5 Hz				5 Hz				5 Hz			
Ambient temperature	-5 to +50 °C				-5 to +50 °C				-5 to +50 °C				-5 to +50 °C			
Coil rated voltage	24 V DC ± 10 %				24 V DC ± 10 %				24 V DC ± 10 %				24 V DC ± 10 %			
Order information Art. no.	153057	153058	153059	153062	153074	153075	153076	153077	166278	166279	166280	166281	166274	166275	166276	166277

■ Interface Boards for Robot Controllers



Ethernet Interface

The Ethernet interface is used for high-speed network communications with other controllers and TCP/IP-enabled peripherals. It can also be used for programming the robot controller and for external, real-time control of the robot itself.

Specifications	2A-HR533E
Application	Ethernet interface; TCP/IP
Type	Built-in board
Range of use	All MELFA robots
LAN interface	10BASE-5, 10BASE-T (selectable)
Connector	RJ-45
Transmission speed	10 MBit/s
Order information Art. no.	129809

CC-Link Interface

The 2A-HR575E interface makes it possible to integrate the CR□-R robot controller in a CC-Link network.

The CC-Link interface is a high-speed bit (for I/Os) and word (for data registers) network card.

Specifications	2A-HR575E
Application	CC-Link interface
Type	Built-in board
Range of use	All MELFA robots (already integrated in CR3 controllers)
Communications cable	Shielded 3-core twisted cable
Max. number of I/O points and data registers	126 I/Os / 16 data register
Refresh rate	7.2 ms
Max. transmission length	100 m at 10 MBit/s, 150 m at 5 MBit/s, 250 m at 2.5 MBit/s, 600 m at 0.62 MBit/s, 1500 m at 0.15 MBit/s
Order information Art. no.	129808

PROFIBUS Interface

The 2A-RZ577A interface card makes it possible to integrate the robot controller in a PROFIBUS network.

Specifications	2A-RZ577A
Application	PROFIBUS/DP interface
Type	Built-in board
Range of use	All MELFA robots
Communications cable	Twisted pair cable
Communications distances	1200 m at 9.6/19.2/93.75 kBit/s, 1000 m at 187.5 kBit/s, 400 m at 500 kBit/s, 200 m at 1500 kBit/s
Max. no. of communications words	122
No. of mountable interface cards	1
Order information Art. no.	155317

Serial Expansion Interface

The 2A-RZ581E interface card adds additional serial inputs to the controller.
In addition to this the card also provides two encoder signal inputs for registering the speed of conveyor belts for the tracking function.

Specifications	2A-RZ581E
Application	Serial extension
Type	Built-in board
Range of use	All MELFA robots
Connections	1 x RS232, 1 x RS422, 2 encoder inputs
No. of mountable interface cards	2
Order information Art. no.	129807

■ Interface Boards for Robot Controllers

I/O Interface

All the robot controllers have an I/O interface with at least 16 inputs and outputs as standard equipment. You can increase the number of I/Os to a maximum of 256 (depends on controller model) by adding 2A-RZ371 interface modules.

Specifications	2A-RZ371
Application	Interface for additional inputs/outputs
Type	Decentralized I/O box with 32 inputs and 32 outputs
Range of use	All MELFA robots
Rated load voltage	Inputs: 12 V / 24 V; outputs: 12 V / 24 V, max. 0.1 A / per output
Max. no. of usable I/O boxes	7
Order information Art. no.	124658

Additional Axis Interface

The 2A-RZ541E interface card enables the controller to control additional axes. It can then control up to two additional axes, interpolating them with the robot's own axes. The additional axes can be connected to configure two 3-axis systems.

Specifications	2A-RZ541E
Application	Controller board for additional axes
Type	Built-in board
Range of use	All MELFA robots
Connections	SSCNET x 1 channel
Max. no. of control axes	8
No. of mountable interface cards	1
Encoder type	Absolute
Order information Art. no.	129801

Pneumatic Hand Interface

The 2A-RZ375 interface card is used to operate the robot's pneumatic gripper. It controls the solenoid valve set (see page 30).

Specifications	2A-RZ375
Application	Interface for pneumatic hand (pneumatic valves)
Type	Built-in board
Range of use	All MELFA robots
Connections	Up tu 4 pneumatic valves
Order information Art. no.	124657

Electric Hand Interface

The 2A-RZ364 interface card is for controlling Mitsubishi's own electric gripper.

