

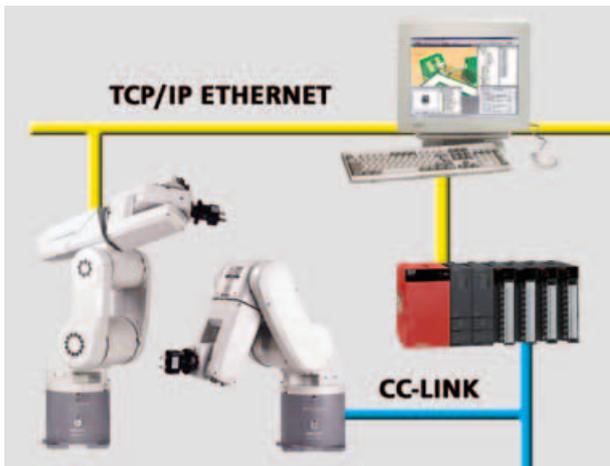
**MELFA-  
Robots:  
RV-A  
RV-S  
RH-AH  
RP-AH**

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**Unfailing Quality  
and Precision Handling**



## MELFA Industrial Robot Systems – High-precision Automation Solutions



*One possible network connection configuration for MELFA robots*

Modern automation technology from Mitsubishi Electric is one of the driving forces behind technical progress and commercial success all over the world. Since 1978 small-scale Mitsubishi robots have been installed in over 30,000 industrial applications in many different fields.

Mitsubishi is now one of the leading manufacturers of small robots. In Europe the company markets SCARA robots with handling payloads of up to 10kg, and articulated-arm robots with 5 and 6 degrees of freedom (DOF) and handling payloads of up to 12 kg.

*Example of a SCARA robot application for placing, soldering and assembly in a manufacturing plant for mobile phones*

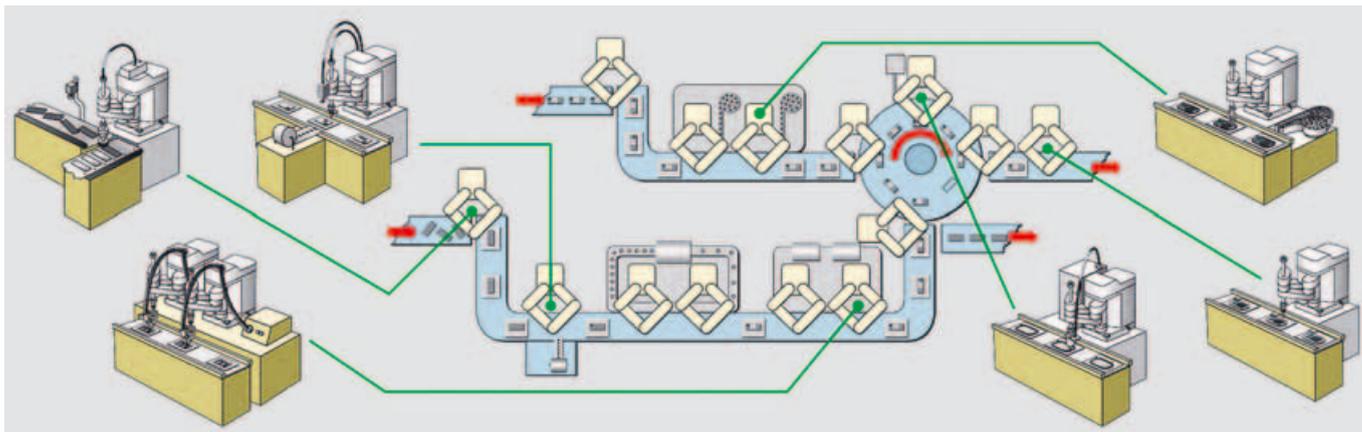
Our customers include top companies in all branches of industry. Maximum reliability is always the top priority for our robots, no matter whether they are used in simple handling operations or the highly-complex applications of car manufacturers and their high-tech suppliers. Whatever the job, you can 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.

The robot programming language MELFA BASIC IV is powerful yet easy to learn, ensuring that users can start producing their own powerful and efficient robot programs in a very short time. Those who prefer systems that are ready to run can have a turnkey solution made for them by one of our automation partners, who have many years of experience

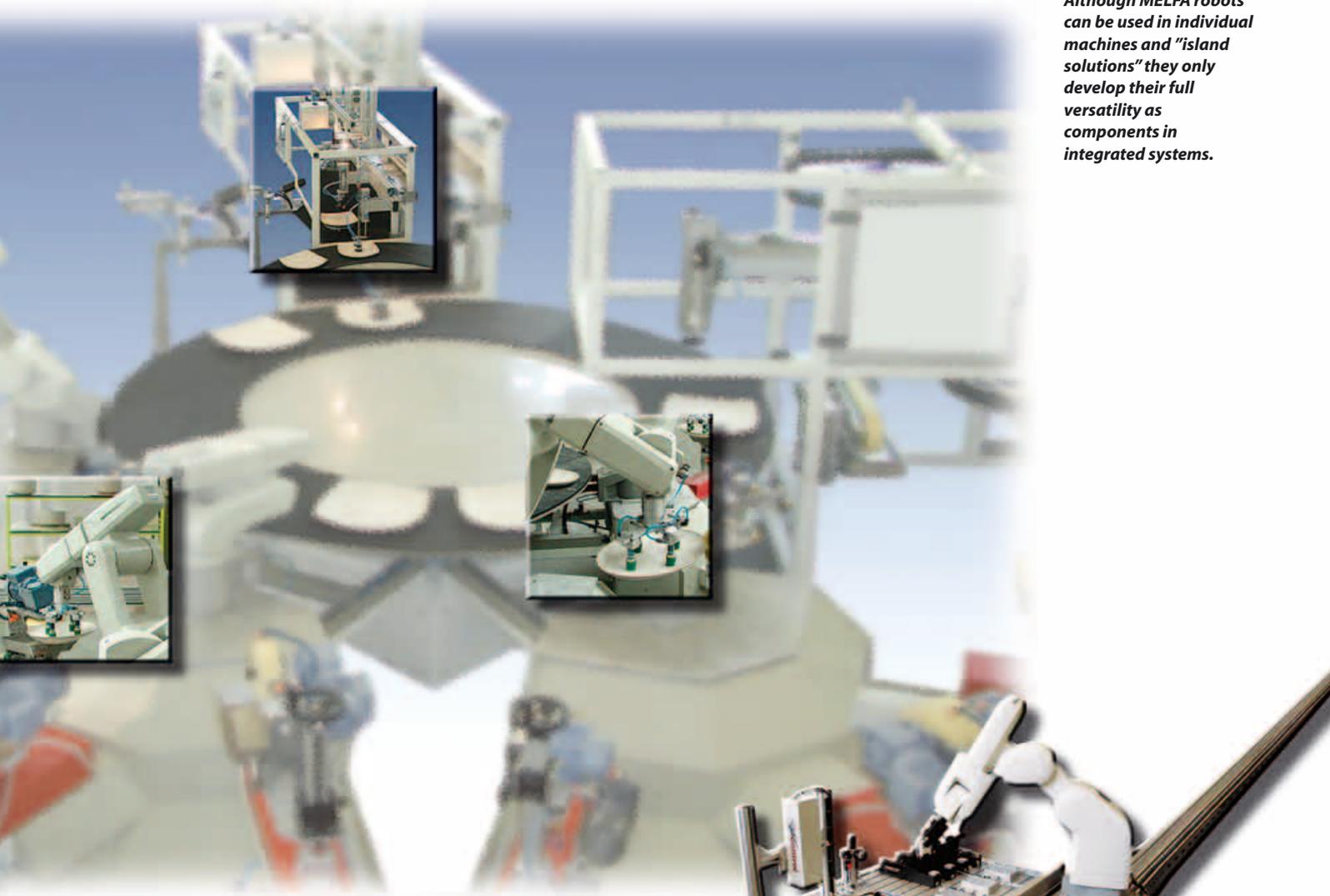
in the development of tailor-made production systems geared to clients' precise needs and wishes.

