

3D Milling Machine MDX-650 SPECIFICATIONS	
T-slot (XY) table size	700 mm x 480 mm (27-1/2 x 18-7/8 in.)
Max. cutting area*	650 mm (X) x 450 mm (Y) x 155 mm (Z) (25-9/16(X) x 17-11/16(Y) x 6-1/16(Z) in.)
XYZ motor	AC servo motor
Feed rate	X, Y, Z-axis: Max. 85 mm/sec. (3-3/8 in./sec.)
Acceleration	0.3G, 0.1G, 0.05G
Software resolution	[When RML-1 has been selected] 0.01 mm/step (0.00039 in.) [When NC codes has been selected] 0.001 mm/step (0.000039 in.) Note that the measurement unit for positioning coordinates is 0.01 mm/step(0.00039 in.).
Mechanical resolution	0.001 mm/step
Spindle motor	DC brushless motor Max. 400W (when with high-torque spindle)
Revolution speed	[High torque spindle and High precision spindle] 3000 to 12000 rpm [High speed spindle] 5000 to 20000 rpm (Variable manually or by the command set)
Tool chuck	Collet or Cutter holder system
Positioning accuracy	±0.1 mm (0.00394 in.) / 300 mm (11-13/16 in.) (Under no-load conditions)
Repeat accuracy	±0.05 mm (0.00197 in.) (Under no-load conditions)
Origin-point reproducibility (when the power is switched on/off)	±0.08 mm (0.00315 in.)
Possible table load weight	[0.3G] 12 kg (26.5 lb.) or less [0.05G] 20 kg (44.1 lb.) or less
Interface	Parallel (in compliance with the specification of Centronics) Serial (under RS-232C standard)
Buffer size	2 Mbyte (Replot buffer: [RML-1] 2 Mbyte [NC codes] Max. 2 Mbyte (end-user setting))
Instruction system	RML-1 (mode1, mode2) or NC codes supported by the MDX-650 (Selectable through display operation)
Power consumption	6.5 A / 117 V 3.5 A / 220 to 230 V 3.5 A / 230 to 240 V
Weight / Dimensions	120 kg (264.5 lb.) / 930 mm (W) x 1085 mm (D) x 870 mm (H) (36-5/8(W) x 42-3/4(D) x 34-5/16(H) in.)
Operation temperature / Operation humidity	5 to 40 °C (41 to 104 °F) / 35 to 80% (no condensation)
Accessories	T-slot clamps: 4, Spanner: 1 (10 mm (3/8 in.)), Z0 position sensor: 1, Power cord: 1, Belt for high-torque spindle: 1, Key connector: 1, Roland Software Package CD-ROM: 1, Hexagonal wrench: 1, Ferrite core: 1, NC-code PROGRAMMER'S MANUAL: 1, USER'S MANUAL: 3 (1. Setup & Maintenance, 2. Cutting Using the Included Software, 3. Cutting Using NC codes)

\*When only the ATC is installed: 540(X) x 450 (Y) x 155(Z) mm (21-1/4(X) x 17-11/16(Y) x 6-1/16(Z) in. When the Rotary Axis Unit is installed, refer to the max. workpiece size in the ZCL-650 specifications.

#### ■ OPTIONS

Automatic Tool Changer ZAT-650 SPECIFICATIONS	
Number of tools housed*	4 or 8 when an optional expansion magazine is installed.
Maximum tool length	110 mm (4-5/16 in.)
Maximum tool diameter	10 mm (3/8 in.)
Tool-holder format	Taper shank: JBS4002 15T 7/24 taper Pull stud: JBS4002 15P (45°), special
Tool-selection method	Direct-changing type, fixed-address specification
Compatible compressed air**	Air pressure 0.7 to 1 Mpa, and Air volume 50 L/min. or more. Air tank capacity 60 L or more.
Spindle speed	3,000 to 12,000 rpm
Operation temperature / Operation humidity	5 to 40°C (41 to 104° F) / 35 to 80% (no condensation)
Packed dimensions and weight	785 (W) x 310 (D) x 235 (H) mm (31 (W) x 12-1/4 (D) x 9-1/4 (H) in.), 12.5 kg (27.6 lb.)
Included items	ATC spindle unit, Air cylinder, Tool magazine, Control box, Air regulator, Z0 sensor base, Air hose, Air nozzle, Positioner, Hexagonal wrenches

\* The expansion magazine cannot be used with the Rotary Axis Unit.  
\*\* A compressor or other compressed-air supply is required to operate the ZAT-650.