Specifications	2A-RZ364
Application	Interface for electric hand
Type	Built-in board
Range of use	All MELFA robots
Order information Art. no.	129875

■ Gripper Signal Cables

Connection Cables

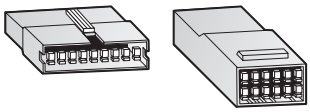
A variety of different cables are available for connecting the control and status monitoring signals of the gripper tools.

When the pneumatic gripper is used you need to monitor the position of the gripper. You should thus always connect a gripper signal input cable when you use the pneumatic gripper.

One end of the cable set is fitted with a plug for the gripper's sensor signals. The other end is without connectors and can be wired as required for your system.

Specifications	1A-GHCD	1A-GR200-RP	1A-HC20	1A-HC200-RP	1S-GR35S-01	1S-GR35S-02	1S-HC35C-02	1S-HC25C-01
Type	Curled connection cable	Hand signal output cable	Hand signal input cable	Hand signal input cable	Hand signal output cable	Hand signal output cable	Hand signal input cable	Hand signal input cable
Range of use (robot type)	A	AH	A	AH	S	SH	S / SH	S / SH
Design	Both sides with connectors	Custom-made	Custom-made	Custom-made	Single sided with connector	Single sided with connector	Single sided with connector	Single sided with connector
Application	Electric and pneumatic gripper	Custom-made magnetic valve set	Monitoring of the gripper condition	Monitoring of the gripper condition	Pneumatic gripper	Pneumatic gripper	Monitoring of the gripper condition	Monitoring of the gripper condition
No. of cores	6	9	8	10	12	12	12	12
Length	350 mm	2000 mm	370 mm	2000 mm	400 mm	350 mm	1200 mm	800 mm
Order information Art. no.	132101	129778	129877	129779	153078	166272	166273	153079

■ Connectors and Valve Signal Cables



The Connection to Your System

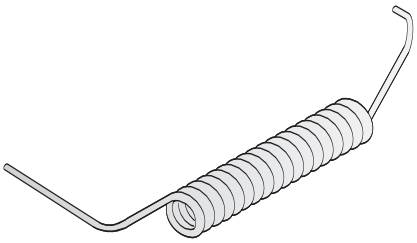
Choose additional components to configure the optimal interface between the robot system and your application.

The wide range of options makes it possible to configure the robot precisely for the individual requirements of your application.

The connectors listed in the following table can be used for making your own cables for the gripper input and output signals (see also the table above).

Specifications	R-SMR-09V-B	R-SMR-10V-N	R-SMR-02V-B	S series Hand OUTPUT	S series Hand INPUT
Type	Gripper output connector	Gripper output connector	Valve connector	Hand signal output connector	Hand signal input connector
Range of use (robot type)	A / AH	AH	A	S / SH	S / SH
Design	Black, 9 pins	White, 10 pins	2 pins	8 pins	6 pins
Shipping contents	Plug and contacts	Plug and contacts	Plug and contacts	Plug and contacts	Plug and contacts
Order information Art. no.	132112	132113	143798	164814	164815

Hand Curl Tube

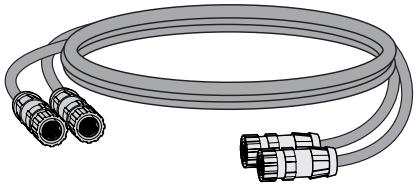


Replacement Gripper Hoses

These spiral hoses are for use with the pneumatic gripper. They are also suitable for use with clean room robots.

Specifications		RV-E-1E-ST0402C	RV-E-1E-ST0404C
Type		Spiral hose	Spiral hose
Range of use (robot type)		A / 3S / 6S / AH	A / 3S / 6S / AH
Application		For single pneumatic gripper	For double pneumatic gripper
Dimensions		2 x Ø4 mm	4 x Ø4 mm
Order information	Art. no.	47390	47389

Drag Chain Cable

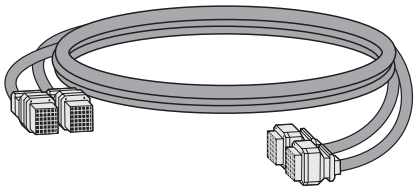


Cables for Flexible Robot Deployment

The standard cable for connecting the robot arm to the controller is 5m long and can only be used for fixed installation. You must use the special cable sets listed in the table below if you need flexible power and signal cables for installation in a drag chain installation. You can also replace the standard connection cables with longer ones if necessary.