When you choose a robot from Mitsubishi you get a tried and tested product that



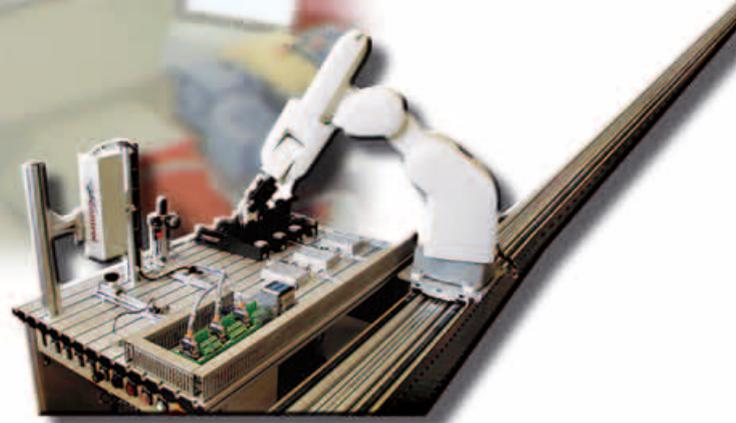
## Industrial Robot Systems

*Although MELFA robots can be used in individual machines and "island solutions" they only develop their full versatility as components in integrated systems.*



has proved itself over and over again in demanding industrial environments. A product that you can

depend on to deliver outstanding performance in your application.



*The robot's work space can be expanded by installing it on a linear travel axes. This adds a linear degree of freedom, radically enlarging the robot's reach and the scale of the system it can serve.*



## The MELFA Concept – Innovation in Movement



*The compressed air and signal inputs are conveniently located near to the ISO 9409-1 gripper mounting flange.*

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

*Signal, power and compressed air connection of the SCARA robots*



► *Compressed air and signal inputs of the RV-1A/2AJ*

►► *Gripper mounting flange (ISO 9409-1-31.5 standard)*

►►► *Gripper mounting flange of the SCARA robots*

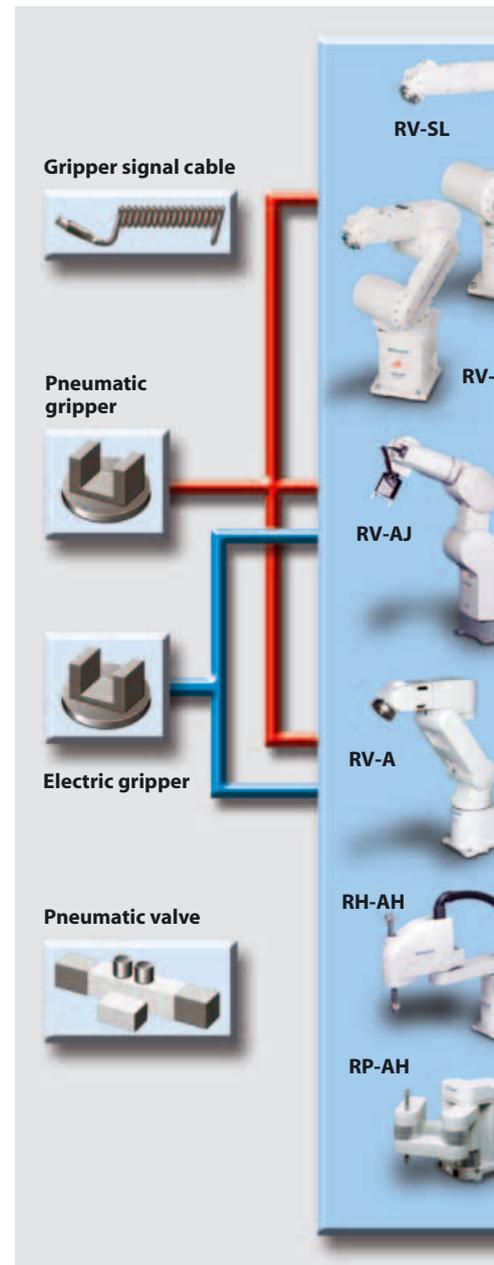


solutions for everything from simple tool and component handling tasks to complex applications in which the entire system is controlled by the robot.

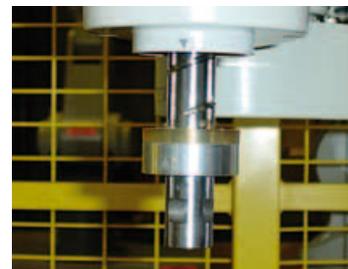
Mitsubishi's compact, 5-Joint closed link robot is the only one of its kind in the world, and it shines with an installation footprint no larger than an A5 sheet of paper and repeatability of  $\pm 0.005\text{mm}$ . This accuracy, combined with a cycle period of just 0.28s, predestines it for use in precise component placement applications.

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.

