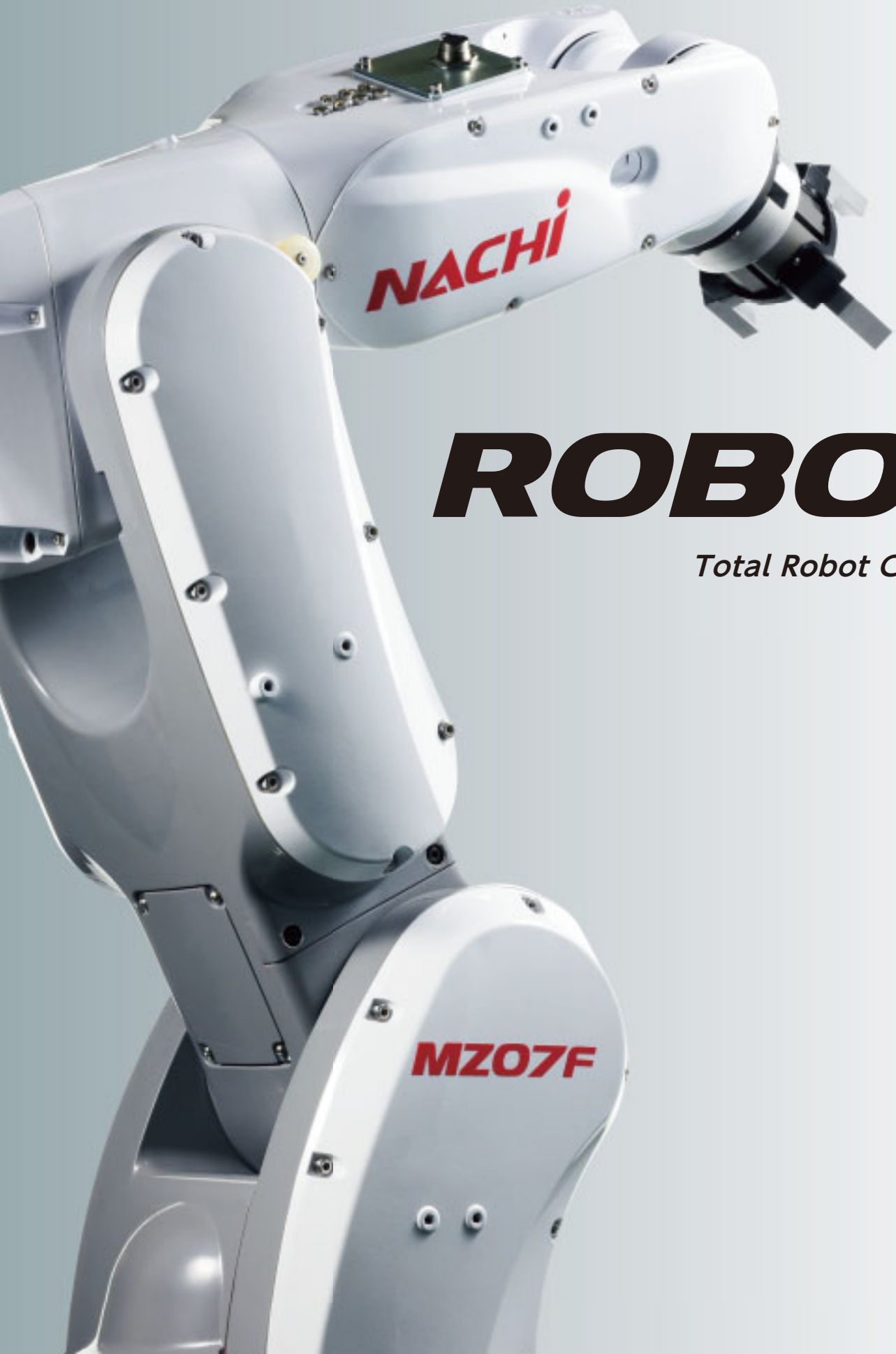
NACHI



ROBOT

Total Robot Catalog


MZS
NACHI
NACHI
MZS

THE FORM FOLLOWS FUNCTION

NACHI-FUJIKOSHI leveraged know-how from their hydraulic and machine tool divisions to become the first Japanese manufacturer of industrial robots in 1968.
Since then, NACHI-FUJIKOSHI has been introducing products built on its technological excellence and innovative strength to accurately respond to market demands. Currently, NACHI-FUJIKOSHI has many partnerships with Automotive and General industries.
Through these partnerships and the delivery of world class products NACHI-FUJIKOSHI has earned a high level of respect among these industries around the world.
From high-speed, high-precision operations to lifting heavy loads used in a full range of assembly work and welding solutions.
NACHI's robots are innovating production facilities with their incredible speed.
We will continue evolving with our customers to meet the world's automation challenges.



LINEUP 3-4

HANDLING 5
Machine Loading, Picking
Loading, Palletizing
Assembly
Deburring/Polishing
Sealing

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CLEAN-ROOM 19

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WORLD SERVICE NETWORK

LINEUP

		HANDLING				
		MZ	MC/MR	MZ Collaborative Robot/CZ	EC	
Process and application	Field					
Number of controlled axes		5 or 6 axes	6 or 7 axes	6 axes	4 axes	
Payload capacity		1 to 70kg	20 to 70kg	5 to 12kg	6 to 10kg	
Maximum reach		350 to 2,502mm	1,260 to 2,050mm	927 to 1,300mm	500 to 1,000mm	
Page Number		5	8	9	11	
Spot welding/ Seam welding	Automotive Automotive parts Metalworking Agricultural machinery Construction machinery		●			
Arc welding			●			
Die casting	Automotive parts Plastics Electric and electronics	●	●	●		
Resin molding		●	●	●		
Press operation handling	Automotive Automotive parts Machine tools Plastics Pharmaceuticals and cosmetics Electric and electronics Metalworking Chemistry Medical equipment Foodstuffs Agricultural machinery Construction machinery					
Machine loading		●	●	●		
Deburring/Polishing		●	●			
Sealing		●	●	●		
General Assembly		●	●	●	●	
Bolt tightening		●	●	●	●	
Picking, aligning, packaging		●	●	●	●	
Shipping and receiving (palletizing)		●	●	●		
Measuring, inspection, testing		●	●	●	●	
Material handling		●	●	●	●	
Glass substrate loading	Electric and electronics					

●: Described typical applications

	HANDLING		PALLETIZING	WELDING	CLEAN-ROOM
	EZ	MC and SC Heavy Loader	LP/MC	SR/SR series(Hollow)	ST-C
					
	4 axes	6 axes	4 or 5 or 6 axes	6 axes	6 axes
	3kg	280 to 1000kg	130 to 500kg	100 to 300kg	133 to 210kg
	450 to 550mm	2,771 to 3,972mm	2,771 to 3,756mm	1,634 to 3,383mm	2,654 to 2,674mm
	12	13	15	17	19
		●		●	
		●		●	
		●		●	
		●		●	
		●		●	
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	●			●	
	●	●			
		●	●	●	
	●	●			●
	●	●	●	●	
					●

Handling robot

Machine loading
Picking
Loading
Assembly
Palletizing
Deburring/Polishing
Sealing



High speed/High precision compact robot

MZ SERIES

High speed/High precision compact robot available with protection against dust and water, multiple installation orientations.
Large selection of payload from 1 to 70kg.
The internal wire routing for the tooling significantly increases cabling reliability so that operations in a narrow space are possible.
Wide operating range improves productivity and also high spec/performance applications such as vision sensor are available.
Meets various automation needs.



MZ01

High speed and high precision
1kg compact robot.

- Number of controlled axes 6 axes
- Payload 1kg
- Maximum reach 350mm

MZ03EL

Maximum reach 1,102mm with 3.5kg payload.
Compact long arm robot.

- Number of controlled axes 6 axes
- Payload 3.5kg
- Maximum reach 1,102mm



MZ04

Reduced footprint with light-weight compact body.
Sophisticated and flowing form.
Smooth surface design, easy to clean covers.

- Number of controlled axes 6 axes
- Payload 4kg
- Maximum reach 541mm







MZ07/MZ07L

Meets various automation needs with various options.

- Number of controlled axes 5 or 6 axes
- Payload 7kg
- Maximum reach MZ07 : 723mm
  MZ07L: 912mm

MZ07F/MZ07LF
MZ10SF/MZ10F NEW

Achieves even higher speed and precision while MZ07 series features, lightweight, compact body, and hollow wrist are maintained.

- Number of controlled axes 6 axes
- Payload 7 to 10kg
- Maximum reach MZ07F, MZ10SF: 723mm
  MZ07LF, MZ10F: 912mm



MZ10

10 kg payload with the same dimensions and workspace as MZ07.

- Number of controlled axes 6 axes
- Payload 10kg
- Maximum reach 723mm



MZ10LF

Achieves payload improvement, longer reach, and higher speed and precision while MZ07 series features, lightweight, compact body, and hollow wrist are maintained.

- Number of controlled axes 6 axes
- Payload 10kg
- Maximum reach 1,202mm

MZ12/MZ12H/MZ15H NEW

IP 67 equivalent (dust-proof, moisture-resistant),
with rust proof/coolant resistant paint.
Powerful and slim multi purpose compact robot.

- Number of controlled axes 6 axes
- Payload 12 to 15kg
- Maximum reach 1,454mm



MZ25/MZ35S NEW

Supports various applications
with large operating range and
powerful wrist.

- Number of controlled axes 6 axes
- Payload 25 to 35kg
- Maximum reach 1,882mm

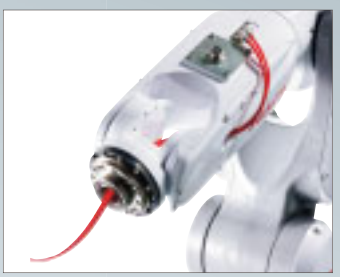


MZ35F/50F/70F/50LF NEW

Space-saving with lightweight/slim body.
Adopts a hollow wrist structure to avoid interference
with peripheral equipment.
Flexible operation even in narrow spaces.

- Number of controlled axes 6 axes
- Payload 35 to 70kg
- Maximum reach 2,102 to 2,502mm

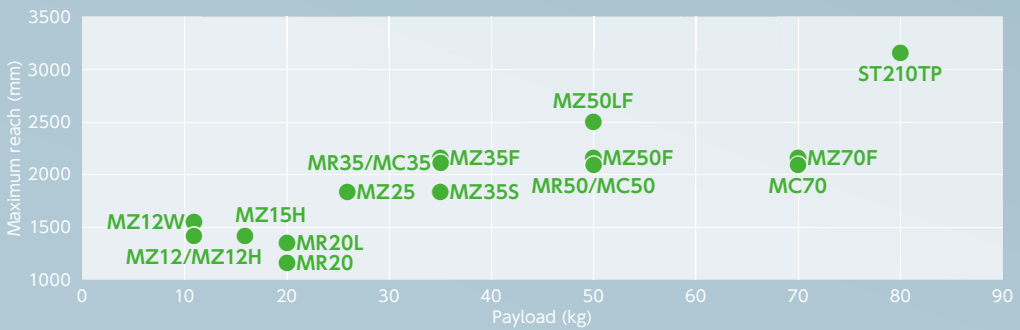




Hollow wrist



Rack storage





Picking



Deburring/Polishing



Machine loading



Assembly



NEW MZ12W

Space-saving/wall mount type robot.
Large wrist torque allows for use with large hands.
Ideal for storing racks in the board transport process, etc.
The hand can be inserted in various directions
with a free control posture that takes advantage
of the vertical multi-joint structure.

- Number of controlled axes 6 axes
- Payload 12kg
- Maximum reach 1,564mm

Powerful and compact multi-purpose robot

MC SERIES

High dust-proof and moisture-resistant, combined with outstanding performance and a full range of functions to handle a variety of applications make these robots ideally suited for a variety of production environments.

- Number of controlled axes 6 axes
- Payload 35 to 70kg
- Maximum reach 2,050mm

Flexible motion “Arm” robot with 7-axes

MR SERIES



With extra articulation, this 7-axis arm design can handle complex motions to flexibly work in processes that other robots cannot.
The compact robot arm greatly reduces the amount of space needed for installations.

- Number of controlled axes 7 axes
- Payload 20 to 50kg
- Maximum reach 1,260 to 2,050mm



Press operation handling robot

ST210TP

Its highly rigid, vibration-dampening design enables exceptional speed. The newly developed specialized press arm attachment provides a much greater reach, accommodating press pitches of up to eight meters. It moves parts horizontally at high speed for efficient press operation.

- Number of controlled axes 7 axes
- Payload 80kg
- Maximum reach 3,106mm





Handling/Transfer



Press-tending

Picking
Assembling support
Assembly
Machine loading

People-friendly collaborative robot

MZ COLLABORATIVE ROBOT CZ

NACHI's collaborative robots MZ Collaborative Robot and CZ10 are fully loaded with human-friendly functions.
Safety fences are not required and makes it easier to install a robot with various applications.





MZ Collaborative Robot

Collaborative robots with high rigidity and safety design that complies with safety standards ISO10218-1/13849-1/TS15066, achieving both high-speed/high-precision performance and safety.
Hand wiring is routed through the hollow wrist to avoid interference with peripheral equipment.
It can operate flexibly even in narrow spaces and contributes to smarter lines.

- Number of controlled axes 6 axes
- Payload 5 to 12kg
- Maximum reach 927 to 1,214mm



CZ10

People-friendly design

People-friendly design with rounded arms and gap between joints.