Specifications		Cable Flex 5 m	Cable Flex 7 m	Cable Flex 9 m	Cable Flex 11 m	Cable Flex 15 m
Type		Flexible drag chain cable				
Range of use (robot type)		A / AH	A / AH	A / AH	A / AH	A / AH
Minimum bending radius		More than 100 mm				
Cable bear isovolumetric ration		≤ 50 %				
Max. movement speed		2000 mm/s				
Protection rating		Oil-proof specification sheath				
No. of cores power cable		10				
No. of cores signal cable		6/1 (7 total)				
Length	m	5	7	9	11	15
Order information	Art. no.	149006	149007	149008	149009	149010

■ Extension Cables for Robots and Controllers



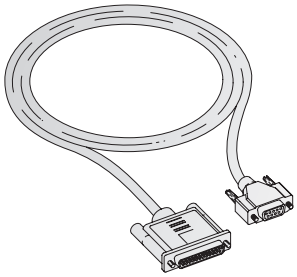
Extension Cables for Power and Signal Connections

These power and signal extension cables make it possible to increase the distance between the controller and the robot arm. Versions are available for either flexible and fixed routing of the cables between the controller and the robot arm. Use the flexible versions for installation of the cables in drag chains and similar configurations. You can also use these cables to extend the length of the standard cables supplied with the robot.

Specifications		1S-05CBL-01	1S-10CBL-01	1S-15CBL-01	1S-05CBL-03	1S-10CBL-03	1S-15CBL-03
Type		Extension cable for a fixed installation in a drag chain					
Range of use (robot type)		6S / 6SL / 12S / 12SL / 12SH			3S / 6SH		
Minimum bending radius		More than 100 mm					
Max. movement speed		2000 mm/s					
Guidance of life count		—					
Protection rating		Oil-proof specification sheath					
No. of cores power cable		1			1		
No. of cores signal cable		1			1		
Length	m	5	10	15	5	10	15
Order information	Art. no.	155827	155830	155665	165967	165968	165969

Specifications		1S-05LCBL-01	1S-10LCBL-01	1S-15LCBL-01	1S-05LCBL-03	1S-10LCBL-03	1S-15LCBL-03
Type		Extension cable for a flexible installation in a drag chain					
Range of use (robot type)		6S / 6SL / 12S / 12SL / 12SH			3S / 6SH		
Minimum bending radius		More than 100 mm					
Cable bear isovolumetric ration		≤ 50 %					
Max. movement speed		2000 mm/s					
Guidance of life count		7.5×10^6					
Protection rating		Oil-proof specification sheath					
No. of cores power cable		3/6 (9 total)			10		
No. of cores signal cable		6/1 (7 total)			5/1/1 (7 total)		
Length	m	5	10	15	5	10	15
Order information	Art. no.	157582	157583	157594	165970	165971	165972

■ Connection Cables for PCs and Inputs/Outputs



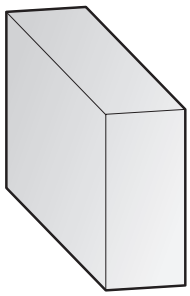
Connection Cables, Connectors

The RV-CAB□ cable is for establishing an RS-232C serial connection between the robot controller and a personal computer.

The RV-E I/O connection cable is for connecting peripherals to the parallel I/O interface. One end of the cable is fitted with a connector for the controller's parallel I/O port. The other end is supplied without a connector so that you can connect the appropriate connectors for your equipment.

Specifications		RV-CAB4	RV-E-E/A-Kabel 5	RV-E-E/A-Kabel 15
Type		Connection cable	Connection cable	Connection cable
Application		Serial (RS232C) connection PC–Controller	I/O port	I/O port
Range of use		All MELFA robots	All MELFA robots	All MELFA robots
Design		9/25-pin plug	Plug on one side	Plug on one side
Length	m	3	5	15
Order information	Art. no.	55653	47387	59947

■ Expansion Option Box

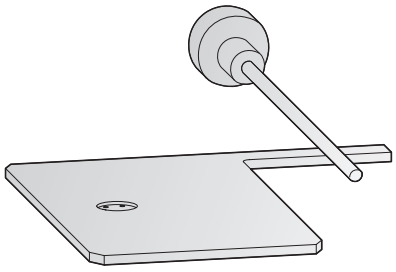


Expansion for Additional Interface Cards

This expansion box is required for the installation of additional interface cards in the CR1 controller (CC-Link, Ethernet, Profibus and serial interface cards and interface cards for additional robot axes). You can install up to 3 additional interface cards in the box.