#### Automatic Tool Changer (Options for ZAT-650) D = nut external diameter

Name	Model No.	Description
Automatic Tool Changer	ZAT-650	
Expansion Magazine	ZM-650	To house additional 4 tools (cannot be used with Rotary Axis Unit)
Tool Holders	15T-NDC5-35-PB	dia. 0.5-5.0 mm, D = 13 mm
	15T-NDC7S-48-PB	dia. 0.5-7.0 mm, D = 22 mm
	15T-NDC7S-55-PB	dia. 0.5-7.0 mm, D = 22 mm
	15T-NDC7S-75-PB	dia. 0.5-7.0 mm, D = 22 mm
	15T-NDC10-52-PB	dia. 0.5-10.0 mm, D = 33 mm
Collets	YCC 5-3	dia. 3.0-2.5 mm, external diameter = 8.5 mm, for 15T-NDC5-35
	YCC 5-4	dia. 4.0-3.5 mm, external diameter = 8.5 mm, for 15T-NDC5-35
	YCC 5-5	dia. 5.0-4.5 mm, external diameter = 8.5 mm, for 15T-NDC5-35
	YCC 7-3	dia. 3.0-2.5 mm, external diameter = 13 mm, for 15T-NDC7S-48/55/75
	YCC 7-4	dia. 4.0-3.5 mm, external diameter = 13 mm, for 15T-NDC7S-48/55/75
	YCC 7-6	dia. 6.0-5.0 mm, external diameter = 13 mm, for 15T-NDC7S-48/55/75
	YCC 10-6	dia. 6.0-5.0 mm, external diameter = 18 mm, for 15T-NDC10-52
	YCC 10-8	dia. 8.0-7.0 mm, external diameter = 18 mm, for 15T-NDC10-52
	YCC 10-10	dia. 10.0-9.0 mm, external diameter = 18 mm, for 15T-NDC10-52
	Wrenches for tool holders	FS10
FS22		for 15T-NDC7S-48/55/75
FS33		for 15T-NDC10-52

#### High Torque Spindle (Options for ZS-650T)

Name	Model No.	Description
High Torque Spindle Unit	ZS-650T	dia. 6 mm collet included (Life cycle : every 5,000 hours)
Collets	ZC-5030	dia. 3 mm, 1 pce.
	ZC-5032	dia. 3.175 mm (1/8"), 1 pce.
	ZC-5040	dia. 4 mm, 1 pce.
	ZC-5048	dia. 3/16", 1 pce.
	ZC-5050	dia. 5 mm, 1 pce.
	ZC-5060	dia. 6 mm, 1 pce.
	ZC-5063	dia. 6.35 mm (1/4"), 1 pce.
	ZC-5080	dia. 8 mm, 1 pce.
	ZC-5095	dia. 3/8", 1 pce.
	ZC-5100	dia. 10 mm, 1 pce.
Collet Set	ZC-500T	dia. 3, 3.175 (1/8"), 4, 5, 6.35 (1/4"), 8, 10 mm, 1 pce. each
Vacuum Adapter	ZAD-500T	For ZS-650T and ZS-650TY

#### High Precision Spindle (Options for ZS-650TY)

Name	Model No.	Description	
High Precision Spindle Unit	ZS-650TY	dia. 6 mm collet included (Life cycle : every 5,000 hours)	
Collets (ISO15488 compliant)	EY16-3	dia. 3.0 mm - 2.5 mm, 1 pce.	
	EY16-3.5	dia. 3.5 mm - 3.0 mm, 1 pce.	
	EY16-4	dia. 4.0 mm - 3.5 mm, 1 pce.	
	EY16-5	dia. 5.0 mm - 4.0 mm, 1 pce.	
	EY16-6	dia. 6.0 mm - 5.0 mm, 1 pce.	
	EY16-8	dia. 8.0 mm - 7.0 mm, 1 pce.	
	EY16-10	dia. 10.0 mm - 9.0 mm, 1 pce.	
	Vacuum Adapter	ZAD-500T	For ZS-650T and ZS-650TY

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#### Rotary Axis Unit ZCL-650 SPECIFICATIONS

Supported workpieces	Resins such as chemical wood and modeling wax (metal not supported)
Max. workpiece size	Items within range of maximum diameter 200 mm* x 410 mm (W) (diameter 7-7/8 in.* x 16-1/8 in. (W)) *Maximum clampable thickness is 50 mm (2 in.)
Clamping method	Set-screw type (Cylinders cannot be mounted.)
X-axis effective stroke	385 mm (15-1/8 in.)
Z-axis effective stroke	155 mm (6-1/16 in.)
Maximum angle of rotation	1080 degrees (3 rotations)
Maximum speed	20 rpm
A-axis mechanical resolution	0.0027 degrees (2.3 μm with workpiece of 100 mm in diameter)
Static precision	Rotation backlash: 3 minutes Eccentricity: 0.3 mm (0.012 in.) or less
Height of center of rotation	123 mm (4.84 in.) from top surface of slider
Maximum workpiece weight	8 kg (17.6 lb.)
Maximum workpiece moment of inertia	0.02 kgm <sup>2</sup>
Unit weight / Unit external dimensions	12 kg (26.5 lb.) / 725 (W) x 270 (D) x 170 (H) mm (28-9/16 (W) x 10-5/8 (D) x 6-11/16 (H) in.)
Control methods	4-axis control, 3-axis simultaneous control
Included items	Rotary axis unit, cable clamp, hexagonal wrenches (6 mm: 1, 3 mm: 1), Y-center detection pin (diameter 6 mm), screws: 4, cap screws: 4, washers: 4, spacers: 4, and slider retainer