- Number of controlled axes 6 axes
- Payload 10kg
- Maximum reach 1,300mm

Awarded the certification by certification organization.
Safety certification :
Conforming to ISO 10218-1
Conforming to TS 15066



Picking



Assembling support



Assembly



Machine loading

SCARA robot

EC SERIES

The EC06 series are simple structure robots with high-speed & high precision. They meet the needs for applications such as assembling & handling.
We have a lineup of a wide range of maximum reach from 500 to 1,000 mm.
Furthermore, the hollow structure at the tip of the wrist simplifies piping and wiring from the robot body to various tools.



EC06

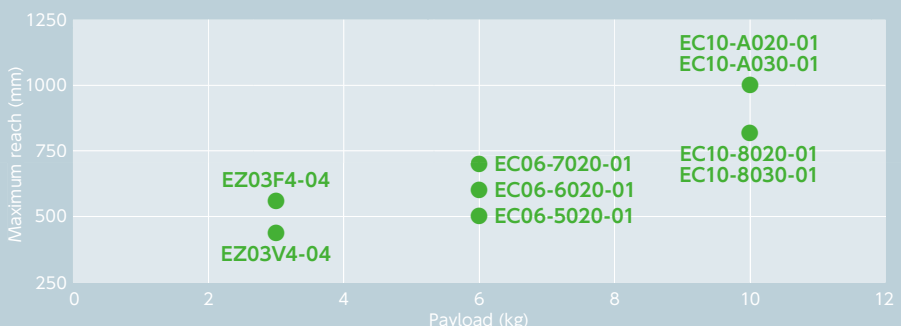
- Number of controlled axes 4 axes
- Payload 6kg
- Maximum reach 500 to 700mm

EC10

The lineup includes four robot types with different maximum reaches and vertical strokes.
The hollow shaft design simplifies wiring, prevents interference with peripheral equipment, and enables a more compact equipment layout.

- Number of controlled axes 4 axes
- Payload 10kg
- Maximum reach 800 to 1,000mm





WING SLICER Type robot

EZ

The EZ robots are high-speed, horizontally articulated & equipped with a space-saving vertical first axis.
They have a high speed, high accuracy structure that is excellent for applications such as assembly and handling. Cable routing is simplified by the hollow construction through the end of the wrist, capable of routing cables through. The internal wire routing for the tooling significantly increases cabling reliability.
The Wing Slicer family has multiple models with varying reach and payload to support a variety of equipment operations.



EZ03

Number of controlled axes	4 axes
Payload	3kg
Maximum reach	450 to 550mm


Packing


Inspection


Assembling

Super heavy loader robot

Automobiles' body handling etc.

With high wrist torque and large operating envelope, these robots are opening up a new era of heavy loading robots.



Super heavy loader robot

MC HEAVY LOADER SERIES

Tool cables and hoses routed inside the hollow arm provides excellent life.



MC1000DL

- Number of controlled axes 6 axes
- Payload 1,000kg
- Maximum reach 3,972mm



MC600

- Number of controlled axes 6 axes
- Payload 600kg
- Maximum reach 2,890mm



SC700DL

- Number of controlled axes 6 axes
- Payload 700kg
- Maximum reach 3,972mm

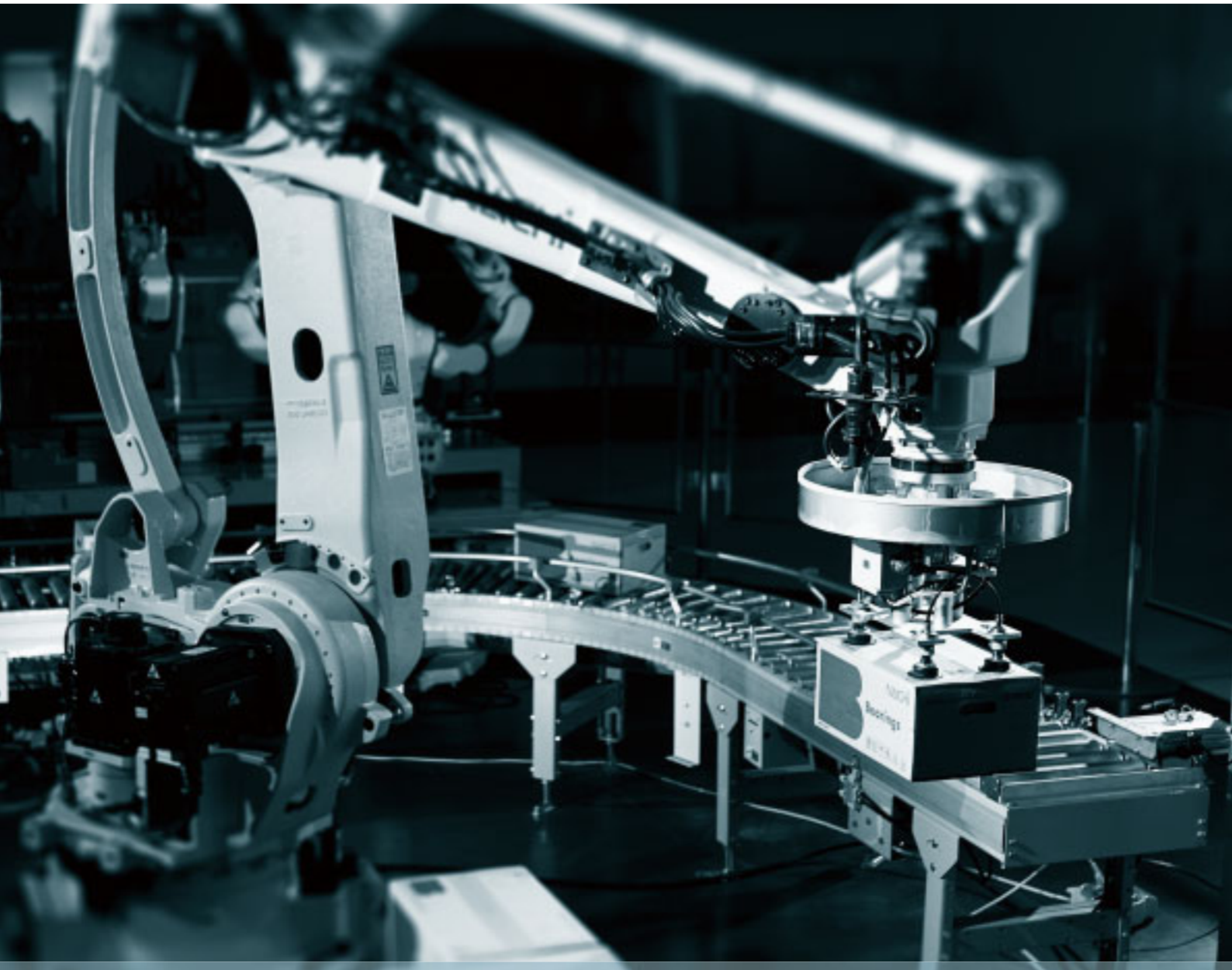
SC HEAVY LOADER

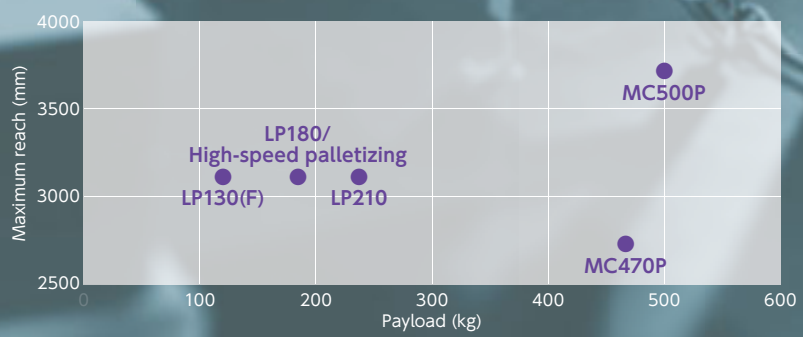
The SC heavy loader robots, with huge load capacity and reach, are excellent for jobs that require heavy lifting. Their large vertical stroke allows more flexible production lines by replacing conventional specialized machinery, such as auto body lifters, with robots.

Palletizing robot

High-speed palletizing robot
Heavy loader palletizing robot

NACHI' s palletizing robots help with intricate palletizing of boxes, crates and sacks for shipping and receiving processes.







High-speed palletizing robot

LP SERIES

The LP series of specialized palletizing robots do large movements quickly.
They can stack products, such as cardboard boxes, or products in bags, such as foodstuffs or chemicals, onto pallets at high speeds.
Loaded with palletizing functions, they can handle a wide variety of stacking patterns.

Number of controlled axes	4 axes
Payload	130 to 210kg
Maximum reach	3,210mm



Heavy loader palletizing robot

MC SERIES

This robot has enough lifting power to handle jobs of loading and stacking beverages, bricks, plastic resins, concrete and other heavy goods.

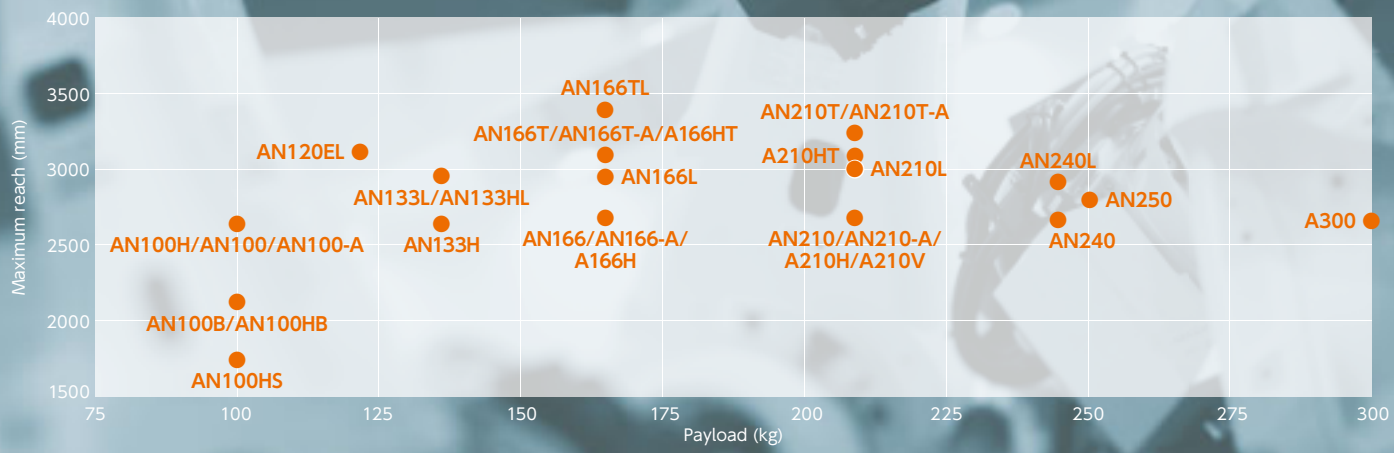
Number of controlled axes	5 or 6 axes
Payload	470 to 500kg
Maximum reach	2,771 to 3,756mm

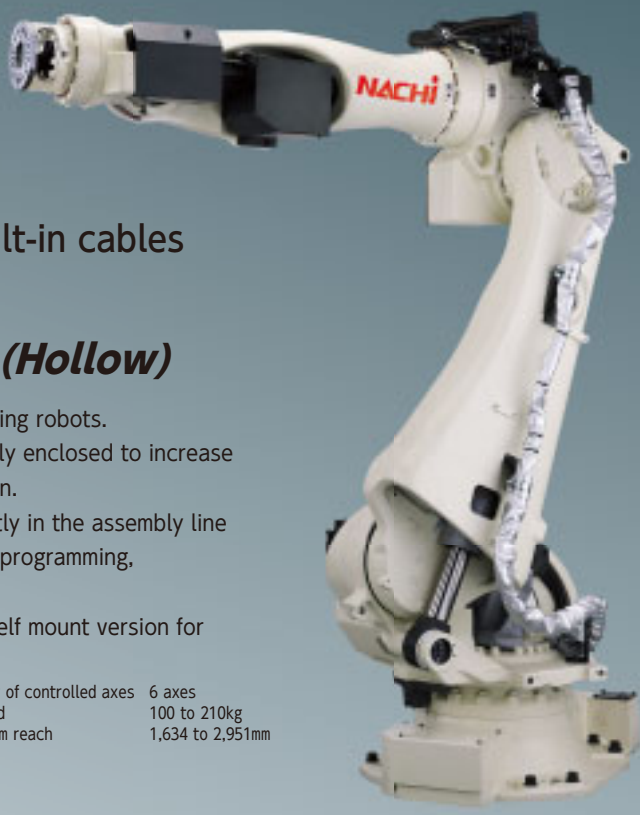
Palletizing

Spot welding robot

Welding robots are the central element of automobile production, especially the auto body welding lines. The performance, functionality, and reliability of the NACHI lineup of spot welding robots are supporting the world of manufacturing.







Spot welding robot with built-in cables

SR SERIES (Hollow)

The next generation of hollow arm spot welding robots.
Cables and hoses for the welding gun are fully enclosed to increase cable reliability and improve rate of operation.
Provides a cleaner profile for installing directly in the assembly line and improves operational accuracy of offline programming, including welding cables.
This hollow arm model is now available in shelf mount version for 166 kg & 210 kg payloads.