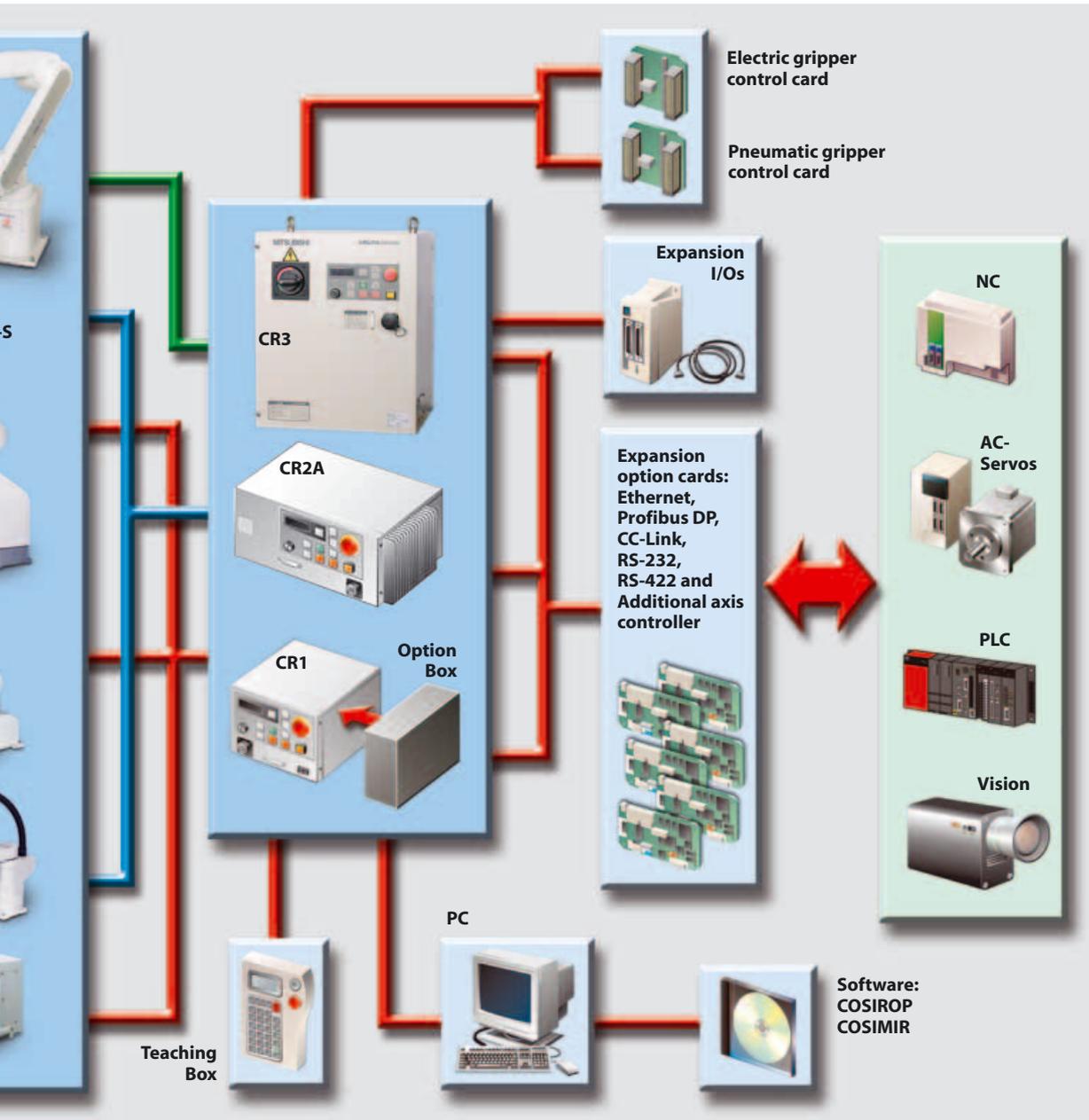
The robot controllers are equally small and compact. With dimensions close to those of a standard PC they can be installed in the most cramped environments without taking up valuable production space. Their multitasking operating system and the powerful MELFA BASIC programming language make it easy to 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.



*Robot System Components*



*Signal, power and compressed air connection of the articulated-arm robots*

Quality requirements are becoming more exacting every day, and as a result Mitsubishi robots in quality control applications are often in operation round the clock, seven days a week – yet another demonstration of the quality and reliability of Mitsubishi robots under the most demanding conditions. 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 is committed to the ongoing development and improvement of its robots, to ensure that they continue to earn the confidence of our customers in the future.



## MELFA Industrial Robot Systems – A Model Range for All Needs



reconfiguration of production systems.

Do you need the speed and high precision of the robots of the RP series? The assembly and product placement capabilities of the RH series of SCARA robots? Or the great versatility of the 5 and 6 DOF robots of the RV series? Whichever product you choose, you always get a system designed from the ground up for continuous operation, that will perform its work reliably 24 hours a day, 7 days a week.

Or does your application impose extreme precision, speed and reach requirements? Robots from Mitsubishi Electric are the solution to all these problems, and more.