Specifications		CR1-EB3
Type		Expansion box for interface boardsx
Application		Controller CR1
Range of use (robot type)		A / AH
Power supply		From the controller by the RT bus coupling
Ambient temperature		0–40 °C
Ambient humidity		45–85 %
Grounding		Class 3 grounding earth (via external terminal; earth resistance ≤ 100 Ω)
Structure		Floor mounting
Dimensions (W x H x D)		87.5 mm x 166 mm x 290 mm
Weight		Approx. 3 kg
Order information	Art. no.	129878

■ Calibration Device



Zero Point Calibration Jig

This calibration jig is used for setting the robot arm's zero point. Zero point calibration is used to maximise the robot's positioning accuracy.

Specifications		RV-E-1E-INST	RH-CAL
Type		Calibration device	Calibration pin
Application		Zero point setting with high accuracy	
Range of use (robot type)		A	S / SH
Order information	Art. no.	47388	145715

■ Options Assignment

Option	Marking	RV-2AJ/1A	RV-3SJB/3SB	RV-6S/6SL	RV-12S/12SL	RH-6SH	RH-12SH	RP-1/3/5AH	Art. no.	See page
Robot model name in catalogue	—	A	S	S	S	SH	SH	AH	—	—
Teaching Box	R28TB	●	●	●	●	●	●	●	124656	22
Electrical hand set	4A-HM01	●							129874	22
Pneumatic hand set	4A-HP01E	●							129873	22
Single valve set	1A-VD01E-RP							●	129780	23
Double valve set	1A-VD02E-RP							●	129781	23
Triple valve set	1A-VD03E-RP							●	129792	23
Quadruple valve set	1A-VD04E-RP							●	129793	23
Single valve set	RV-E-1E-VD01E	●							47397	23
Double valve set	RV-E-1E-VD02E	●							47398	23
Single valve set	1S-VD01E-01				●				153057	23
Double valve set	1S-VD02E-01				●				153058	23
Triple valve set	1S-VD03E-01				●				153059	23
Quadruple valve set	1S-VD04E-01				●				153062	23
Single valve set	1S-VD01E-02		●	●					153074	23
Double valve set	1S-VD02E-02		●	●					153075	23
Triple valve set	1S-VD03E-02		●	●					153076	23
Quadruple valve set	1S-VD04E-02		●	●					153077	23
Single valve set	1S-VD01ME-03						●		166278	23
Double valve set	1S-VD02ME-03						●		166279	23
Triple valve set	1S-VD03ME-03						●		166280	23
Quadruple valve set	1S-VD04ME-03						●		166281	23
Single valve set	1S-VD01ME-04					●			166274	23
Double valve set	1S-VD02ME-04					●			166275	23
Triple valve set	1S-VD03ME-04					●			166276	23
Quadruple valve set	1S-VD04ME-04					●			166277	23
Ethernet interface	2A-HR533E	●	●	●	●	●	●	●	129809	24
CC-Link interface	2A-HR575E	●	●	●	●	●	●	●	129808	24
PROFIBUS interface	2A-RZ577A	●	●	●	●	●	●	●	155317	24
Serial expansion	2A-RZ581E	●	●	●	●	●	●	●	129807	24
I/O interface	2A-RZ371	●	●	●	●	●	●	●	124658	24
Additional axis interface	2A-RZ541E	●	●	●		●	●	●	129801	24
Pneumatic hand interface	2A-RZ375	●	●	●	●	●	●	●	124657	24
Electric hand interface	2A-RZ364	●							129875	24
Curled connection cable	1A-GHCD	●							132101	26
Hand signal output cable	1A-GR200-RP							●	129778	26
	1S-GR35S-01		●	●	●				153078	26
	1S-GR35S-02					●	●		166272	26
Hand signal input cable	1A-HC20	●							129877	26
	1A-HC200-RP							●	129779	26
	1S-HC35C-02		●	●	●	●	●		166273	26
	1S-HC25C-01		●	●	●	●	●		153079	26
Gripper output connector	R-SMR-09V-B	●						●	132112	26
Gripper input connector	R-SMR-10V-N							●	132113	26
Valve input connect	R-SMR-02V-B	●							143798	26
Hand signal output connector	S-series Hand OUTPUT		●	●	●	●	●		164814	26
Hand signal input connector	S-series Hand INPUT		●	●	●	●	●		164815	26
Valve connection cable	RV-E-1E-GR35S	●							47391	26
Hand curl tube	RV-E-1E-ST0402C	●	●	●				●	47390	27
	RV-E-1E-ST0404C	●	●	●				●	47389	27
Flexible drag chain cable	Cable Flex 5 m	●						●	149006	27
	Cable Flex 7 m	●						●	149007	27
	Cable Flex 9 m	●						●	149008	27
	Cable Flex 11 m	●						●	149009	27
	Cable Flex 15 m	●						●	149010	27
Extension cable for fixed installation in a drag chain	1S-05CBL-01			●	●		●		155827	28
	1S-10CBL-01			●	●		●		155830	28
	1S-15CBL-01			●	●		●		155665	28
	1S-05CBL-03		●			●			165967	28
	1S-10CBL-03		●			●			165968	28
	1S-15CBL-03		●			●			165969	28
Extension cable for flexible installation in a drag chain	1S-05LCBL-01			●	●		●		157582	28
	1S-10LCBL-01			●	●		●		157583	28
	1S-15LCBL-01			●	●		●		157594	28
	1S-05LCBL-03		●			●			165970	28
	1S-10LCBL-03		●			●			165971	28
	1S-15LCBL-03		●			●			165972	28
PC connection cable	RV-CAB4	●	●	●	●	●	●	●	55653	29
Connection cable for I/O interface	RV-E-E/A-Kabel 5	●	●	●	●	●	●	●	47387	29
	RV-E-E/A-Kabel 15	●	●	●	●	●	●	●	59947	29
Extension box	CR1-EB3	●						●	129878	29
Calibration device	RV-E-1E-INST	●							47388	29
Calibration pin	RH-CAL		●	●	●	●	●		145715	29