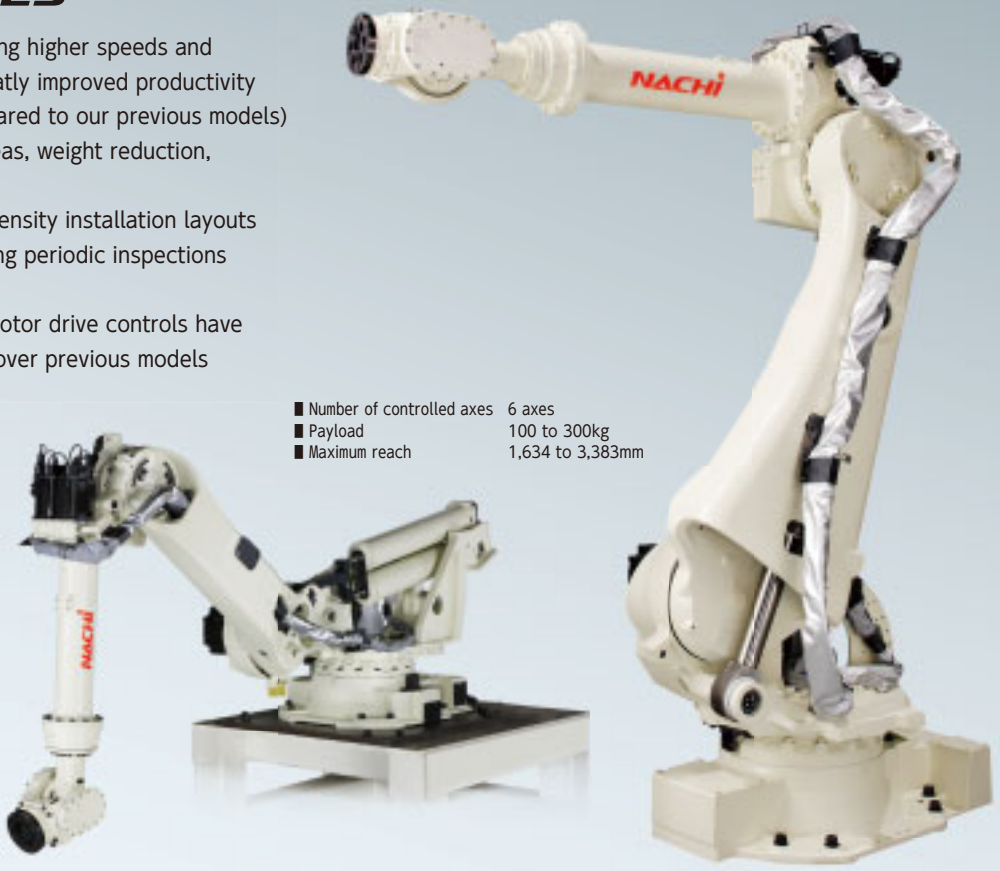
Number of controlled axes	6 axes
Payload	100 to 210kg
Maximum reach	1,634 to 2,951mm

Ultra-fast spot welding robot

SR SERIES

The Ultimate Spot Welding Robot. Using higher speeds and vibration damping properties, we greatly improved productivity by shortening cycle times 30% (compared to our previous models) improvements were made in three areas, weight reduction, higher rigidity, and faster controls.
The compact design allows for high density installation layouts and maintenance is streamlined making periodic inspections and parts replacement easy to do.
The lighter weight and the latest in motor drive controls have reduced power consumption by 5% over previous models reducing environmental impact.
A new long arm type with a payload capacity of 210/240 kg is added to the lineup.
In addition, the payload can be selected up to a maximum of 300 kg, meeting further needs on site.

Number of controlled axes	6 axes
Payload	100 to 300kg
Maximum reach	1,634 to 3,383mm





Spot welding

Clean-room robot

Our series of clean-room robots suppress the dust created by arm movements and are designed to be used in clean rooms. These high-performance loading robots support the heart of the flat panel display production process.

Clean-room loading



ST-C SERIES

- Number of controlled axes 6 axes
- Payload 133 to 210kg
- Maximum reach 2,654 to 2,674mm



OPTIONS





FLEXhand

Servo hand controlled as an additional axis by the robot controller.
Capable of handling many shapes without changing the hand.
This is an excellent tool for small-lot multiple item production.


Compact Flex Hand (for MZ)

- The measurement function that automatically detects the dimensions of the workpiece only by the servo hand that is controlled as an additional axis in synchronization with the robot motion enables sensorless selection of workpiece.
- Since the pressure can be set in 1N increments, it is also compatible with fragile workpieces.
- Even if the motor power or power supply goes down, the hand mechanism self-locks to prevent the workpiece from falling.



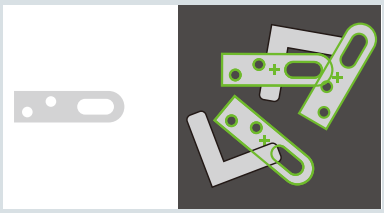
Force sensor

This function controls the robot by accurately detecting the applied force. This powerful tool makes it possible for robots to do delicate operations at high speed, such as following, pushing, loading (press fitting), detecting position and phase during assembly and production processes.



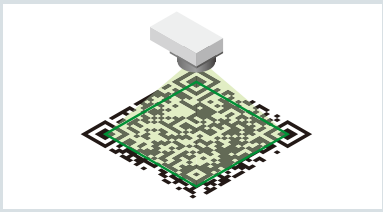
Compact vision sensor NVsmart

Integrated A1:D58, lighting, and image processing equipment to save space and wiring. Processing speed is also improved 2.5 times compared with the conventional one. It can be configured and monitored on teach pendant and also supports additional control of external cameras. It is possible to recognize mixed workpieces, and supports character recognition, barcode recognition, OCR.



Position posture recognition

Posture can be correctly recognized even when various workpieces are mixed.



Barcode recognition

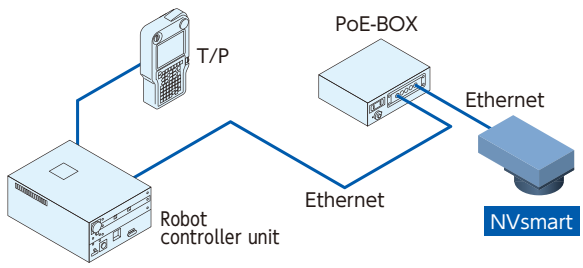
Recognizes barcodes/QR codes without additional equipment such as QR Code Scanners.



Cooperation with teach pendant

Vision setting and monitoring can be set through robot teach pendant.

NVsmart System Configuration Diagram



Connector insertion application

The new visual control application enables high-speed and high-precision insertion of FPC and FFC for various applications such as smartphones and in-vehicle displays.





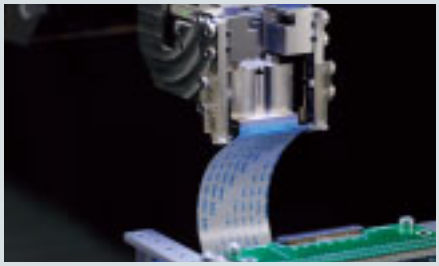
High-precision and high-speed operation

- Our original visual control enables high-speed, high-precision insertion into the connector.
- Performs real-time scanning and repeats measurements and movements until the target point is reached. Follow-up correction is possible even if the target point deviates during movement.
- Since a force sensor is not used, connector insertion time is greatly reduced.

Equipped with traceability function as standard*

- Visual inspection results at the time of insertion and completion are saved as image data.
- Equipped with a QR code reader function as standard, it is possible to manage and record inspection results and link to image data.

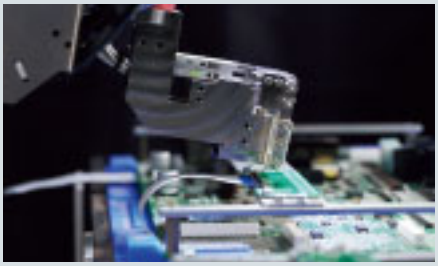
* USB port expansion cable (optional) and USB flash drive (Customer Prepared) are required.



Grip



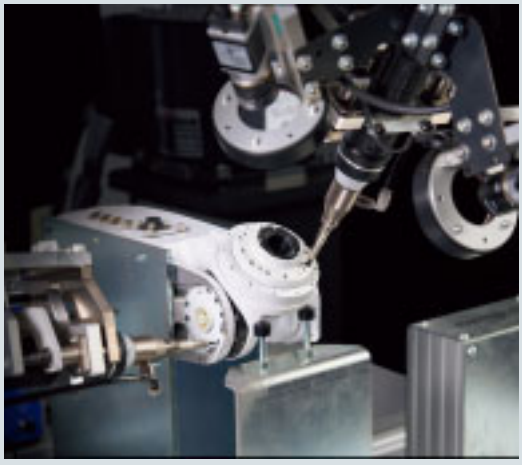
Insert

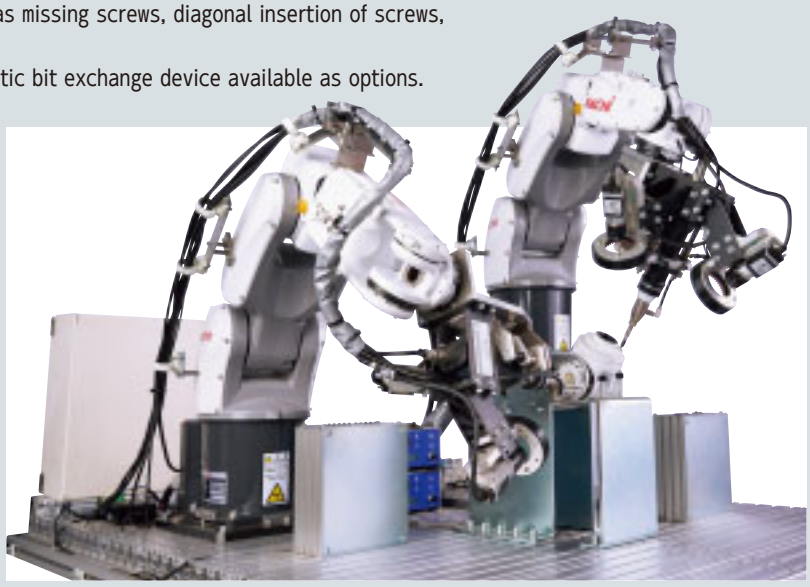


Inspection

Screw tightening unit STU5

- Automatically correct the relative positions of screws and screw holes in three dimensions using a 3D vision device.
- Automatically corrects the tilt of the screw relative to the screw hole using cameras from two directions.
- Reduces failures related to screw tightening work such as missing screws, diagonal insertion of screws, and floating screws.
- Screw tightening status traceability function and automatic bit exchange device available as options.



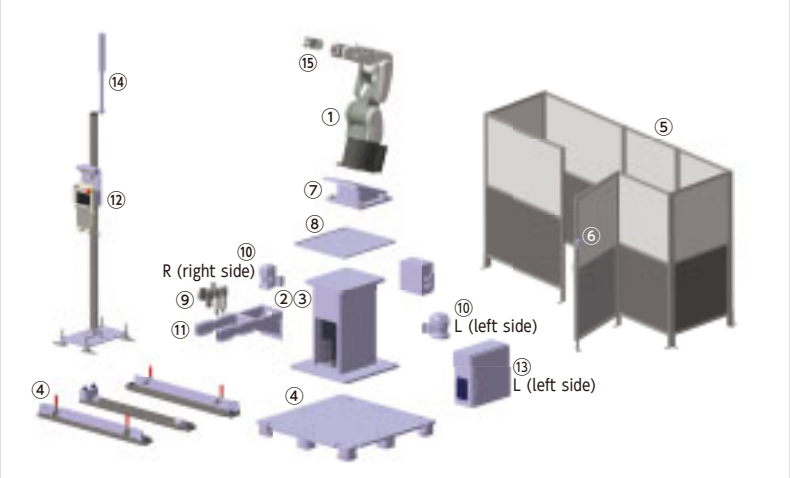


System standard kit

- Standard kit for building automated equipment using robots with a payload of 5 to 12 kg.
- Systemize by combining necessary equipment.
- Pre-installed operating screen, I/O settings, and standard robot program.
- Easy installation and relocation with Plug & Play.
- Movable with a hand lifter, so you can use it when and where you want.



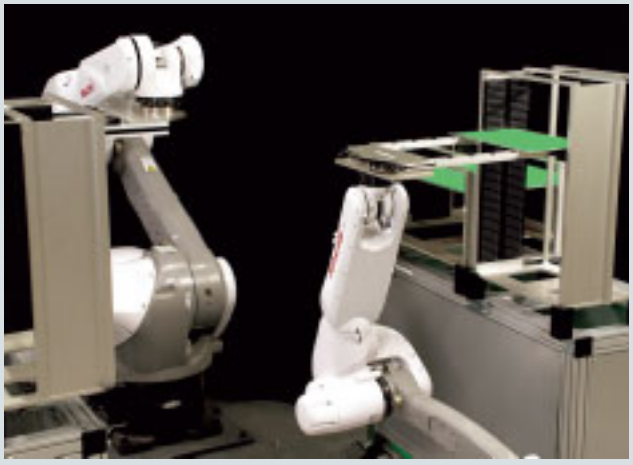
System standard kit components



①Robot	⑨Air pressure conditioning unit
②Robot riser	⑩Safety laser scanner
③Robot clamping parts	⑪Pallet installation arm
④Movable installation unit (movable side module/fixed base)	⑫Teach pendant holder stand
⑤Safety fence	⑬Connection box for system controller (installed on the left side in this diagram)/Breaker box
⑥Safety fence option	⑭Signal tower
⑦Tilted installation stand	⑮Robot gripper (MZ standard gripper or small flex gripper)
⑧Oil pan	

PCB transfer cell

- Realizes many PCB transfer operations existing in PCB production line
- Vacuum pad position is automatically changed according to PCB size. Variable pitch vacuum hand for multiple models realizes variable pitch function without drive source
- MZ12W with unique axis structure for storing PCB in racks in narrow spaces
- MZ-F medium payload series ideal for replacing PCB magazine racks



CONTROLLERS

Introducing the intelligent robot controller based on Windows.
Robots and additional axis are easy to operate by using the teach pendant. Vision and force sensors, as well as networks, are managed in one place.