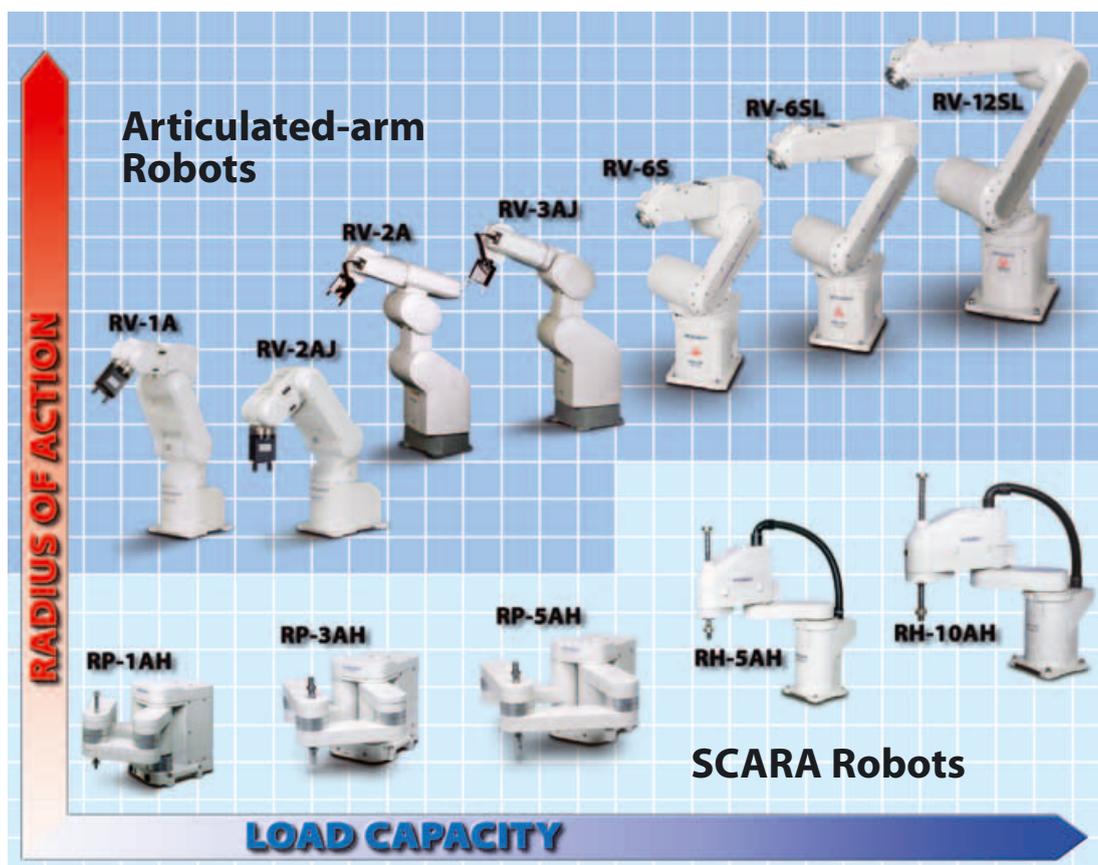
### A comprehensive range of products

The MELFA line includes a broad selection of robot models and versions. This

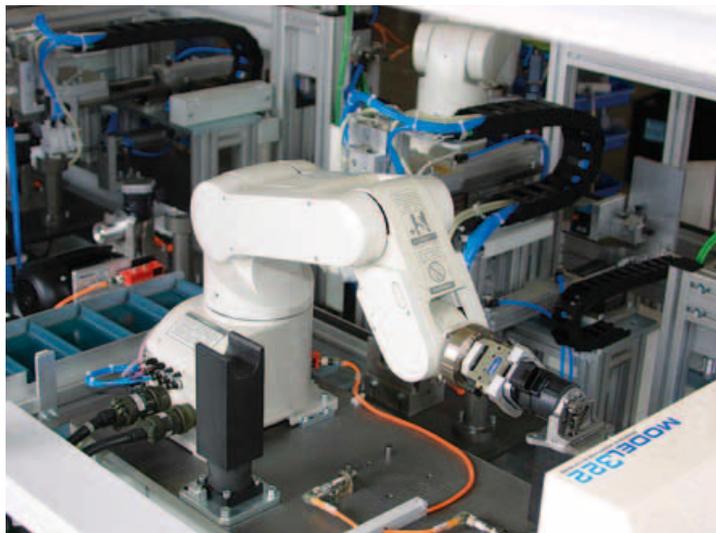
family of products is designed to meet all the needs of most industrial applications, and they also provide the extreme flexibility required for quick

*The MELFA range of robots has everything you need. They are available in a wide variety of configurations and performance classes:*

- From SCARA to articulated-arm robots
- From 4 to 6 degrees of freedom
- From 1kg to 10kg handling payloads
- From 150mm to 1,385mm action radius



# RV-2AJ/RV-1A Articulated-arm Robots – The Powerful Compact Class



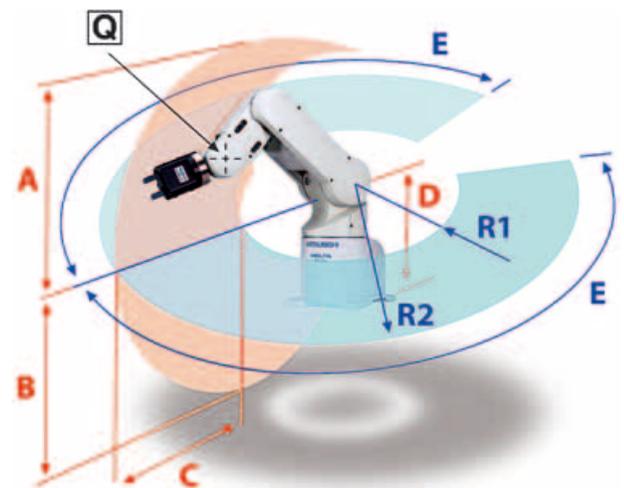
The combination of small dimensions and a reach of around 400mm make these two 5 and 6 DOF robots very popular in applications calling for compact robots that can be installed right next to or even in the system they are serving. They are predestined for handling tasks involving the removal and/or placement of small components. Other applications include quality control and sample handling in laboratories and medical facilities.



*The degrees of freedom of the RV-2AJ and RV-1A robots*

Component handling can be performed with a single electric gripper or up to two pneumatic grippers. Pre-installed pneumatic hoses in the robot arm make connection of the compressed air for the grippers quick and easy. Need a larger work space combined with compact dimensions? Just like all other Mitsubishi robots this model can be installed on carriage for traversing along a linear axis.

Model	RV-2AJ	RV-1A
Degrees of freedom	5	6
Maximum payload	2 kg	1 kg
Gripper flange reach	482 mm	490 mm
Repeatability	±0.02 mm	±0.02 mm
Max. speed	2,100 mm/s	2,200 mm/s
Controller type	CR1	CR1
Pick and place (cycle period in mm)	1.1 s	1.2 s
Reach (from Q/mm)	A 410, B 285	A 418, B 308
Reach (from Q/mm)	C 190, D 300	C 211, D 300
Reach (from Q/deg.)	E 150	E 150
Reach (from Q/mm)	R1 220, R2 410	R1 207, R2 418
Robot weight	17 kg	19 kg



## RV-3AJ/RV-2A Articulated-arm Robots – The Reliable Mid-range Solution



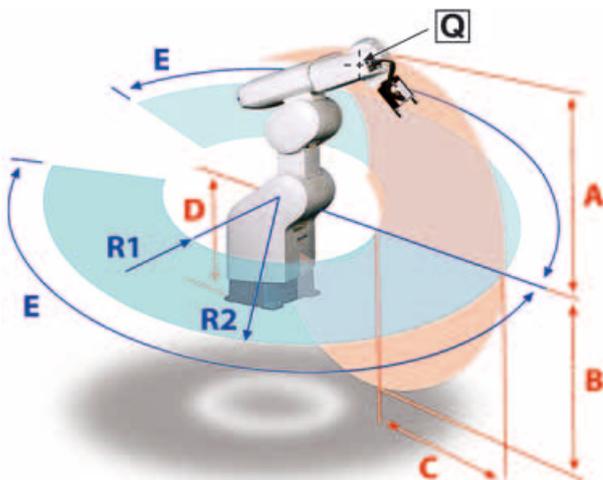
The degrees of freedom of the RV-3AJ and RV-2A robots

Typical applications for these two robots include handling samples for analysis instruments and similar manipulations in other quality control applications. Their slim design and exceptional mobility make it easy to integrate them in test setups and other systems.

### Free choice of grippers

The robot can be fitted with one electric gripper or up to two pneumatic grippers, depending on the task at hand. Gripper force is continuously adjustable, making it possible to handle even fragile items safely and securely.

Pneumatic hoses and signal cables are pre-installed in the robot, making gripper connection quick and simple.