■ MELFA-BASIC IV Programming

Easy-to-Learn MELFA-BASIC IV Programming Language

Mitsubishi robots are controlled with programs written in the powerful MELFA BASIC IV programming language. This language is based on standard BASIC, which makes it very easy to learn. In addition to the familiar standard BASIC instructions and constructs like FOR … NEXT and GOTO, MELFA BASIC IV also has some extensions required for robots, including additional data types, instructions for movement and gripper control and I/O instructions. The familiarity of standard BASIC makes it easy for beginners to get started with robot programming.

Despite its simplicity and short learning curve, MELFA BASIC IV is a powerful language that can be used to create very complex robot programs.

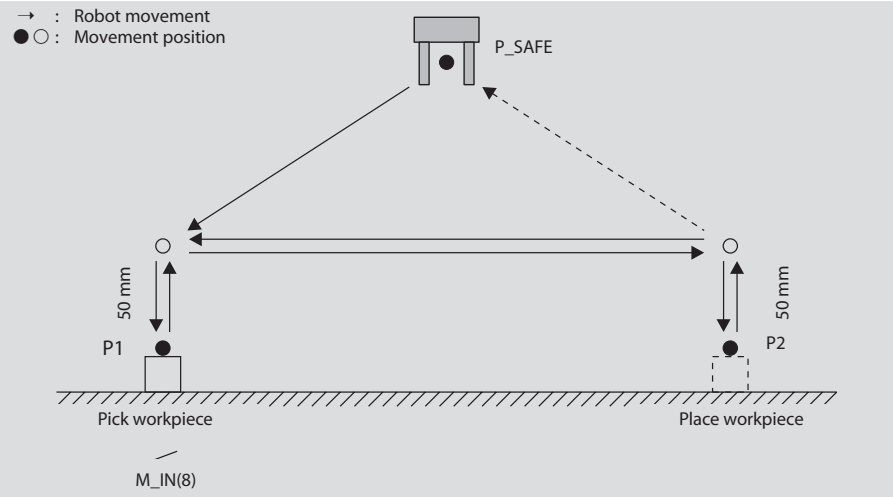
In addition to controlling simple movement sequences this high-level language can also perform complex calculations without having to access a connected PC. This is made possible by a comprehensive library of integrated functions, including trigonometry functions.