	CFDq Controller Unit	CFDs controller
		
Item	Specifications	
Basic specifications for controller		
Controllable axes	6	
Maximum controllable axes	6	8
Volume	6.0L	12.4L
Weight	5kg	8.9kg
External dimensions (mm)	270(W)×270(D)×82.9(H) Exclude Fan Motor, Switch, Connector, etc.	310(W)×250(D)×160(H) Exclude rubber feet, switches/connectors
Position reader	Absolute encoder	
Programming system	Teaching playback	
Operating panel	–	Mode switch (teach/playback), emergency stop button
Cables between robot and control panel	2m, 5m, 10m, 15m, 20m (connector type) extension (total) 25m	
Additional slot	PCIe×1 slots	PCIe×2 slots
PLC function	Software PLC ISaGRAF 6	
Protection class	IP20 equivalent	
Power supply	Single phase 200–230VAC, 50/60Hz, D grounding, max. leakage 10mA	
Ambient temperature/humidity	0 to 45°C (50/60Hz) 20 to 85% (No dew or frost allowed)	
Safety function	Safety sequence PLd, category 3 (ISO 13849 -1)	
Overseas compliance	Europe: CE, Korea: KCs, North America UL/CSA	
Controller options		
Power voltage converter	Single phase 100 VAC, 50/60 Hz	
External storage	USB Flash Drive (1 GB)	
Additional axes	–	Additional 2 axes
Fieldbus	EtherNet/IP, EtherCAT, Profinet, CC-Link and others. Maximum 2 channels can be installed.	EtherNet/IP, EtherCAT, Profinet, CC-Link and others. Maximum 4 channels can be installed.
Additional input/output signals	Additional I/O board: 32 points/32 points	Additional compact I/O board: Maximum 16/16 point, Additional I/O board: Maximum 64/64 point
Output signals	Additional I/O board: Transistor output	Additional compact I/O board : Relay contact output, Additional I/O board: Transistor output
Analog input/output	–	
Vision sensor	NVsmart	
Conveyor tracking function	Conveyor tracking control	
Palletize function	Palletize and de-palletize	
Robot language	JIS B 8439 SLIM compliant	
Robot monitoring function	–	Position/speed monitoring function: PLd, category 3 (ISO 13849 -1)

	FD controller **FD18**	FD controller **FD20**
		
Item	Specifications	
Basic specifications for controller		
Controllable axes	6	
Maximum controllable axes	8	
External dimensions (mm)	300(W)×600(D)×530(H) Excluded Casters (50mm), Switches/connectors	580(W)×532(D)×490(H) Excluded Casters (50mm), Switches/connectors
Position reader	Absolute encoder	
Programming system	Teaching playback	
Operating panel	Mode switch (teach/playback), emergency stop button	
Cables between robot and control panel	5m, 10m, 15m, 20m, 25m (connector type) extension (total) 25m	
User interface	User panel : On back	
Additional slot	PCI×2 slots	PCI×3 slots
PLC function	Software PLC ISaGRAF 6	
Protection class	IP54 equivalent	
Power supply	3ϕ 200–230VAC, 50/60Hz, D grounding, breaker 40A, max. leakage 30mA	
Ambient temperature/humidity	0 to 45°C (50/60Hz) 20 to 85% (No dew or frost allowed)	
Safety function	Safety sequence :PLe, category 4 (ISO 13849 -1)	
Controller options		
Overseas compliance	Europe: CE, Korea: KCs, North America UL/CSA	
Power voltage converter	380/400/420/440/460/480VAC (3ϕ 50/60Hz) Transformer BOX size: W300×D600×H430 Casters (90mm), Switches/connectors not included Size when controller and transformer BOX are connected: W300×D600×H960 Casters (90mm), Switches/connectors not included	380/400/420/440/460/480VAC (3ϕ 50/60Hz) Built-in transformer
External storage	USB Flash Drive (1 GB)	
Additional axes	Gun, slider, jig and gripper	
Fieldbus	DeviceNet、CC-Link、CC-Link IE Field and others. Maximum 4 channels can be installed.	
Additional input/output signals	Additional compact I/O board: Maximum 14/10 point, Additional I/O board: Maximum 32/32 point	Additional compact I/O board: Maximum 14/10 point, Additional I/O board: Maximum 64/64 point
Output signals	Relay contact specifications cations 32 point	Relay contact specifications cations 32 point
Analog input/output	2/4 point	
Vision sensor	NVsmart	
Conveyor tracking function	Conveyor tracking control	
Palletize function	Palletize and de-palletize	
Robot language	JIS B 8439 SLIM compliant	
Robot monitoring function	Position/speed monitoring function:PLd, category 3 (ISO 13849 -1)	

Teach pendant

A small and lightweight teach pendant.
Equipped with a high-definition touch panel and has a wide range of optional functions.



Item	Specification	
	CFDq	CFDs/FD18/FD20
Display	5.7 inch VGA color LCD touch panel	
Language	Japanese (Kanji, Hiragana, Katakana, Alphanumeric) English/Chinese/Korean option*: German/Italian/Spanish/Taiwanese	
Enable SW	One-handed enable switch, three positions, (left hand side)	
Operation function	Axis operation key, value input key, selection/function key, motors on key, emergency stop	
External storage interface	USB port	
Cable length	8m, 15m, 20m, 25m, 30m (connector type)	
Protection class	IP65 equivalent	
External dimensions (mm)	163(W)×74.5(D)×353(H)	
Weight	0.9kg	

* Included in the standard specification for CFDs controller

Option Graphic user interface **Flex Gui**

Freely customize the screen of the teach pendant. It can be used as an operating panel for the entire system including peripheral devices.



FlexGui

- Creation of operating monitor screens tailored to applicable processes and applications.
- Intuitive system operation with touch panel
- The entire system can be controlled by using the software PLC function.
- Abolishing the independent system controller, contributing to space savings and cost reductions.

FlexGui Remote

- Connect a computer to the robot controller
- Remote display and operation of teach pendant (FlexGui) screen

FlexGui Toolbox

- Easily create screens with the editing tool “FlexGui Toolbox”
- Prepare a wide variety of parts (items that make up the screen)

NEW

Tablet TP

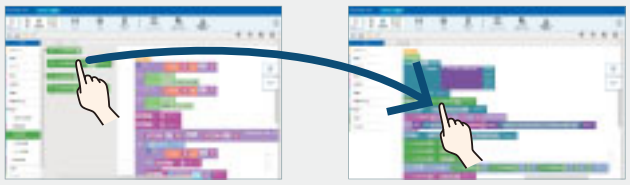
Tablet TP is a new type of teaching device that uses a commercially available tablet attached to a special holder.
The large, easy-to-read screen provides unprecedented operability.



Item	Specification
	TBHLDR-0000/TBHLDR-0010
Compatible robot Controller model	MZ03EL/MZ04/MZ07/MZ10 series/CFDs-0000*1, MZ-F series/CFDs-0000F, MZ01 series/CFDs-0040*1, MZ12 series/CFDs-3000, MZ Collaborative Robot/CFDs-0000C
Compatible tablet specifications *2	Screen size: 10-13 inches, thickness: 10mm or less, weight: 1.1kg or less (see standard specifications for details)
Number of controlled axes	Standard 6 axes (robot axes only) *External axes are not supported
Teaching method	Teaching playback
Number of program selections	9,999 species
Operating switch	Emergency stop button, +/- button, Select button
Protection class	IP54 equivalent (excluding tablet PC and USB Type C cable)
Power supply	DC24V±10% Supplied from TP cable (FD19TP-D04M)
Ambient temperature	0 to 40℃
Transport/storage temperature	-25 to 55℃ (up to 70℃ allowed within one day)
Ambient humidity	20-85% (No dew, nor frost allowed)
Elevation	At 1000m or lower sea level
External dimensions (mm)	224.8(W)×225.6(D)×83.2(H) *Excluding tablet and TP cable.
Standard mass	775g *Excluding tablet and TP cable.

*1: Even in the case of CFDs controller, the following robots are not supported. please note. EC series (CFDs-0040/CFDs-2040F), EZ (CFDs-0000)
*2: This may not apply depending on the shape of the tablet. In addition, the weight specifications of compatible tablet is a reference value.
Please note that we do not guarantee that the product will not be destroyed or malfunction due to the fall impact.

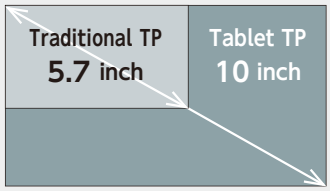
Easy programming with Drag&Drop



Large screen that is easy to see and press

Large, easy-to-press button





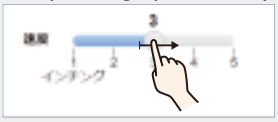
*Tablets will be provided by the customer.

Intuitive operability like a smartphone

Tap the icon



Manipulate graphs directly



Easy-to-understand guides and tutorials

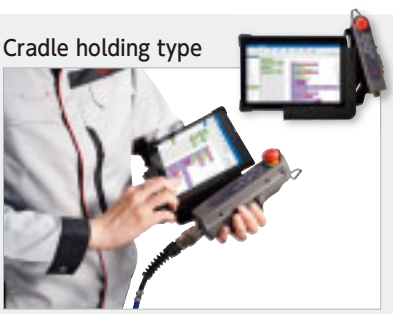
Guide function
If you touch the part you want to see the explanation, the message will be displayed.

Tutorial function
A video with audio guide explains basic usage.

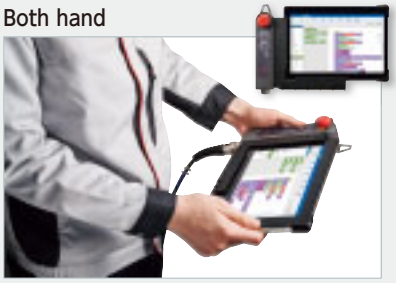
Customize the way you hold it

By replacing the holder parts, you can freely change between holding it in both hands and holding it in arm.
Additionally, the grip angle can be changed according to the operator's preference, allowing a comfortable holding position and reducing fatigue during long hours of teaching work.

Cradle holding type



Both hand

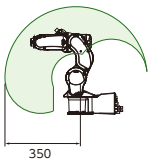
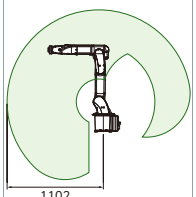
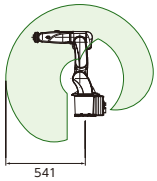
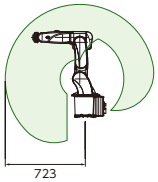
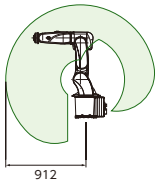


LIST OF SPECIFICATIONS

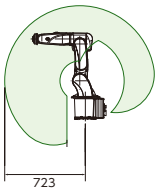
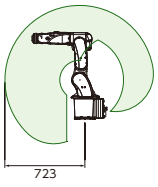
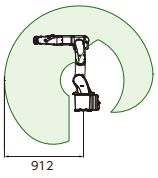
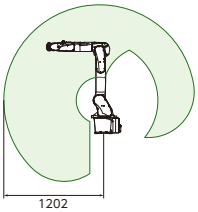
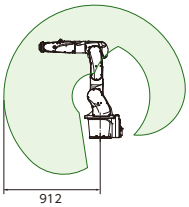
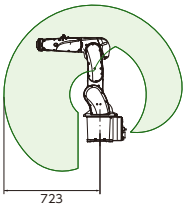






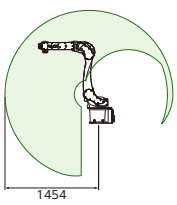
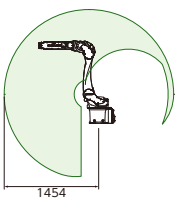
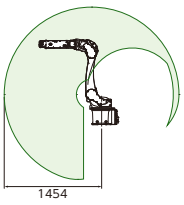
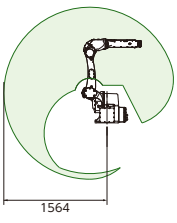
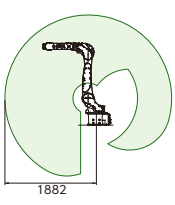
Type				MZ01	MZ03EL	MZ04 (MZ04D)	MZ04E (MZ04DE)	MZ07 (MZ07P)	MZ07L (MZ07LP)
No. of axes				6				6(5)*1	
Max. working envelope	Arm	J1	Swivel 1	±170°					
		J2	Horizontal	−90~+85°	−135~+80°	−145~+90°		−135~+80°	
		J7	Swivel 2	–					
		J3	Vertical	−111~+175°	−155~+270°	−125~+280°		−136~+270°	−139~+270°
	Wrist	J4*1	Rotation 2	±145°	±190°			±190° (−)	
		J5	Bend	±125°	±120°				
		J6	Rotation 1	±360°					
Max. speed	Arm	J1	Swivel 1	320°/s	300°/s	480°/s	200°/s	450°/s	300°/s
		J2	Horizontal	320°/s	230°/s	460°/s	150°/s	380°/s	280°/s
		J7	Swivel 2	–					
		J3	Vertical	375°/s	360°/s	520°/s	190°/s	520°/s	360°/s
	Wrist	J4*1	Rotation 2	600°/s	550°/s	560°/s		550°/s (−)	
		J5	Bend	600°/s	550°/s	560°/s		550°/s	
		J6	Rotation 1	600°/s	1,000°/s	900°/s		1000°/s	
Maximum load		Wrist		1kg	3.5kg	4kg		7kg	
		Load capacity on forearm		0.25kg	–				
Allowable static load torque for wrist		J4*1	Rotation 2	0.9N·m	6N·m	8.86N·m		16.6N·m (−)	
		J5	Bend	0.9N·m	6N·m	8.86N·m		16.6N·m	
		J6	Rotation 1	0.78N·m	2.9N·m	4.9N·m		9.4N·m	
Allowable moment of inertia for wrist		J4*1	Rotation 2	0.008kg·m^2	0.12kg·m^2	0.2kg·m^2		0.47kg·m^2 (−)	
		J5	Bend	0.008kg·m^2	0.12kg·m^2	0.2kg·m^2		0.47kg·m^2	
		J6	Rotation 1	0.006kg·m^2	0.03kg·m^2	0.07kg·m^2		0.15kg·m^2	
Maximum reach				350mm	1,102mm	541mm		723mm	912mm
Pose repeatability				±0.02mm	±0.03mm	±0.02mm		±0.02mm	±0.03mm
Ambient temperature*2/ humidity				0 to 40°C/20 to 85% RH (without condensation)	0 to 45°C/20 to 85% RH (without condensation)				
Vibration				0.5 G or less					
Installation				Floor, wall, inverted, tilted mount			Floor, inverted mount	Floor, wall, inverted, tilted mount	
Ingress protection				IP40 equivalent	IP67 equivalent	IP40 equivalent*3		IP67 equivalent	
Weight				10kg*4	39kg	26kg*4	25kg*4	36kg*4	38kg*4
Power consumption				0.4kVA					
Supported Controller				CFDs/CFDq	CFDs	CFDs	CFDs	CFDs	CFDs
Working envelope									