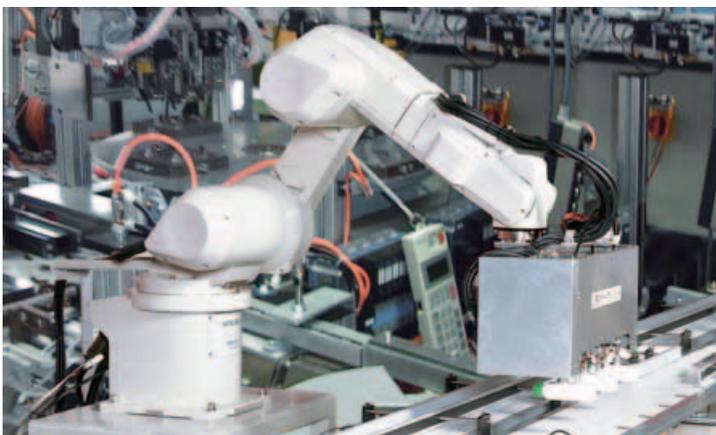


Model	RV-3AJ	RV-2A
Degrees of freedom	5	6
Maximum payload	3 kg	2 kg
Gripper flange reach	715 mm	706 mm
Repeatability	±0.04 mm	±0.04 mm
Max. speed	3,500 mm/s	3,500 mm/s
Controller type	CR1	CR1
Pick and place (cycle period in mm)	1.25 s	1.3 s
Reach (from Q) in mm	A 530, B 457	A 521, B 459
Reach (from Q) in mm	C 308, D 350	C 348, D 350
Reach (from Q) in deg.	E 160	E 160
Reach (from Q) in mm	R1 322, R2 630	R1 273, R2 621
Robot weight	33 kg	37 kg

# RV-6S/RV-6SL/RV-12SL Articulated-arm Robots – Exceptional Power and Reach



With handling payloads of up to 12 kg, a truly impressive maximum workspace radius of 1,385 mm and exceptional precision (repeatability:  $\pm 0.05$  mm) the new RV-S



series is predestined for handling parts in industrial production and for chaining plant stations. An IP65 protection rating provides the capabilities needed for heavy-duty applications, like those in the motor industry suppliers sector. The state-of-the-art technology used in this series drastically reduces work cycle times. All the new robots complete the 12-inch test in less than a second!

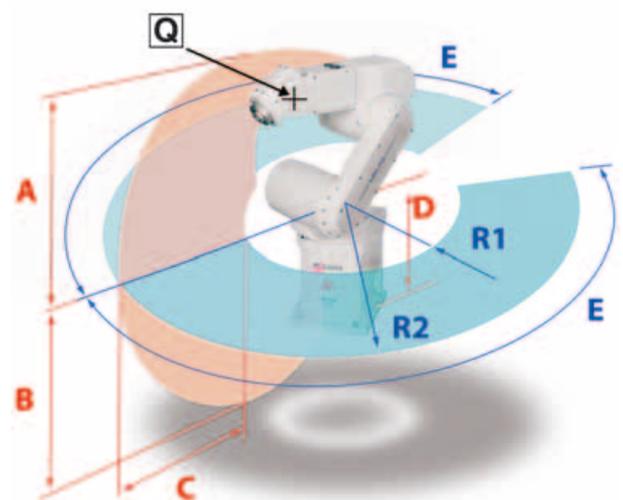
### Multifunctional robot controllers

The robots are controlled by the multitasking controllers CR2B or CR3. Connection of any image processing system, control of up to 8 additional axes and high-speed communication via an Ethernet link are just a few of the impressive highlights of this high-performance robot controllers. Other features include automatic conveyor belt tracking, crash detection without sensors and a wide range of powerful functions for work cycle optimisation.



*The degrees of freedom of the RV-6S and RV-12SL robots*

Model	RV-6S	RV-6SL	RV-12SL
Degrees of freedom	6	6	6
Maximum payload	6 (5) kg	6 (5) kg	12 (10) kg
Gripper flange reach	781 mm	987 mm	1,482 mm
Repeatability	$\pm 0.02$ mm	$\pm 0.02$ mm	$\pm 0.05$ mm
Max. speed	9,300 mm/s	8,500 mm/s	9,500 mm/s
Controller type	CR2B	CR2B	CR2B
Pick and place (cycle period in mm)	0.4 s	0.6 s	0.7 s
Reach (from Q/mm)	A 611, B 529	A 817, B 705	A 1,235, B 1,035
Reach (from Q/mm)	C 437, D 350	C 617, D 350	C 928, D 450
Reach (from Q/deg.)	E 170	E 170	E 170
Reach (from Q/mm)	R1 258, R2 696	R1 285, R2 902	R1 457, R2 1,385
Robot weight	58 kg	60 kg	98 kg



## RP-AH SCARA Robots – Outstanding Speed Plus High Precision



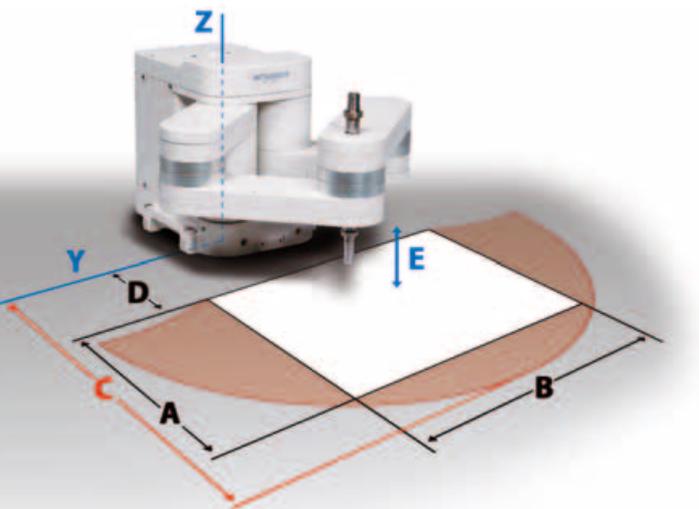
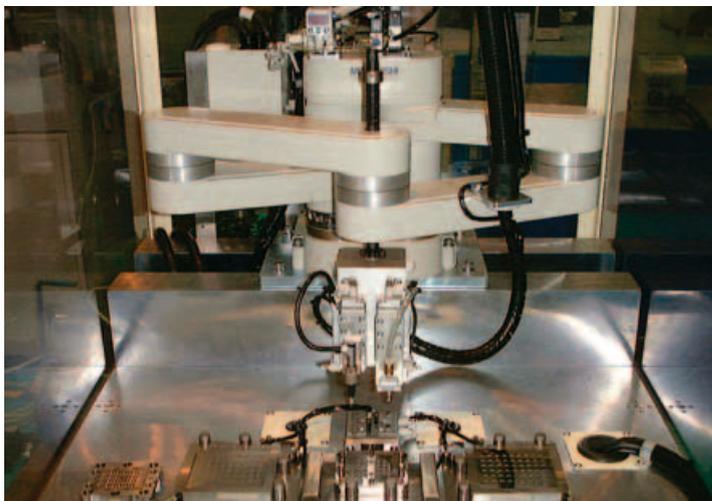
The degrees of freedom of the RP-1AH, RP-3AH and RP-5AH robots

The RP-1AH is in its element in all applications where parts have to be processed quickly and precisely in cramped quarters. It has an installation footprint of just 200 x 160mm and a reach of 236mm, and it can place components with a precision of  $\pm 0.005\text{mm}$ . This combination of compact dimensions and great precision predestine the RP robots for micro-handling tasks like micro-assembly and the population and soldering of SMD circuit boards for mobile phones. The robots of this series are incomparably more flexible than traditional automated machines, and this pays off in greatly enhanced efficiency and higher productivity.