You can store up to 88 programs in the controller and control up to 256 inputs and outputs. Another powerful feature is 3D circular interpolation, which makes it possible to program highly-complex processing sequences in 3D space.

Programming

Robot programs are written with the MELFA BASIC IV instructions with the help of a PC and the teaching box. The positions are defined with the teaching box and the actual program is written on the PC.

Programs are written using the COSIROP programming software package for industrial robots. You can find more information about the programming software on page 32.



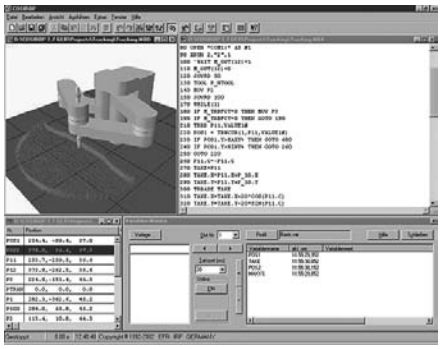
Sample Program

The sample program below is for a pick-and-place operation. The input signal M_IN(8) tells the program that there is a workpiece in position P1. When a workpiece is present the input signal is set to 1 and the pick-and-place operation is performed. The workpiece is picked up from position P1 and deposited in position P2. If no workpiece is present the robot remains in the retracted position P_SAFE.

Pick-and-Place Program

10	MVS P_SAFE	Move to safe position
20	IF M_IN(8) = 0 THEN 20 ELSE 30	Wait until input bit 8 is set
30	HOPEN 1	Open gripper 1
40	MVS P1, –50	Move longitudinally to a position 50mm from P1 relative to the tool
50	MVS P1	Move to position P1
60	HCLOSE 1	Close gripper 1
70	DLY 0.2	Wait for 0.2s to ensure proper closing of gripper
80	MVS P1, –50	Move longitudinally to a position 50mm from P1 relative to the tool
90	MVS P2, –50	Move longitudinally to a position 50mm from P2 relative to the tool
100	MVS P2	Move to position P2
110	HOPEN 1	Open gripper 1 and deposit workpiece
120	DLY 0.2	Wait for 0.2s to ensure proper opening of gripper
130	MVS P2, –50	Move longitudinally to a position 50mm from P2 relative to the tool
140	IF M_IN(8) = 1 THEN 40 ELSE 150	If another workpiece is present repeat the pick-and-place operation
150	MVS P_SAFE	If no workpiece is present return to safe position and end program
160	END	Program end

■ Programming Software COSIROP



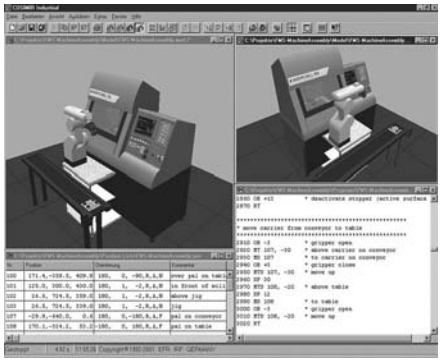
COSIROP

COSIROP is the programming, configuration, online and diagnostics software package for all Mitsubishi robots. You can use it to develop programs in the MOVEMASTER COMMAND and MELFA BASIC languages and transfer them between the PC and the robot controller. The programming software package is distributed on a CD containing versions in both German and English.

The update license can only be used if you already have a license for 1, 5 or 10 users.