* Maximum speeds are maximum values, they will vary depending on the wrist load conditions and operating program.
*1: For the 5-axis specifications (MZ07P and MZ07LP), the configuration does not have the J4 axis. *2: Using at 1,000 m or lower sea level. Ambient temperature has limitations when allowable altitude is exceeded.
*3: MZ04 and MZ04E have IP40 equivalence. MZ04D and MZ04DE have IP67 (dust proof and water proof) equivalence.
4: Wall mount Rear Connection Type: +4kg (MZ04 Series), +6kg (MZ07* Series) / Bottom Connection Type: +6kg (MZ04* Series), +8kg (MZ07* Series), +2.5kg (MZ01)
*5: Operating range is limited when mounted on a wall or tilted. (Example: #1-axis operating range is ±30° for wall mount)

						
	MZ10	**MZ07F**	**MZ07LF**	**MZ10LF**	**MZ10F**	**MZ10SF**
	6	6				
	±170°	±170°				
	−135~+80°	−135~+80°				
	–	–				
	−136~+270°	−136~+270°	−139~+270°	−136~+270°	−138~+270°	−136~+270°
	±190°	±190°				
	±120°	±120°				
	±360°	±360°				
	300° /s	450° /s	300° /s			
	250° /s	380° /s	280° /s	200° /s	240° /s	250° /s
	–	–				
	360° /s	520° /s	360° /s	330° /s		360° /s
	454° /s	550° /s		470° /s		
	343° /s	550° /s		470° /s		
	707° /s	1000° /s		740° /s		
	10kg	7kg		10kg		
	–	–				
	17.9N·m	16.9N·m		20N·m		
	17.9N·m	16.9N·m		20N·m		
	10.4N·m	9.4N·m		10.4N·m		
	0.47kg·m^2	0.49kg·m^2		0.6kg·m^2		
	0.47kg·m^2	0.49kg·m^2		0.6kg·m^2		
	0.15kg·m^2	0.15kg·m^2		0.2kg·m^2		
	723mm	723mm	912mm	1,202mm	912mm	723mm
	±0.03mm	±0.015mm	±0.02mm	±0.025mm	±0.02mm	
	0 to 45˚C/20 to 85% RH (without condensation)					
	0.5 G or less					
	Floor, inverted mount	Floor, wall, inverted, tilted mount*5		Floor, inverted mount		
	IP67 equivalent					
	36kg	41kg	43kg	55kg	54kg	41kg
	0.4kVA	0.7kVA	0.8kVA	0.8kVA	0.8kVA	0.8kVA
	CFDs	CFDs/CFDq	CFDs/CFDq	CFDs/CFDq	CFDs/CFDq	CFDs/CFDq
						

1 [N·m] = 1/9.8 [kgf·m]

LIST OF SPECIFICATIONS

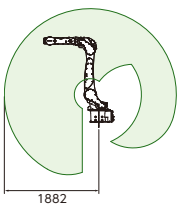
Type				MZ12	MZ12H	MZ15H	MZ12W	MZ25
No. of axes				6			6	6
Max. working envelope	Arm	J1	Swivel 1	±170°			±95°	±170°
		J2	Horizontal	−160~+90°			+180~−70°	−150~+105°
		J7	Swivel 2	–			–	–
		J3	Vertical	−147~+210°			+210°~−147°	−161~+289°
	Wrist	J4	Rotation 2	±190°			±190°	±190°
		J5	Bend	±140°		±135°	±135°	±145°
		J6	Rotation 1	±360°			±360°	±360°
Max. speed	Arm	J1	Swivel 1	260°/s			260°/s	210°/s
		J2	Horizontal	230°/s			230°/s	185°/s
		J7	Swivel 2	–			–	–
		J3	Vertical	260°/s			260°/s	270°/s
	Wrist	J4	Rotation 2	470°/s			470°/s	420°/s
		J5	Bend	470°/s		280°/s	280°/s	420°/s
		J6	Rotation 1	700°/s	740°/s	620°/s	620°/s	672°/s
Maximum load			Wrist	12kg		15kg	12kg	25kg
			Load capacity on forearm*1	–			–	–
Allowable static load torque for wrist		J4	Rotation 2	25N·m	26.5N·m	35N·m	55N·m	52N·m
		J5	Bend	25N·m	26.5N·m	35N·m	55N·m	52N·m
		J6	Rotation 1	9.8N·m	12N·m	15N·m	50N·m	32N·m
Allowable moment of inertia for wrist		J4	Rotation 2	0.7kg·m^2	0.9kg·m^2	1.6kg·m^2	3kg·m^2	2.4kg·m^2
		J5	Bend	0.7kg·m^2	0.9kg·m^2	1.6kg·m^2	3kg·m^2	2.4kg·m^2
		J6	Rotation 1	0.2kg·m^2	0.3kg·m^2	0.8kg·m^2	2.6kg·m^2	1.3kg·m^2
Maximum reach				1,454mm			1,564mm	1,882mm
Pose repeatability				±0.04mm			±0.04mm	±0.05mm
Ambient temperature*2/ humidity				0 to 45°C/20 to 85% RH (without condensation)				
Vibration				0.5 G or less				
Installation				Floor, inverted, tilted mount		Floor, inverted mount	Floor, inverted, tilted mount	
Ingress protection				IP67 equivalent				
Weight				160kg	165kg	165kg	205kg	250kg
Power consumption				1.8kVA		1.8kVA	2.0kVA	2.55kVA
Supported Controller				CFDs	CFDs	CFDs	CFDs	FD18/FD20
Working envelope								

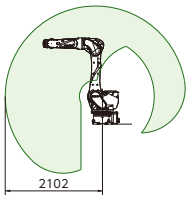
* Maximum speeds are maximum values, they will vary depending on the wrist load conditions and operating program.
*1: This value changes by placement and load conditions of a wrist.
*2: Using at 1,000 m or lower sea level. Ambient temperature has limitations when allowable altitude is exceeded.

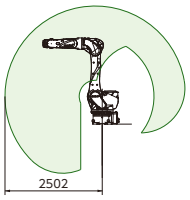


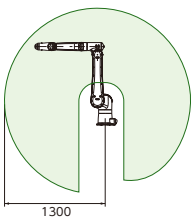



	MZ35S	MZ35F	MZ50F	MZ70F	MZ50LF	CZ10
	6	6				6
	±170°	±180°				±170°
	−150~+105°	−135~+80°				−75~+225°
	–	–				–
	−161~+289°	−143.5~+260°				−77~+227°
	±190°	±190°				±180°
	±145°	±145°				±170°
	±360°	±360°				±360°
	210° /s	188° /s	185° /s	180° /s		120° /s
	140° /s	180° /s		145° /s	140° /s	120° /s
	–	–				–
	225° /s	195° /s	185° /s	170° /s	180° /s	180° /s
	350° /s	280° /s	260° /s	240° /s	260° /s	180° /s
	260° /s	310° /s	260° /s	240° /s	260° /s	180° /s
	400° /s	420° /s	370° /s	350° /s	370° /s	180° /s
	35kg	35kg	50kg	70kg	50kg	10kg
	–	–				–
	110N·m	165N·m	216N·m	309N·m	216N·m	25.9N·m
	110N·m	165N·m	216N·m	309N·m	216N·m	25.9N·m
	60N·m	102N·m	147N·m	170N·m	147N·m	5.9N·m
	5kg·m^2	16kg·m^2	30kg·m^2	30kg·m^2	30kg·m^2	0.75kg·m^2
	5kg·m^2	16kg·m^2	30kg·m^2	30kg·m^2	30kg·m^2	0.75kg·m^2
	1.5kg·m^2	5kg·m^2	12kg·m^2	12kg·m^2	12kg·m^2	0.08kg·m^2
	1,882mm	2,102mm			2,502mm	1,300mm
	±0.05mm	±0.06mm				±0.1mm
	0 to 45˚C/20 to 85% RH (without condensation)					
	0.5 G or less					
	Floor, inverted, tilted mount	Floor, inverted mount				Floor, inverted mount
	IP67 equivalent					IP65 equivalent
	250kg	593kg			611kg	61kg
	2.55kVA	2.17kVA				1kVA
	FD18/FD20	FD18/FD20			FD18/FD20	CCZ







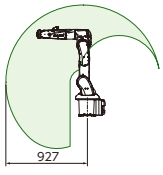
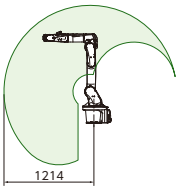
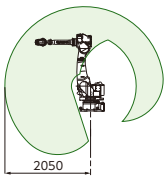


1 [N·m] = 1/9.8 [kgf·m]

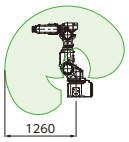
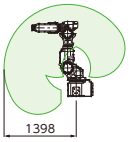
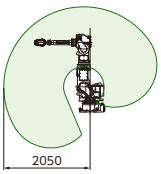
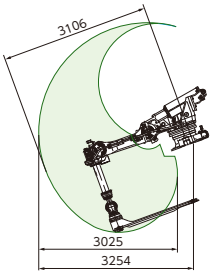
LIST OF SPECIFICATIONS





Type				MZ Collaborative Robot 5kg Payload	MZ Collaborative Robot 12kg Payload	MC35	MC50	MC70
No. of axes				6		6		
Max. working envelope	Arm	J1	Swivel 1	±170°		±165°		
		J2	Horizontal	−135~+80°		−135~+80°		
		J7	Swivel 2	–		–		
		J3	Vertical	−136~+90°	−153~+157°	−146~+260°		
	Wrist	J4	Rotation 2	±190°	±190°	±360°		
		J5	Bend	±120°	±120°	±125°		
		J6	Rotation 1	±360°	±360°	±450°		
Max. speed	Arm	J1	Swivel 1	270°/s	120°/s	185°/s	180°/s	175°/s
		J2	Horizontal	245°/s	120°/s	180°/s		145°/s
		J7	Swivel 2	–	–	–		
		J3	Vertical	310°/s	180°/s	190°/s	180°/s	165°/s
	Wrist	J4	Rotation 2	550°/s	440°/s	305°/s	255°/s	235°/s
		J5	Bend	550°/s	440°/s	305°/s	255°/s	235°/s
		J6	Rotation 1	950°/s	700°/s	420°/s	370°/s	350°/s
Maximum load			Wrist	5kg	12kg	35kg	50kg	70kg
			Load capacity on forearm*1	–	–	15kg		
Allowable static load torque for wrist		J4	Rotation 2	16.9N·m	20N·m	160N·m	210N·m	300N·m
		J5	Bend	16.9N·m	20N·m	160N·m	210N·m	300N·m
		J6	Rotation 1	9.4N·m	10.4N·m	90N·m	130N·m	150N·m
Allowable moment of inertia for wrist		J4	Rotation 2	0.49kg·m^2	0.60kg·m^2	16kg·m^2	30kg·m^2	
		J5	Bend	0.49kg·m^2	0.60kg·m^2	16kg·m^2	30kg·m^2	
		J6	Rotation 1	0.15kg·m^2	0.20kg·m^2	5kg·m^2	12kg·m^2	
Maximum reach				927mm	1,214mm	2,050mm		
Pose repeatability				±0.020mm	±0.025mm	±0.07mm		
Ambient temperature*2/ humidity				0 to 40°C/20 to 85% RH (without condensation)		0 to 45°C/20 to 85% RH (without condensation)		
Vibration				0.5 G or less				
Installation				Floor	Floor, inverted mount	Floor mount (OP: inverted, wall, tilted)		
Ingress protection				IP67 equivalent		Wrist: IP67 equivalent, main body: IP54 equivalent (OP: IP65/67 equivalent)		
Weight				53kg	66kg	640kg		
Power consumption				0.8kVA		5kVA		
Supported Controller				CFDs	CFDs	FD18/FD20	FD18/FD20	FD18/FD20
Working envelope								

* Maximum speeds are maximum values, they will vary depending on the wrist load conditions and operating program.
*1: This value changes by placement and load conditions of a wrist.
*2: Using at 1,000 m or lower sea level. Ambient temperature has limitations when allowable altitude is exceeded.