The RP-3AH and RP-5AH models have handling payloads of 3kg and 5kg and a reach of 335mm and 453mm,

making them ideal for applications requiring more lifting capacity and longer reaches.



Model	RP-1AH	RP-3AH	RP-5AH
Degrees of freedom	4	4	4
Maximum payload	1 kg	3 kg	5 kg
Controller type	CR1	CR1	CR1
Repeatability x/y	$\pm 0.005\text{ mm}$	$\pm 0.008\text{ mm}$	$\pm 0.01\text{ mm}$
Pick and place (cycle period in mm)	0.28 s	0.33 s	0.38 s
A x B (in mm)	105 x 150 (DIN A6)	150 x 210 (DIN A5)	210 x 300 (DIN A4)
C (in mm)	234	332	451
D (in mm)	95	130	170
E-axes travel (in mm)	30	50	50
Robot weight	12 kg	24 kg	25 kg

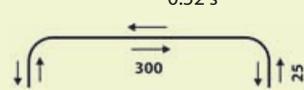
# RH-AH SCARA Robots – Specialists for Palletising



SCARA robots are ideal for sorting, palletising and component installation. They have a short cycle period of less than 0.5 seconds for a

movement sequence of 25mm vertical lift, 300mm horizontal traverse and 25mm vertical lower and return (the 12" test).



Model	RH-5AH55	RH-10AH85
Degrees of freedom	4	4
Maximum payload	5 kg	10 kg
Controller type	CR2A	CR2A
Gripper flange reach	von 198 bis 550 mm	von 278 bis 850 mm
Axis range in degrees	<b>J1</b> ±127, <b>J2</b> ±137	<b>J1</b> ±140, <b>J2</b> ±145
Repeatability	±0.02 mm	±0.025 mm
Z-axis travel in mm	200	350
Pick and place (cycle period in mm)	0.48 s	0.52 s
		
Max. speed	5,360 mm/s	5,650 mm/s
Robot weight	19 kg	40 kg

## No reference point travel

Travel and position are measured with absolute encoders, so that the robot can start work as soon as it is powered up without wasting time with reference point traverses. In fact, the robot can even resume at the point where it left off after power failures and emergency shutdowns in the middle of a movement sequence. In most cases, this eliminates the need to reset the entire system.



*The degrees of freedom of the RH-5AH and RH-10AH robots*

## Optimum gripper connections

Pneumatic hoses and signal connection lines are routed inside the robot, making it easy to connect grippers and sensors.

## Unpack, calibrate, start work

You can start work almost as soon as you have unpacked the robot and installed the arm assembly. You only have to enter the reference point data recorded at the factory, then the robot is ready to execute the first movements.





## The Robot Controller – A Compact Switching & Control Package

*The convenient Teaching Box is used for manual entry of the working positions of the MELFA robot. It also has functions for testing the entire programmed movement sequence after it has been entered.*

*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.*

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. The impressive performance specifications of these controllers speak for themselves.

### Number-crunching 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.

### Work space limitation

You can define multiple “no-go” areas within the robot’s work space that the robot is not permitted to enter, even in teaching mode. This makes it possible to protect the product being manipulated and the robot from dangerous collisions.

### Digital inputs and outputs

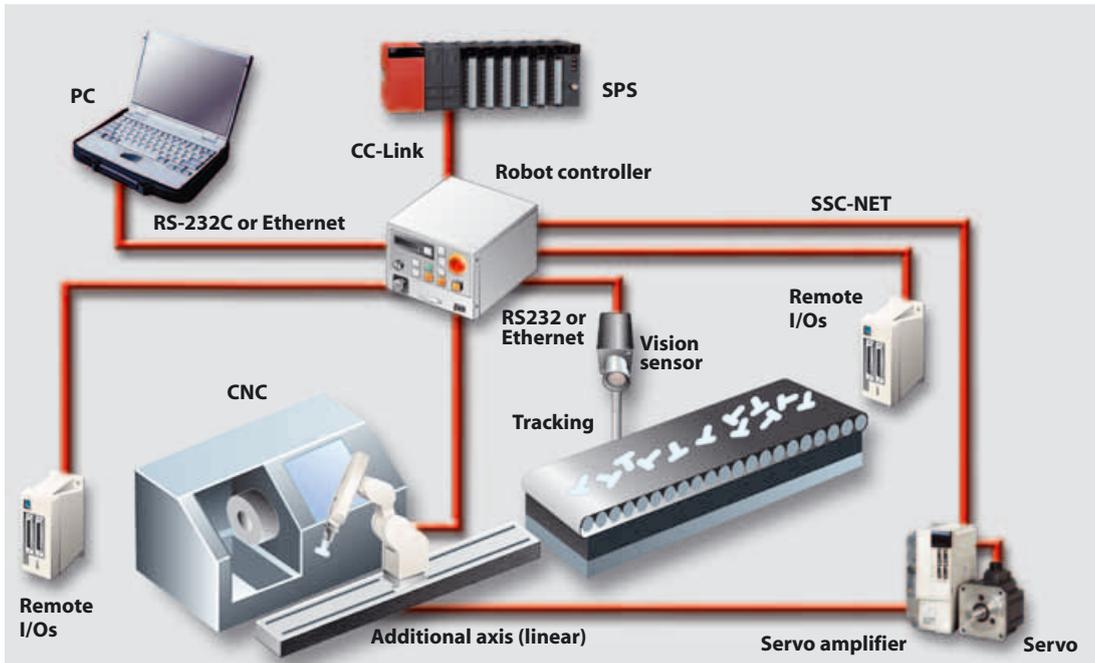
In their standard configurations the CR1 has 16 digital inputs and 16 digital outputs, the CR2/CR3 32 digital inputs and 32 digital outputs. Optional remote I/O boxes make it possible to increase this to up to 256 inputs and 256 outputs for complex applications.

### 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.

<b>Controller type</b>	<b>CR1, CR2, CR3</b>
<b>Control mode</b>	PTP and CP
<b>Processor</b>	64-bit RISC + DSP
<b>Control functions</b>	Axial, linear and 3-D circular interpolation; palletising functions, interrupt control and multitasking
<b>Max. position points</b>	88
<b>Max. Anzahl der Positionspunkte</b>	2,500 per program
<b>Max. program lines</b>	5,000 per program
<b>Internal I/Os</b>	<b>CR1:</b> 16 I/16 O, max. 240 I/240 O <b>CR2/CR3:</b> 32 I/32 O, max. 256 I/256 O
<b>Safety functions</b>	EMERGENCY OFF and door contact switch
<b>Power supply</b>	<b>CR1/CR2:</b> 207-253V AC, single-phase <b>CR3:</b> 400 V AC, three-phase
<b>Max./normal power consumption</b>	3.5kVA/0.9kVA
<b>Outside dimensions (W/H/D in mm)</b>	<b>CR1:</b> 212/166/290, <b>CR2:</b> 460/200/400, <b>CR3:</b> 450/975/380

*Example of a robot system configuration*



**Enhanced path precision**

Applications like laser cutting and welding require extreme path precision. An enhanced path precision function for applications like this can be switched on and off as required.