Software Licences		1 user	5 users	10 users	Update license
Supported robot models		All			
Language		English / German (on one 1 CD)			
Operating system		Microsoft Windows 98/XP/2000			
Order information	Art. no.	170050	170051	170052	170053

■ Simulation Software COSIMIR

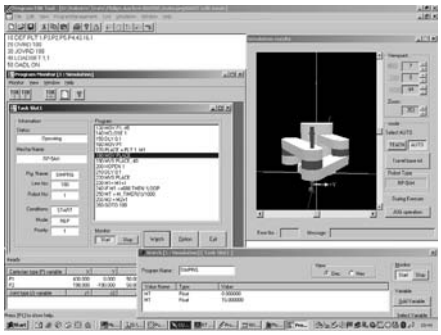


COSIMIR

COSIMIR is the 3D robot simulation package for all Mitsubishi robots. It can be used for planning your work cell, checking the accessibility of all positions and optimising your layout. You can simulate all movement sequences and handling operations to identify and prevent potential collisions and optimise your cycle times. After simulating and testing your programs you can then transfer them directly to the robot controller, either via the standard RS-232C port or via the optional Ethernet interface (TCP/IP). If you use the Ethernet interface you can also easily connect to the controller via the Internet and perform program changes and servicing across very large distances.

Software		COSIMIR Industrial
Supported robot models		All
Language		English / German
Description		Programming and simulation software
Operating system		Microsoft Windows 98/XP/2000
Order information	Art. no.	51681

■ PC Support Software for Robots



PC Support Software

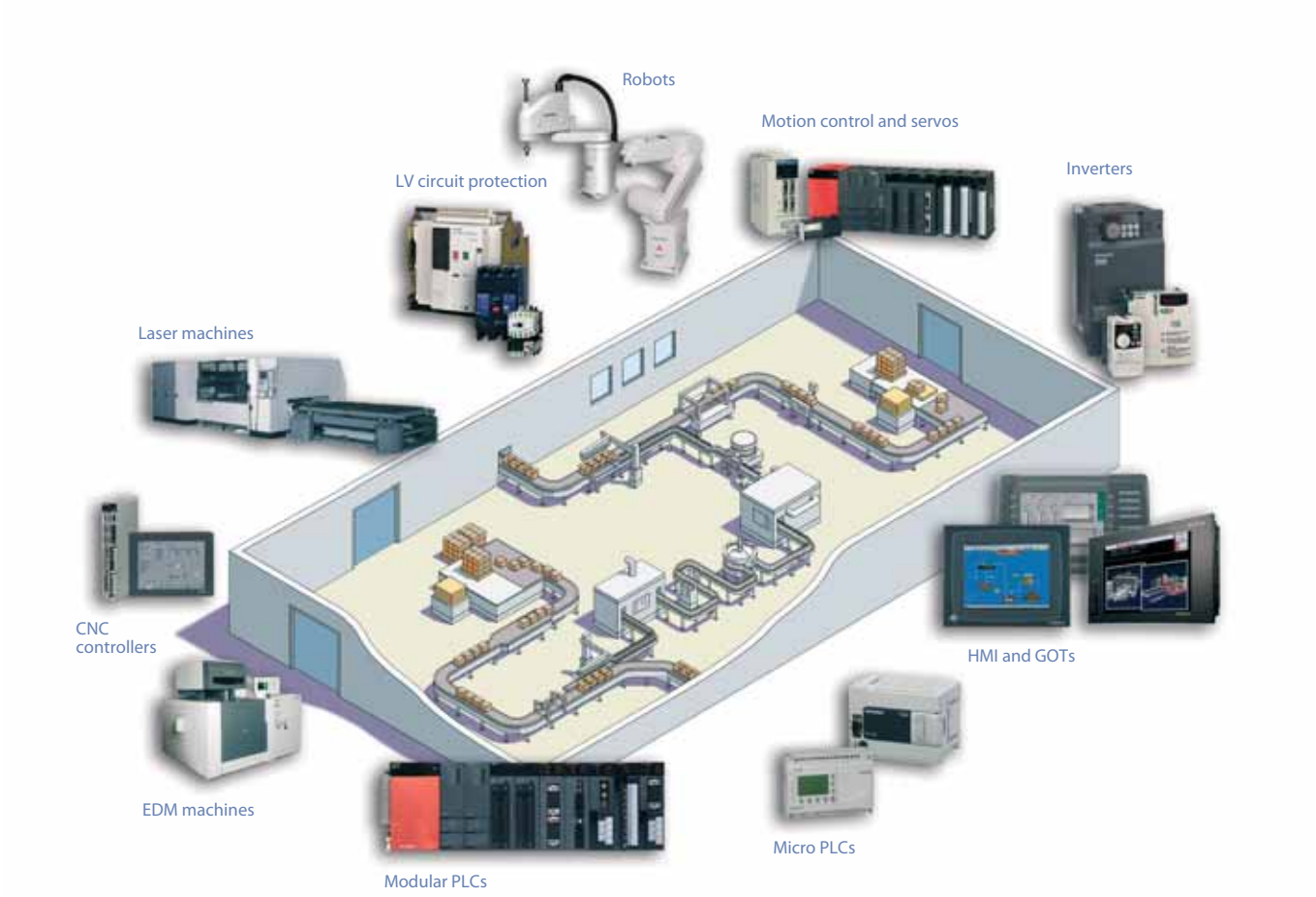
The PC support software package makes an ideal complement to the COSIROP robot programming software. Its highlights include a function for restoring position data, for example so that you can achieve a quick restart after replacing a robot. The software can also monitor the robot's maintenance intervals.