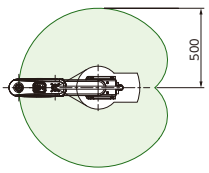
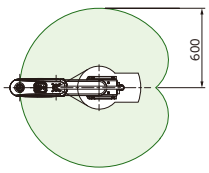
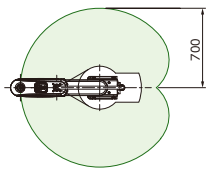
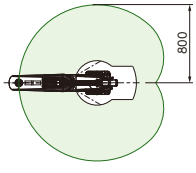
	MR20	MR20L	MR35	MR50	ST210TP-01
					
	7		7		7
	±180°		±165°		±180°
	−120~+55°		−120~+55°		−35~+120°
	±180°		±190°		(Press arm link) ±65°
	−166~+135°		−146~+140°		−96~+210°
	±180°		±360°		±360°
	±135°	±139°	±125°		±120°
	±360°		±450°		±360°
	170° /s		180° /s	175° /s	110° /s
	170° /s		175° /s	140° /s	90° /s
	170° /s		130° /s		(Press arm link) 120° /s
	170° /s		180° /s	165° /s	95° /s
	250° /s	360° /s	305° /s	255° /s	130° /s
	250° /s	360° /s	305° /s	255° /s	130° /s
	300° /s	600° /s	420° /s	370° /s	250° /s
	20kg		35kg	50kg	80kg
	–		15kg		30kg
	80.8N·m	49N·m	160N·m	210N·m	–
	80.8N·m	49N·m	160N·m	210N·m	–
	44.1N·m	23.5N·m	90N·m	130N·m	–
	6kg·m^2	1.6kg·m^2	16kg·m^2	30kg·m^2	J7 axis rotation 80kg·m^2
	6kg·m^2	1.6kg·m^2	16kg·m^2	30kg·m^2	
	2.3kg·m^2	0.8kg·m^2	5kg·m^2	12kg·m^2	
	1,260mm	1,398mm	2,050mm		3,106mm
	±0.06mm		±0.07mm		±0.3mm
	0 to 45˚C/20 to 85% RH (without condensation)				
	0.5 G or less				
	Floor, inverted mount		Floor mount(OP: inverted, wall, tilted)		Shelf mount (installed at 20° angle)
	IP65 equivalent		IP67 equivalent		–
	230kg		745kg		1,650kg
	1kVA		4.1kVA		7kVA
	FD18/FD20	FD18/FD20	FD18/FD20	FD18/FD20	FD18/FD20
					

1 [N·m] = 1/9.8 [kgf·m]

LIST OF SPECIFICATIONS





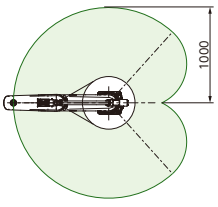
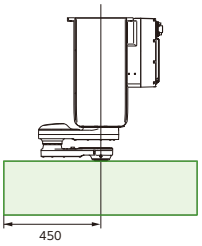
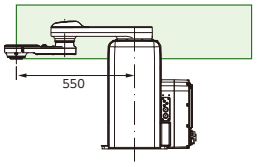
Type			EC06-5020-01	EC06-6020-01	EC06-7020-01	EC10-8020-01	EC10-8030-01
No. of axes			4			4	
Max. working envelope	J1	Swivel 1	±140°			±132°	
	J2	Swivel 2	±150°			±150°	
	J3	Vertical	200mm			200mm	300mm
	J4	Rotation	±360°			±360°	
Max. speed	J1	Swivel 1	420°/s			340°/s	
	J2	Swivel 2	720°/s			630°/s	
	J3	Vertical	1,100mm/s			1,100mm/s	
	J4	Rotation	2660°/s			2,700°/s	
Maximum Payload			6kg (3kg rated)			10kg (rated 5kg, conditional 12kg)	
Allowable moment of inertia for wrist	J4	Rotation	0.05kg·m² (0.01kg·m² rated)			0.02kg·m²	
Maximum reach			500mm	600mm	700mm	800mm	
Pose repeatability			±0.02mm			±0.025mm	
Ambient temperature*1/ humidity			0 to 40°C/20 to 80% RH (without condensation)			5 to 40°C/20 to 80% RH (without condensation)	
Vibration			0.5 G or less (4.9m/s²)			0.5 G or less	
Installation			Floor mount				
Ingress protection			IP20			IP20 equivalent	
Weight			17kg	17kg	18kg	41kg	
Power consumption			0.5kVA			0.8kVA	
Supported Controller			CFDs	CFDs	CFDs	CFDs	
Working envelope							

* Maximum speeds are maximum values, they will vary depending on the wrist load conditions and operating program.
*1: Using at 1,000 m or lower sea level. Ambient temperature has limitations when allowable altitude is exceeded.

1 [N·m] = 1/9.8 [kgf·m]





Type			EC10-A020-01	EC10-A030-01	EZ03V4-04	EZ03F4-04
No. of axes			4		4	
Max. working envelope*1	J1	Swivel 1	±132°		Vertical: 250/150mm*3	
	J2	Swivel 2	±150°		Swivel 1: ±170°	
	J3	Vertical	200mm	300mm	Swivel 2: ±180°	Swivel 2: ±145°
	J4	Rotation	±360°		±360°	
Max. speed*1	J1	Swivel 1	300°/s		Vertical: 1,400/1,200mm/s*3	
	J2	Swivel 2	620°/s		Swivel 1: 450°/s	
	J3	Vertical	1,100mm/s		Swivel 2: 720°/s	
	J4	Rotation	2,700°/s		2,400°/s	
Maximum Payload			10kg (rated 5kg, conditional 12kg)		3kg (2kg rated)	
Allowable moment of inertia for wrist	J4	Rotation	0.02kg·m^2		0.05kg·m^2	
Maximum reach			1,000mm		450mm	550mm
Pose repeatability			±0.025mm		±0.014mm	
Ambient temperature*2/ humidity			5 to 40°C/20 to 80% RH (without condensation)		0 to 45°C/20 to 85% RH (without condensation)	
Vibration			0.5 G or less		0.5 G or less (4.9m/s^2)	
Installation			Floor mount		Inverted mount	Floor mount
Ingress protection			IP20 equivalent		IP20	
Weight			44kg		40kg	41kg
Power consumption			0.8kVA		0.6kVA	
Supported Controller			CFDs		CFDs	CFDs
Working envelope						

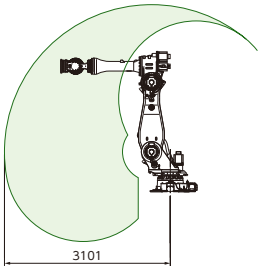
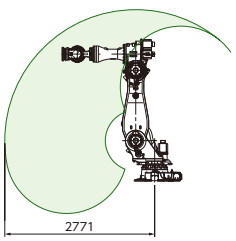
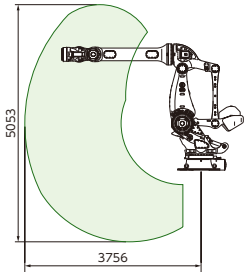
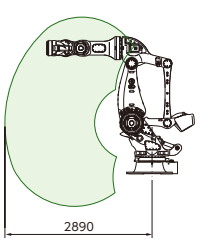
* Maximum speeds are maximum values, they will vary depending on the wrist load conditions and operating program.
*1: EZ03V4-04 and EZ03F4-04 have different motion range. J1: up/down, J2: swivel 1, J3: swivel 2.
*2: Using at 1,000 m or lower sea level. Ambient temperature has limitations when allowable altitude is exceeded.
*3: There are two types of maximum operating envelopes: 250 mm and 150 mm. The 250 mm has a maximum speed of 1,400 mm/s. The 150 mm has a maximum speed of 1,200 mm/s.

1 [N·m] = 1/9.8 [kgf·m]

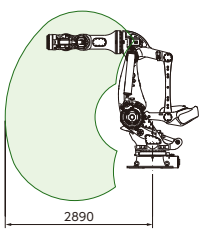
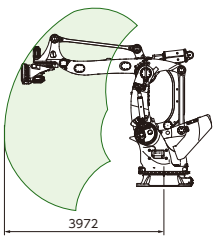
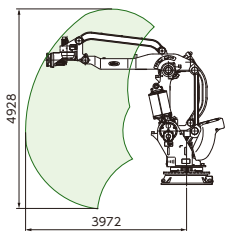
LIST OF SPECIFICATIONS





Type				MC280L	MC350	MC400L	MC600
No. of axes				6			
Max. working envelope	Arm	J1	Swivel 1	±180°			
		J2	Horizontal	−100~+40°		−105~+60°	
		J7	Swivel 2	–			
		J3	Vertical	−147~+130°	−180~+130°	−130~+30°	−140~+30°
	Wrist	J4	Rotation 2	±360°		±210°	
		J5	Bend	±125°		±120°	
		J6	Rotation 1	±360°		±360° *1	
Max. speed	Arm	J1	Swivel 1	105°/s		90°/s	
		J2	Horizontal	105°/s	95°/s	90°/s	
		J7	Swivel 2	–			
		J3	Vertical	95°/s		90°/s	
	Wrist	J4	Rotation 2	120°/s	110°/s		
		J5	Bend	120°/s	110°/s		
		J6	Rotation 1	200°/s	180°/s		
Maximum load			Wrist	280kg	350kg	400kg	600kg
			Load capacity on forearm*2	25kg	50kg		
Allowable static load torque for wrist		J4	Rotation 2	1,921N·m	2,750N·m	3,450N·m	
		J5	Bend	1,921N·m	2,750N·m	3,450N·m	
		J6	Rotation 1	988N·m	1,235N·m	1,725N·m	
Allowable moment of inertia for wrist		J4	Rotation 2	400kg·m^2		600kg·m^2	
		J5	Bend	400kg·m^2		600kg·m^2	
		J6	Rotation 1	250kg·m^2		400kg·m^2	
Maximum reach				3,101mm	2,771mm	3,756mm	2,890mm
Pose repeatability				±0.09mm			
Ambient temperature*3/ humidity				0 to 45°C/20 to 85% RH (without condensation)			
Vibration				0.5 G or less			
Installation				Floor mount			
Ingress protection				–			
Weight				1,660kg	1,620kg	3,400kg	3,300kg
Power consumption				9kVA	8.6kVA	19.3kVA	
Supported Controller				FD20	FD20	FD20	FD20
Working envelope							

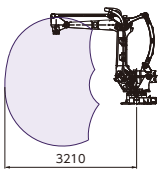
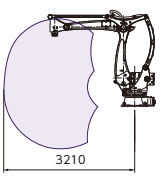
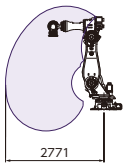
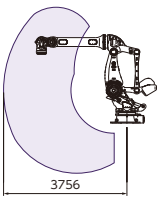
*1: The initial settings are ±210°. When passing cable through the hollow part of the 6th axis, use a range of ±210°.
When a cable is not passed through, the operating envelope can be extended to a maximum of ±360°, depending on the usage conditions.
*2: This value changes by placement and load conditions of a wrist.
*3: Using at 1,000 m or lower sea level. Ambient temperature has limitations when allowable altitude is exceeded.

			
	MC700	**MC1000DL**	**SC700DL**
		6	
	±180°	±160°	±160°
	−105~+60°	−85~+45°	−85~+45°
		–	
	−140~+30°	−90~+45°	−90~+40°
	±210°	−9.7~+90° (+9.7°)*4	−10~+90°
	±120°	±125° *5	±125°
	±360° *1	±9.7°	±10°
	80° /s	45° /s	45° /s
	80° /s	40° /s	30° /s
		–	
	80° /s	40° /s	30° /s
	100° /s	20° /s*6	30° /s
	100° /s	65° /s	50° /s
	160° /s	70° /s	30° /s
	700kg	1,000kg	700kg
	25kg	–	–
	3,450N·m	21,000N·m	13,800N·m
	3,450N·m	–	3,920N·m
	1,725N·m	4,410N·m	2,940N·m
	600kg·m^2	5,200kg·m^2	3,000kg·m^2
	600kg·m^2	4,000kg·m^2	1,800kg·m^2
	400kg·m^2	1,740kg·m^2	1,000kg·m^2
	2,890mm	3,972mm	3,972mm
	±0.09mm		±0.5mm
	0 to 45˚C/20 to 85% RH (without condensation)		
	0.5 G or less		
	Floor mount		
		–	
	3,320kg	9,000kg	7,000kg
	9.3kVA	19kVA	7kVA
	FD20	FD11/FD20	FD20
			

*4: Max motion range of axis 4 varies due to the wrist payload weight. Wrist load 300 kg <: -9.7°~+90°, Wrist load 300 kg ≥: -9.7°~+9.7°
*5: In order to make axis 5 move, axis 4 must be in ±4° from ground level when payload is installed on the wrist.
*6: Axis 4 speed achieves to this value when wrist payload is less than 300 kg and motion range is enough wide.