**Expansion options for your applications**

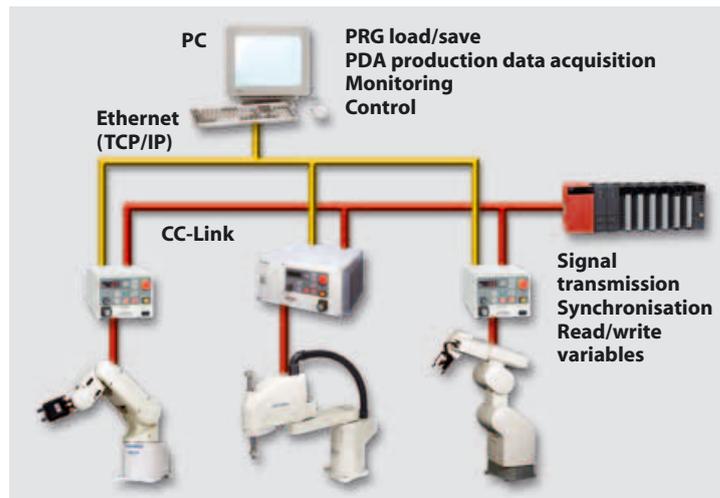
You can expand the robot and add features required by your applications with expansion cards that plug into slots in the controller, similar to the expansion cards in a personal computer.

**Control for additional axes**

The controller can handle up to 8 additional axes, in addition to the robot's own axes, and up to 2 of the additional axes can be interpolated with the robot.

**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



*Example of a network connection configuration*

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.

**RS232, RS422/485, tracking**

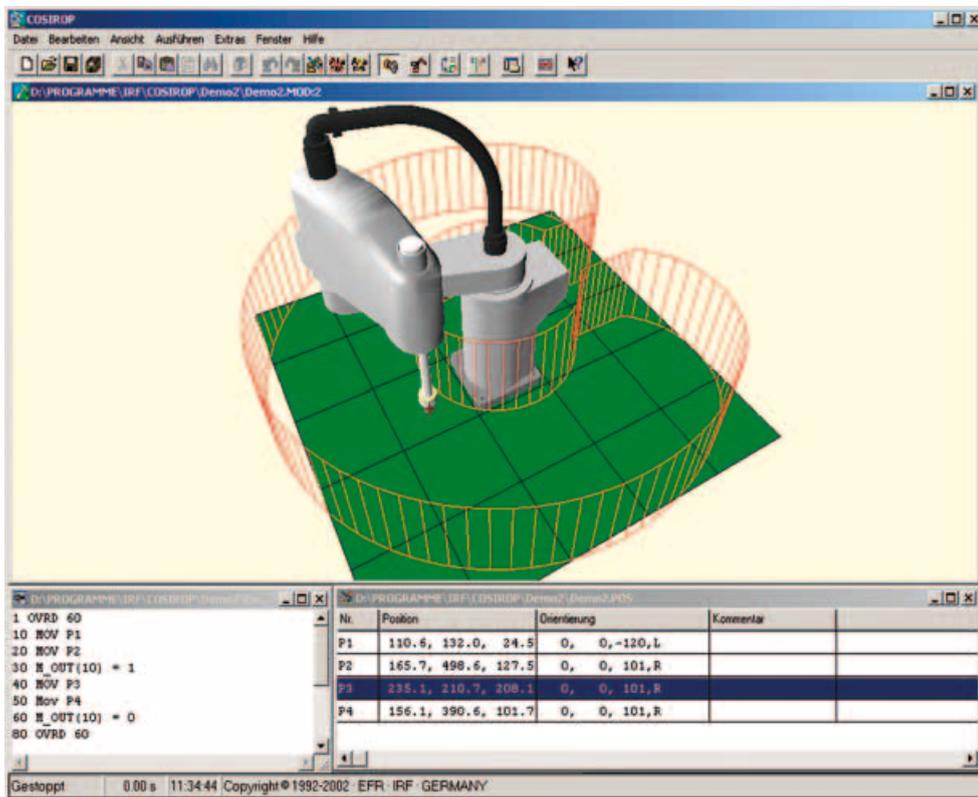
This expansion card provides several serial communications options for the connection of peripherals and two encoder inputs for the registration of conveyor belt speeds. In combination with the corresponding integrated system functions these

encoder inputs allow the implementation of a "tracking" function, with which the robot can synchronise with the conveyor belt and process products while they are in motion.

**CC-Link and high-speed I/O network**

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.

## COSIROP – Programming Software for the Real World



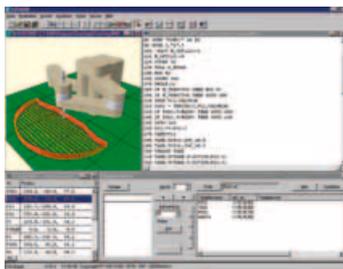
While the programs are being executed you can monitor and visualise the robot with the help of COSIROP's comprehensive control and diagnostics functions. The real-time axis speeds and motor currents are displayed clearly, together with the statuses of all the robot's inputs and outputs. Live monitoring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

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

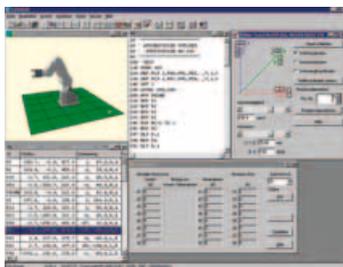
Other useful functions include:

- 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

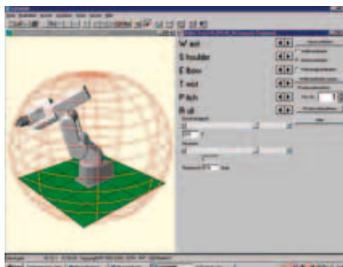
### Variable monitor for program checking