Among the standard softwareversion 3A-02C-WINE there is also the software 3A-01C-WINE availible. This software has the additional ability to simulate the movement of the robot in a 3-dimensional graphical display. Furthermore a special feature of this software is, to display the cycle time of the movement at the end of the simulation. So you can already optimize the program at your PC instead of optimizing at the real equipment.

Software		3A-02C-WINE	3A-01C-WINE
Supported robot models		All	
Language		English	
Functions for robot models	program editing	All	
	monitor function	All	
	parameter setting	All	
	program backup	All	
	program conversion	From M / E / EN to NARC	
	remote maintenance (via modem)	All	
	position repair	S / SH	
	maintenance forecast	S / SH	
Robot movement simulation		no	yes
Calculation of the cycle time		no	yes
Operating system		Microsoft Windows 98/XP/2000	

Order information	Art. no.	158015	170064

A World of Automation Solutions



Mitsubishi offer 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 represents space development, transportation, semiconductors, energy systems, communications and information processing, audio visual equipment, 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 a Mitsubishi automation solution – because we know first hand about the need for reliable, efficient, easy-to-use automation and control.

As one of the world's leading companies with a global turnover of 3.4 trillion Yen (approximately $30.8 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.

Global Partner. Local Friend.

EUROPEAN SERVICE GROUP
MITSUBISHI ELECTRIC EUROPE B.V.
Gothaer Str. 8
D-40880 RATINGEN
Training Hotline:
+49 (0) 2102 486 1880

EUROPEAN DEVELOPMENT CENTER
MITSUBISHI ELECTRIC EUROPE B.V.
Gothaer Str. 8
D-40880 RATINGEN

FRANCE
MITSUBISHI ELECTRIC EUROPE B.V.
25, Boulevard des Bouvets
F-92741 NANTERRE CEDEX
Phone: + 33 1 55 68 55 68

GERMANY
MITSUBISHI ELECTRIC EUROPE B.V.
Gothaer Str. 8
D-40880 RATINGEN
Phone: +49 (0) 1805 000 765
Training: +49 (0) 2102 486 1880

UNITED KINGDOM
MITSUBISHI ELECTRIC EUROPE B.V.
Travellers Lane
UK-HATFIELD HERTS. AL10 8 XB
Phone: +44 (0) 17 07 27 61 00
Training:
+44 (0) 17 07 27 89 16

IRELAND
MITSUBISHI ELECTRIC EUROPE B.V.
Irish branch,Westgate Business Park, Ballymount
IRL-DUBLIN 24
Phone: + 353 1 41 98 80 0

ITALY
MITSUBISHI ELECTRIC EUROPE B.V.
C.D. Colleoni - P. Perseo Ing. 2,
Via Paracelso 12
I-20041 AGRATE BRIANZA (MI)
Phone: + 39 (0)39 / 60 53 1

SPAIN
MITSUBISHI ELECTRIC EUROPE B.V.
Carretera de Rubí 76-80
E-08190 SANT CUGAT DEL VALLÉS
Phone: +34 93 56 53 13 1

For more information about our partners across Europe, please visit the contacts page of our internet site at www.mitsubishi-automation.com

MITSUBISHI ELECTRIC
FACTORY AUTOMATION

Mitsubishi Electric Europe B.V. /// FA - European Business Group /// Gothaer Straße 8 /// D-40880 Ratingen /// Germany
Tel.: +49(0)2102-4860 /// Fax: +49(0)2102-486112 /// info@mitsubishi-automation.com /// www.mitsubishi-automation.de

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