1 [N·m] = 1/9.8 [kgf·m]

LIST OF SPECIFICATIONS

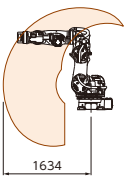
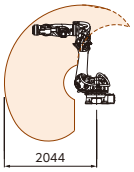
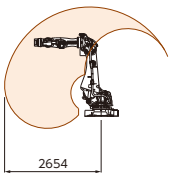
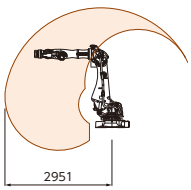
Type				LP130−01	LP130F	LP180−01	LP210	High-speed palletizing	MC470P	MC500P
										
No. of axes				4					6	5
Max. working envelope	Arm	J1	Swivel 1	±180°					±180°	±180°
		J2	Horizontal	−95~+41°	−94.5~+40.7°	−95~+41°		−95~+45°	−100~+40°	−105~+60°
		J7	Swivel 2	−					−	
		J3	Vertical	−117~+17°	−116.9~+17.2°	−117~+17°		−117.5~+17.5°	−180~+35°	−130~+30°
	Wrist	J4	Rotation 2	±360°					±360° *1	−
		J5	Bend	−					±125° *1	±120°
		J6	Rotation 1	−					±360°	
Max. speed	Arm	J1	Swivel 1	130° /s	145° /s	115° /s	105° /s	140° /s	105° /s	90° /s
		J2	Horizontal	115° /s		100° /s		125° /s	95° /s	90° /s
		J7	Swivel 2	−					−	
		J3	Vertical	115° /s		105° /s	100° /s	130° /s	95° /s	90° /s
	Wrist	J4	Rotation 2	400° /s	535° /s	360° /s	300° /s	400° /s	110° /s	−
		J5	Bend	−					110° /s	110° /s
		J6	Rotation 1	−					180° /s	180° /s
Maximum load		Wrist		130kg		180kg	210kg	180kg	470kg	500kg
		Load capacity on forearm*2		25kg					30kg	25kg
Allowable static load torque for wrist		J4	Rotation 2	−					2,750N·m	−
		J5	Bend	−					2,750N·m	3,450N·m
		J6	Rotation 1	−					0N·m	1,725N·m
Allowable moment of inertia for wrist		J4	Rotation 2	50kg·m²		69kg·m²	100kg·m²	69kg·m²	400kg·m²	−
		J5	Bend	−					400kg·m²	600kg·m²
		J6	Rotation 1	−					250kg·m²	400kg·m²
Maximum reach				3,210mm					2,771mm	3,756mm
Pose repeatability				±0.09mm						
Ambient temperature*3/ humidity				0 to 45°C/20 to 85% RH (without condensation)						
Vibration				0.5 G or less						
Installation				Floor mount						
Ingress protection				IP50 equivalent	−	IP50 equivalent		−	−	
Weight				1,150kg					1,620kg	3,350kg
Power consumption				6.2kVA					8.6kVA	9.7kVA
Supported Controller				FD20	FD20	FD20	FD20	FD20	FD20	FD20
Working envelope										

*1: Software limits the downward vertical range of axis 5 to ±5° .
Axis 4 can move ±360° and axis 5 can move ±125° only when the encoder correction screen or software limit settings screen is open.
*2: This value changes by placement and load conditions of a wrist.
*3: Using at 1,000 m or lower sea level. Ambient temperature has limitations when allowable altitude is exceeded.

1 [N·m] = 1/9.8 [kgf·m]






Type				SR series (Hollow)				
				AN100HS	AN100HB	AN100H	AN133H	AN133HL
No. of axes				6				
Max. working envelope	Arm	J1	Swivel 1	±180°				
		J2	Horizontal	−120~+60°		−80~+60°		
		J7	Swivel 2	–				
		J3	Vertical	−125~+90°	−151~+90°	−146.5~+150°		−133.4~+150°
	Wrist	J4	Rotation 2	±210°				
		J5	Bend	±125°				
		J6	Rotation 1	±210°				
Max. speed	Arm	J1	Swivel 1	136°/s		125°/s	120°/s	115°/s
		J2	Horizontal	115°/s			110°/s	105°/s
		J7	Swivel 2	–				
		J3	Vertical	160°/s		121°/s	118°/s	113°/s
	Wrist	J4	Rotation 2	210°/s	225°/s	210°/s		
		J5	Bend	175°/s				
		J6	Rotation 1	310°/s	315°/s	310°/s		
Maximum load			Wrist	100kg			133kg	
			Load capacity on forearm*1	20kg				
Allowable static load torque for wrist		J4	Rotation 2	830N·m	650N·m	830N·m		
		J5	Bend	830N·m	650N·m	830N·m		
		J6	Rotation 1	441N·m	315N·m	441N·m		
Allowable moment of inertia for wrist		J4	Rotation 2	85kg·m^2				
		J5	Bend	85kg·m^2				
		J6	Rotation 1	45kg·m^2				
Maximum reach				1,634mm	2,044mm	2,654mm		2,951mm
Pose repeatability				±0.06mm				
Ambient temperature*2/ humidity				0 to 45°C/20 to 85% RH (without condensation)				
Vibration				0.5 G or less				
Installation				Floor mount				
Ingress protection				IP54 equivalent				
Weight				690kg	750kg	1,040kg		1,070kg
Power consumption				7kVA				
Supported Controller				FD18/FD20	FD18/FD20	FD18/FD20	FD18/FD20	FD18/FD20
Working envelope				 1634	 2044	 2654		 2951

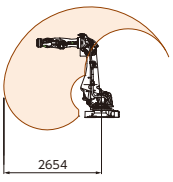
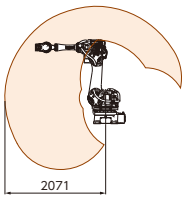
*1: This value changes by placement and load conditions of a wrist.
*2: Using at 1,000 m or lower sea level. Ambient temperature has limitations when allowable altitude is exceeded.

1 [N·m] = 1/9.8 [kgf·m]

LIST OF SPECIFICATIONS

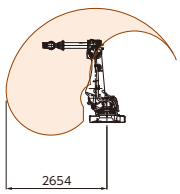
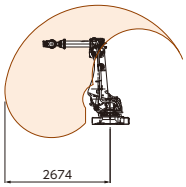
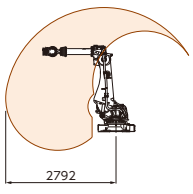
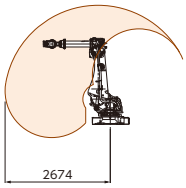




Type				SR series (Hollow) A166H	SR series (Hollow) A210H	SR series AN100B
No. of axes				6		
Max. working envelope	Arm	J1	Swivel 1	±180°		±180°
		J2	Horizontal	−80~+60°		−120~+60°
		J7	Swivel 2	–		–
		J3	Vertical	−146.5~+150°		−150~+180°
	Wrist	J4	Rotation 2	±210°		±360°
		J5	Bend	±125°		±135°
		J6	Rotation 1	±210°		±360°
Max. speed	Arm	J1	Swivel 1	120° /s	115° /s	136° /s
		J2	Horizontal	110° /s	105° /s	110° /s
		J7	Swivel 2	–		–
		J3	Vertical	115° /s	113° /s	130° /s
	Wrist	J4	Rotation 2	175° /s	130° /s	240° /s
		J5	Bend	171° /s	130° /s	233° /s
		J6	Rotation 1	280° /s	205° /s	351° /s
Maximum load			Wrist	166kg	210kg	100kg
			Load capacity on forearm*1	20kg		25kg/Max.45kg
Allowable static load torque for wrist		J4	Rotation 2	960N·m	1337N·m	580N·m
		J5	Bend	960N·m	1337N·m	580N·m
		J6	Rotation 1	520N·m	720N·m	290N·m
Allowable moment of inertia for wrist		J4	Rotation 2	100kg·m^2	200kg·m^2	45kg·m^2
		J5	Bend	100kg·m^2	200kg·m^2	45kg·m^2
		J6	Rotation 1	50kg·m^2	155kg·m^2	22.7kg·m^2
Maximum reach				2,654mm		2,071mm
Pose repeatability				±0.06mm		
Ambient temperature*2/ humidity				0 to 45°C/20 to 85% RH (without condensation)		
Vibration				0.5 G or less		
Installation				Floor mount		
Ingress protection				IP54 equivalent		Wrist has IP67 and main body has IP54 equivalent
Weight				1,100kg		690kg
Power consumption				7kVA		
Supported Controller				FD18/FD20	FD18/FD20	FD18/FD20
Working envelope						

*1: This value changes by placement and load conditions of a wrist.
*2: Using at 1,000 m or lower sea level. Ambient temperature has limitations when allowable altitude is exceeded.
*3: Equipped with a cable support on the arm, suitable for spot welding.

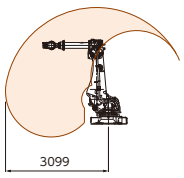
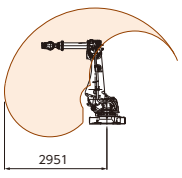
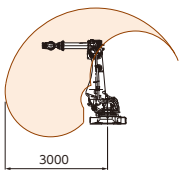
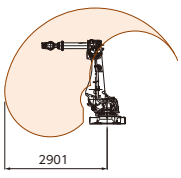


	SR series					
	AN100 (AN100-A) *3	AN166 (AN166-A) *3	AN210 (AN210-A) *3	AN240	AN250	A300
	6	6				6
	±180°	±180°				±180°
	−80~+60°	−80~+60°				−80~+60°
	–	–				–
	−146.5~+150°	−146.5~+150°			−140~+150°	−146.5~+150°
	±360 (±210)°	±360 (±210)°		±360°		±360°
	±135 (±120)°	±135 (±120)°	±130 (±120)°	±130°		±130°
	±360 (±205)°	±360 (±205)°		±360°		±360°
	136° /s	125° /s	115° /s	105° /s	100° /s	105° /s
	135° /s	115° /s	105° /s	90° /s		90° /s
	–	–				–
	135° /s	121° /s	113° /s	100° /s	95° /s	90° /s
	240° /s	180° /s	140° /s	130° /s	125° /s	120° /s
	233° /s	173° /s	133° /s	125° /s		120° /s
	351° /s	260° /s	200° /s	195° /s	190° /s	200° /s
	100kg	166kg	210kg	240kg	250kg	300kg
	45kg/Max.90kg (15kg/Max.60kg)			20kg/Max.45kg		25kg/Max.50kg
	580N·m	951N·m	1,337N·m			1,830N·m
	580N·m	951N·m	1,337N·m			1,830N·m
	290N·m	490N·m	720N·m			930N·m
	60kg·m^2	88.9kg·m^2	141.1kg·m^2		225.4kg·m^2	330kg·m^2
	60kg·m^2	88.9kg·m^2	141.1kg·m^2		225.4kg·m^2	330kg·m^2
	30kg·m^2	45kg·m^2	79kg·m^2		196kg·m^2	240kg·m^2
	2,654mm	2,654mm	2,674mm		2,792mm	2,674mm
	±0.06mm					±0.1mm
	0 to 45˚C/20 to 85% RH (without condensation)					
	0.5 G or less					
	Floor mount					
	Wrist has IP67 and main body has IP54 equivalent					
	960 (1,060)kg		990 (1,090)kg	990kg	1,030kg	1,170kg
	7kVA					8.1kVA
	FD18/FD20	FD18/FD20	FD18/FD20	FD18/FD20	FD18/FD20	FD20
						

1 [N·m] = 1/9.8 [kgf·m]

LIST OF SPECIFICATIONS



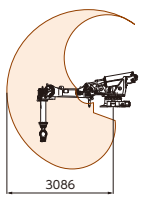
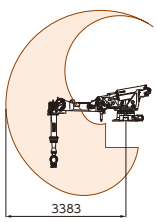
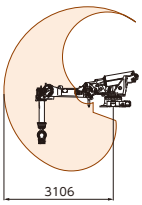
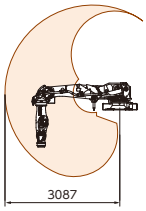
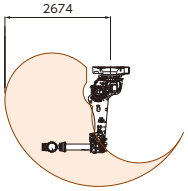
Type				SR series				
				AN120EL	AN133L	AN166L	AN210L	AN240L
No. of axes				6			6	
Max. working envelope	Arm	J1	Swivel 1	±180°			±180°	
		J2	Horizontal	−80~+60°			−80~+60°	
		J7	Swivel 2	–			–	
		J3	Vertical	−127.7~+150°	−133.4~+150°		−132.4~+150°	−135.8~+150°
	Wrist	J4	Rotation 2	±360°			±360°	
		J5	Bend	±135°			±130°	
		J6	Rotation 1	±360°			±360°	
Max. speed	Arm	J1	Swivel 1	115°/s	125°/s	115°/s	100°/s	
		J2	Horizontal	105°/s	115°/s	105°/s	90°/s	
		J7	Swivel 2	–			–	
		J3	Vertical	113°/s	121°/s	113°/s	95°/s	
	Wrist	J4	Rotation 2	140°/s			125°/s	
		J5	Bend	173°/s			125°/s	
		J6	Rotation 1	260°/s			190°/s	
Maximum load			Wrist	120kg	133kg	166kg	210kg	240kg
			Load capacity on forearm*1	45kg/Max.90kg			20kg	
Allowable static load torque for wrist		J4	Rotation 2	687N·m	800N·m	951N·m	1,000N·m	1,140N·m
		J5	Bend	687N·m	800N·m	951N·m	1,000N·m	1,140N·m
		J6	Rotation 1	353N·m	400N·m	490N·m	720N·m	720N·m
Allowable moment of inertia for wrist		J4	Rotation 2	60kg·m^2	76kg·m^2	88.9kg·m^2	141.1kg·m^2	
		J5	Bend	60kg·m^2	76kg·m^2	88.9kg·m^2	141.1kg·m^2	
		J6	Rotation 1	30kg·m^2	38kg·m^2	45kg·m^2	79kg·m^2	
Maximum reach				3,099mm	2,951mm		3,000mm	2,901mm
Pose repeatability				±0.06mm			±0.08mm	
Ambient temperature*2/ humidity				0 to 45°C/20 to 85% RH (without condensation)				
Vibration				0.5 G or less				
Installation				Floor mount				
Ingress protection				Wrist has IP67 and main body has IP54 equivalent				
Weight				985kg	980kg		1,050kg	
Power consumption				7kVA				
Supported Controller				FD18/FD20	FD18/FD20	FD18/FD20	FD18/FD20	
Working envelope				 3099	 2951		 3000	 2901

*1: This value changes by placement and load conditions of a wrist.
*2: Using at 1,000 m or lower sea level. Ambient temperature has limitations when allowable altitude is exceeded.
*3: Equipped with a cable support on the arm, suitable for spot welding.