### Online position definition and motor current monitoring



### Online-Teach-In function with single-axis mode



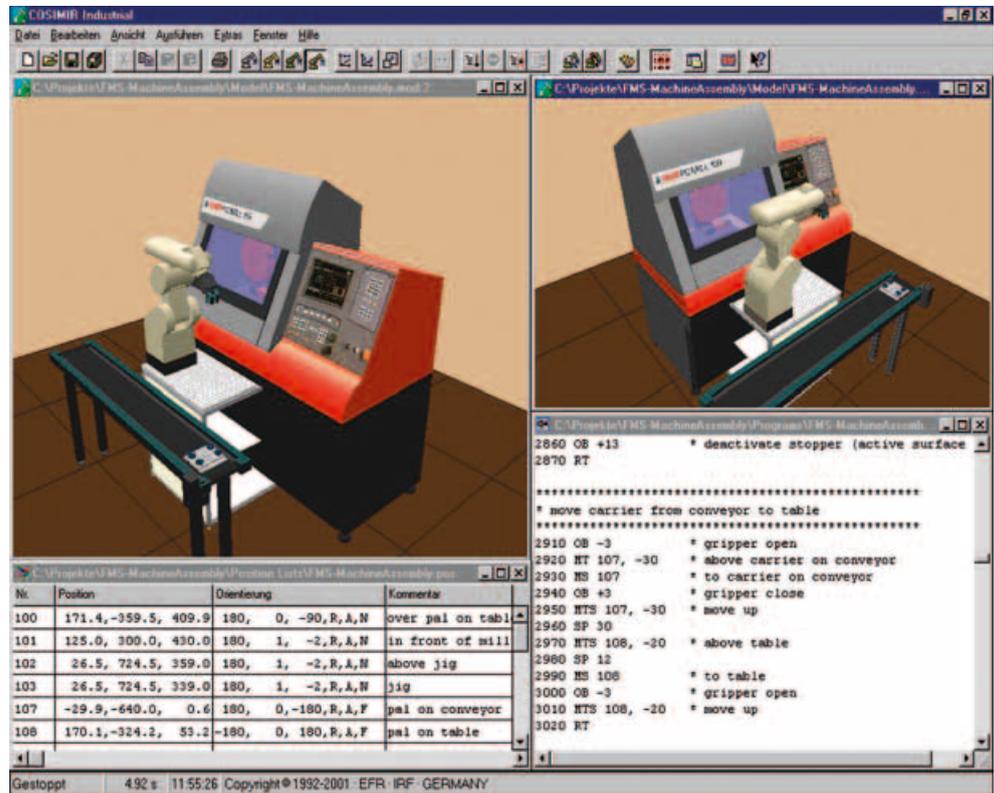
A powerful robot programming language needs an equally powerful programming environment. COSIROP is the programming environment for all Mitsubishi robots. It allows you to create robot programs in minutes using the MELFA BASIC IV or MOVEMASTER COMMAND robot programming languages. After testing and optimising 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.

# COSIMIR® Industrial – Integrated Simulation and Programming Software

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

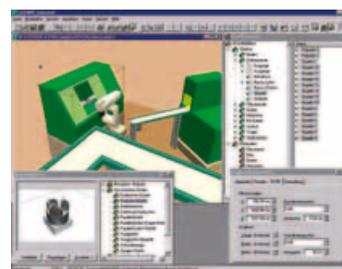
The powerful tools of the COSIMIR® package help you throughout the planning, programming and test phases. Reachability checks in the early planning stages help you to select the most suitable robot systems for the task. You can move the robots and other work cell components around in the simulation at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

COSIMIR® uses the native robot languages (MELFA-BASIC 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 the familiar robot languages and all your existing know-how and skills when you are working with the simulation. The comprehensive online

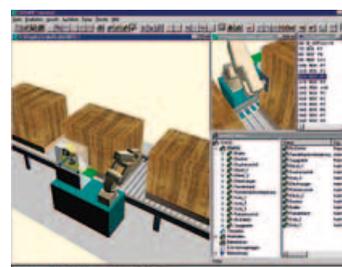


help system is always available when you need support with the formulation of the necessary syntax. After creating your robot programs you can test them directly in the simulation environment, eliminating the need to remove the actual work cell from the production process for testing.

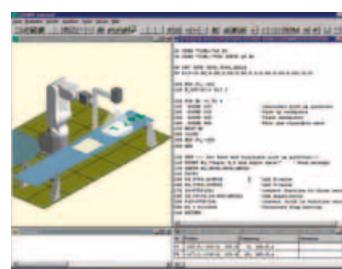
The COSIMIR® and COSIROP packages are powerful tools for achieving maximum efficiency and cost-effectiveness in the configuration and operation of robot-supported automation solutions, and they allow you to plan and operate your systems with a very high degree of confidence.



**The Model Explorer  
simplifies object  
management**



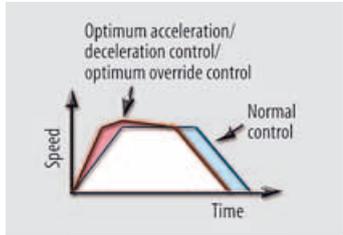
**You can open any  
number of view  
windows**



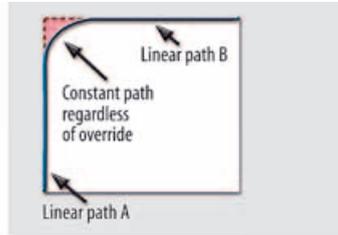
**Program execution  
monitoring in the  
simulation**

# MELFA Robot Systems – Practical Functions for all Applications

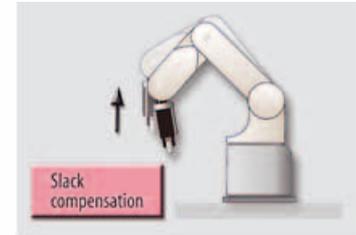
All MELFA robots feature a large number of advanced integrated system functions that enable you to adapt and optimise their performance for the specific needs of your applications.



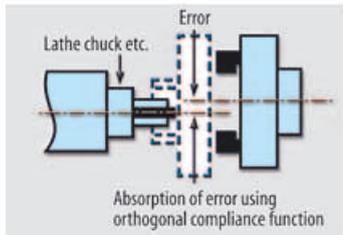
Automatic acceleration and braking ramp optimisation for faster cycle times



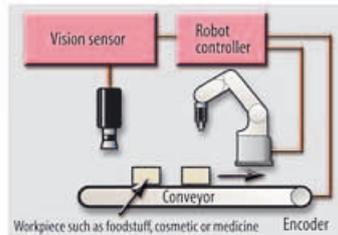
Continuous Path function for faster cycle times



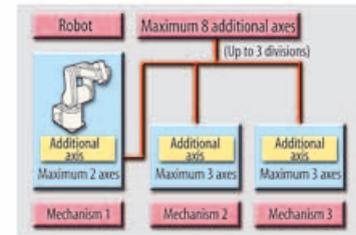
Gravity compensation for greater positioning and palletising precision



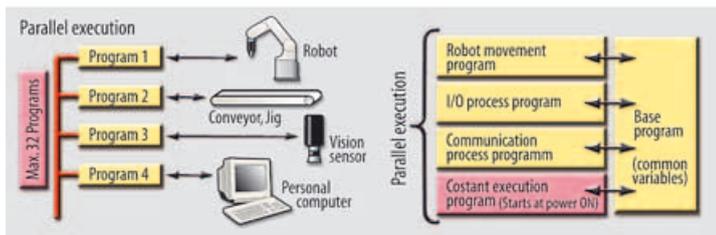
Orthogonal "compliance control" function for interactive response to opposing forces



Object tracking function for faster cycle times



Control functions for up to 8 additional axes



Multitasking function for parallel execution of multiple tasks

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