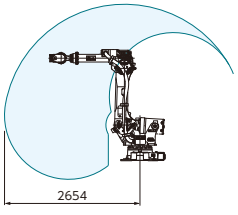
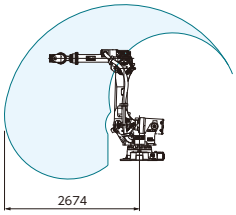


	SR series			SR series (Hollow)		SR series
	AN166T*3	AN166TL	AN210T*3	A166HT	A210HT	A210V
	6			6		6
	±180°			±180°		±165°
	−65~+120°			−65~+120°		−80~+60°
	–			–		–
	−106~+210°	−90~+210°	−106~+210°	−112~+210°		−146.5~+150°
	±360 (±210)°	±360°	±360 (±210)°	±210°		±360°
	±135 (±120)°	±135°	±130 (±120)°	±125°		±130°
	±360 (±205)°			±210°		±360°
	110° /s	105° /s	100° /s	120° /s	115° /s	115° /s
	110° /s	90° /s		110° /s	105° /s	105° /s
	–			–		–
	115° /s		100° /s	115° /s	113° /s	113° /s
	180° /s	140° /s	140° /s	175° /s	130° /s	140° /s
	173° /s		133° /s	171° /s	130° /s	133° /s
	260° /s		200° /s	280° /s	205° /s	200° /s
	166kg		210kg	166kg	210kg	210kg
	45kg/Max.90kg (15kg/Max.60kg)			20kg		45kg/Max.90kg
	951N·m		1,337N·m	960N·m	1,337N·m	1,337N·m
	951N·m		1,337N·m	960N·m	1,337N·m	1,337N·m
	490N·m		720N·m	520N·m	720N·m	720N·m
	88.9kg·m^2		141.1kg·m^2	100kg·m^2	200kg·m^2	141.1kg·m^2
	88.9kg·m^2		141.1kg·m^2	100kg·m^2	200kg·m^2	141.1kg·m^2
	45kg·m^2		79kg·m^2	50kg·m^2	155kg·m^2	79kg·m^2
	3,086mm	3,383mm	3,106mm	3,087mm		2,674mm
	±0.08mm			±0.08mm		±0.15mm
	0 to 45˚C/20 to 85% RH (without condensation)					
	0.5 G or less					
	Shelf mount					Inverted mount
	Wrist has IP67 and main body has IP54 equivalent			IP54 equivalent		Wrist has IP67 and main body has IP54 equivalent
	1,210 (1,310)kg	1,240kg	1,250 (1,350)kg	1,160kg		990kg
	7kVA					
	FD18/FD20	FD18/FD20	FD18/FD20	FD18/FD20	FD18/FD20	FD18/FD20
						

1 [N·m] = 1/9.8 [kgf·m]

LIST OF SPECIFICATIONS



Type				ST133CF	ST166CF	ST210CF
No. of axes				6		
Max. working envelope	Arm	J1	Swivel 1	±165°		
		J2	Horizontal	−80~+60°		
		J7	Swivel 2	–		
		J3	Vertical	−137~+150°		
	Wrist	J4	Rotation 2	±360°		
		J5	Bend	±135°		±130°
		J6	Rotation 1	±360°		
Max. speed	Arm	J1	Swivel 1	130°/s	110°/s	100°/s
		J2	Horizontal	130°/s	110°/s	90°/s
		J7	Swivel 2	–		
		J3	Vertical	130°/s	110°/s	95°/s
	Wrist	J4	Rotation 2	230°/s	170°/s	130°/s
		J5	Bend	230°/s	170°/s	130°/s
		J6	Rotation 1	305°/s	260°/s	200°/s
Maximum load			Wrist	133kg	166kg	210kg
			Load capacity on forearm*1	70kg		
Allowable static load torque for wrist		J4	Rotation 2	745N·m	951N·m	1,337N·m
		J5	Bend	745N·m	951N·m	1,337N·m
		J6	Rotation 1	411N·m	490N·m	720N·m
Allowable moment of inertia for wrist		J4	Rotation 2	60.9kg·m^2	88.9kg·m^2	141.1kg·m^2
		J5	Bend	60.9kg·m^2	88.9kg·m^2	141.1kg·m^2
		J6	Rotation 1	30.2kg·m^2	45kg·m^2	79kg·m^2
Maximum reach				2,654mm		2,674mm
Pose repeatability				±0.06mm		
Ambient temperature*2/ humidity				10 to 45°C/20 to 85% RH (without condensation)		
Vibration				0.5 G or less		
Installation				Floor mount		
Ingress protection				–		
Weight				1,120kg		1,160kg
Power consumption				4.2kVA		
Clean rating*3				Class 6		
Supported Controller				FD20	FD20	FD20
Working envelope						

*1: This value changes by placement and load conditions of a wrist.
*2: Using at 1,000 m or lower sea level. Ambient temperature has limitations when allowable altitude is exceeded.
*3: Clean rating complies with ISO 14644-1

1 [N·m] = 1/9.8 [kgf·m]

SUPPORT SOFTWARE/FEATURES

To assist with setup, operation, and maintenance, various functions such as PC software and software PLC can be programmed and simulations are prepared.

FD on Desk Ⅱ (Programming PC software)

Simulation and offline programming product for NACHI robots

FD on Desk Ⅱ Pro — Options

FD on Desk Ⅱ Regular — Options

FD on Desk Ⅱ Light — Standard *CFD controller only

Grade		Pro		Regular		Light	Trial version (Demo Licence)
Type No.		FDONDESK2-PRO	FDONDESK2-PRO-D	FDONDESK2-REG	FDONDESK2-REG-D	–	–
Licence certification		Licence file	USB dongle	Licence file	USB dongle	Actual Robot Controller required	ASK
CFD	Offline mode	○		○		○	△
	Monitor mode	○		○		○	×
	View mode	○		○		○	×
FD	Offline mode	○		○		△	△
	Monitor mode	○		○		△	×
	View mode	○		○		△	×
Program generation function from CAD		○		×		×	×
Multiple controller operation		○		×		×	×
Save shape file		○		○		○	×

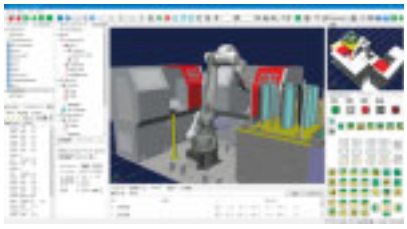
○ : Usableness
△ : Enable to use in operator level BEGINNER. (Applied to MZ, ES and EZ)
× : Unusableness

FD on Desk Ⅲ (Programming PC software) Options

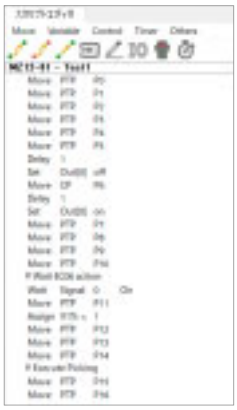
PC software that makes it easy and smooth for robot applications with programming and simulation functions

Compatible controller: FD/CFD/CFDs/CFDq/FD18/FD20

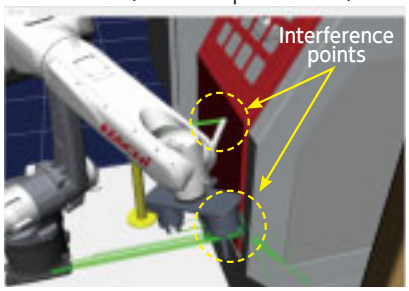
- Supports reading of large-scale files such as peripheral devices.



- Visual programming



- High performance interference surveillance, video output function, etc.



User task functions Standard

Possible to program processes in parallel with robot operations

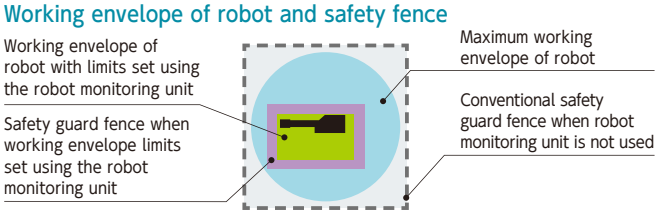
- Time consuming calculations and robot operations are processed in parallel to reduce cycle times
- Various statuses are shown on the screen on the teach pendant

Robot Monitoring Unit RMU Options

- Safety control unit monitors robot conditions (position and speed)
- Possible to reduce costs and space
- Facilities are safer because the positions and speeds of robots are monitored

→Limit working envelope of robot
→Minimize size of safety fences

Working envelope of robot and safety fence



FD-ST easy Options

PC software that can teach robot operation programs and simulate operation program on a PC.

- Automatic path generation function specifies edges on the workpiece and automatically generate teaching points for robot to work with.
- Provides an advanced 3D Viewer for importing complex data, viewing scene graphs, and drawing in high definition



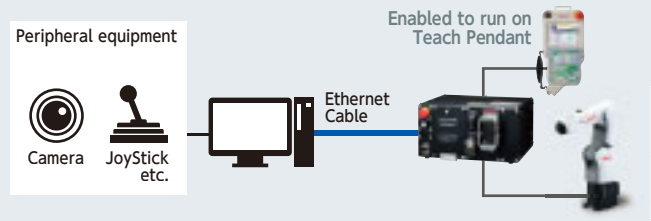
Software PLC Standard

Incorporated PLC functionality into robot control software

- Eliminates the necessity of external PLC and reduces equipment costs
- Programming is also possible on teach pendant

OpenNR-IF Options

Users can create their own application software to connect to the FD controller and external devices (cameras, etc.).



Monitoring function of robot operation

- Indication of robot move command
- Acquisition of robot status (Input/output signals, Variables, Shift Values)

Robot systems

System products

NACHI's system engineering team puts its wealth of experience to work for you, providing system solutions that are easy to use along with high-cost performance.

Peripheral devices for the robot

NACHI provides proven highly-reliable robot application devices.

Offline program system

Robot operations can be simulated before installation to check performance. Creating an operation program beforehand allows the robot to be directly installed in the assembly line.



Post-installation service

From setup through startup

NACHI's skilled technicians provide support during the installation process, from setup to connection, teaching, movement, and supervision, until the line is fully operational.

Quick response to emergency calls

NACHI's specialized technicians are "on-call" to immediately respond to customer emergencies.

Reliable support from remote locations

Robots can be operated remotely when placed online, allowing specialized service professionals to provide accurate support to worldwide locations.

The right parts when you need them

Our service locations always have important maintenance parts in stock. We can deliver the parts you need quickly.

Periodic inspections

As a trusted and reliable partner, NACHI performs periodic inspections to extend the life of your robot.

Overhauls

NACHI provides a selection of services suited to the conditions of your robot and performs overhauls to ensure that your robot is always in the best condition. NACHI can also provide temporary replacement robots to keep your line operating during repairs.





Overhauls

Training

Robot training course

Fully utilize your Nachi robots, we have robot training classes which use our own curriculum to teach the basics of operating and maintaining robots.
We support a wide range of robots from compact MZ series to large robots and offer training classes tailored to your needs. We will flexibly comply to your request, please feel free to contact us.

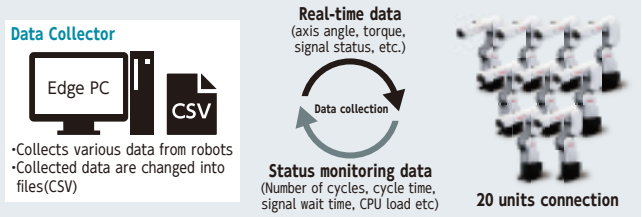




NR: connect

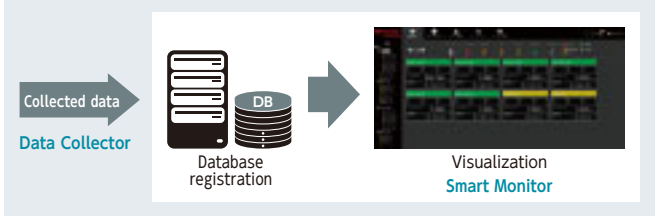
Software enables to collection of robot operation data and visualizations.
By connecting robots to NR: connect, it is possible to collect, visualize operational status data* and improve maintainability.
*Real-time data: 23 items such as "each axis angle" and "each axis current"
Condition monitoring data: 56 items such as "cycle time," "life time" and "CPU load"

Data Collector (Robot data collection software) Options



- Constantly monitor the error status of robot controller and automatically save the status when an error occurs
- The output data can be imported to the customer's core system, etc.

Smart Monitor (robot data monitoring software) Options



- Display the data collected by Data Collector clearly on a screen
- Intuitive UI gives you easy access to the information you need so that robot operation status can be checked in real-time.
- When an error occurs, the operating status before and after the error is displayed graphically and makes it easy to understand the situation before and after the error.

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NACHI

NACHI-FUJIKOSHI CORP.

Safety precautions

- Before using any robot, review all documentation including operating instructions and other attached documents. Familiarize yourself with the contents in order to ensure proper robot operation.
- When a robot is to be used for an application where robot operation may directly threaten the life or cause physical harm to personnel, a careful examination of its intended use is required. Contact a NACHI-FUJIKOSHI sales representative to provide details of the intended use. Obtain proper training prior to operating robot.
- Photos used in this document show the robots without safety fences, equipment, and devices that are required to comply with the applicable laws and regulations for ensuring safety. These photos are only provided to illustrate what is being described.
- The external appearances, specifications, etc. of the products portrayed in this catalog are subject to change without notice due to improvements in performance.

CATALOG NO.	R7001E-29

2026.11.X-MD-ABE