#### Others

Name	Model No.	Description
Rotary Axis Unit	ZCL-650	
Table Spacers	ZA-503	Materials that need the Table Spacer: 131 mm (5-3/16") - 150 mm (5-7/8") The height of the Table Spacer: 30 mm (1-3/16")
	ZA-505	Materials that need the Table Spacer: 101 mm (4") - 130 mm (5-1/8") The height of the Table Spacer: 50 mm (1-15/16")
	ZA-508	Materials that need the Table Spacer: 51 mm (2") - 100 mm (3-15/16") The height of the Table Spacer: 80 mm (3-1/8")
	ZA-613	Materials that need the Table Spacer: less than 50 mm (1-15/16") The height of the Table Spacer: 130 mm (5-1/8")
Safety Cover	ZBX-650	1042 mm (W) x 1030 mm (D) x 798 mm (H) / 68 kg (41-1/16" (W) x 40-9/16" (D) x 38-9/16" (H) / 149.9 lb.)

dia = flute diameter, R = flute radius, ℓ = flute length, L = overall length, d = shank diameter, NT = number of flute

Description	Model No.	Specifications (unit = mm)	Collet chuck			
			For ZS-650T	For ZS-650TY	For ZS-650SH	
Square end mill (High speed steel)	ZHS-100	dia. = 1, 3 ℓ x 6d x 50L x 2NT	ZC-5060	EY16-6	ZC-23	
	ZHS-200	dia. = 2, 6 ℓ x 6d x 50L x 2NT	ZC-5060	EY16-6	ZC-23	
	ZHS-300	dia. = 3, 10 ℓ x 6d x 50L x 2NT	ZC-5060	EY16-6	ZC-23	
	ZHS-400	dia. = 4, 8 ℓ x 6d x 60L x 2NT	ZC-5060	EY16-6	ZC-23	
	ZHS-500	dia. = 5, 10 ℓ x 6d x 60L x 2NT	ZC-5060	EY16-6	ZC-23	
	ZHS-600	dia. = 6, 15 ℓ x 6d x 55L x 2NT	ZC-5060	EY16-6	ZC-23	
	ZHS-800	dia. = 8, 15 ℓ x 10d x 60L x 2NT	ZC-5100	EY16-10	not available	
	ZHS-1000	dia. = 10, 25 ℓ x 10d x 70L x 2NT	ZC-5100	EY16-10	not available	
	Square end mill (Cemented carbide)	ZUS-300	dia. = 3, 15 ℓ x 3d x 60L x 2NT	ZC-5030	EY16-3	ZC-23
		ZUS-400	dia. = 4, 20 ℓ x 4d x 60L x 2NT	ZC-5040	EY16-4	ZC-23
ZUS-500		dia. = 5, 25 ℓ x 5d x 60L x 2NT	ZC-5050	EY16-5	ZC-23	
ZUS-600		dia. = 6, 35 ℓ x 6d x 60L x 2NT	ZC-5060	EY16-6	ZC-23	
Ball end mill (Cemented carbide)		ZUB-150	R1.5, 10 ℓ x 3d x 65L x 2NT	ZC-5030	EY16-3	ZC-23
		ZUB-200	R2.0, 12 ℓ x 4d x 65L x 2NT	ZC-5040	EY16-4	ZC-23
	ZUB-250	R2.5, 20 ℓ x 5d x 65L x 2NT	ZC-5050	EY16-5	ZC-23	
	ZUB-300	R3.0, 30 ℓ x 6d x 65L x 2NT	ZC-5060	EY16-6	ZC-23	
Ball end mill (High speed steel)	ZHB-400	R4.0, 14 ℓ x 8d x 100L x 2NT	ZC-5080	EY16-8	not available	
	ZHB-500	R5.0, 18 ℓ x 10d x 100L x 2NT	ZC-5100	EY16-10	not available	

\*1 pce. of ZC-5060(6d) collet is included in ZS-650T.

\*1 pce. of EY16-6(5-6d) collet is included in ZS-650TY.

\*ZC-23 is a collet set of 1 pce. each of 3d, 4d, 5d, and 6d.

Roland

## 3D Milling Machine

# MDX-650

*A Revolutionary New Concept in Product Design*



MODELA Pro

## 3D Milling Machine

# MDX-650

## Introducing Subtractive RP

Roland's innovative MDX-650 3D Milling Machine is revolutionizing rapid prototyping. In addition to the machine's amazing affordability, Subtractive RP (SRP) can dramatically reduce the time and cost of product development over traditional additive processes.

## Precision and Automation Combined

The MDX-650 incorporates Feed Forward Processing for fast cutting while maintaining extremely precise accuracy. With Digital AC Servo motors on the X-, Y-, and Z- axes and a choice of High Precision or High Torque Spindles, the MDX-650 can effortlessly mill a variety of materials\*. An optional Automatic Tool Changer (ATC) and Rotary Axis Unit enhance operation and productivity by allowing the MDX-650 to automatically change tools and mill two or four-surface molds and prototypes. Easy-to-use MODELA Player CAM software comes standard.

The MDX-650 offers engineers and designers the opportunity to quickly and inexpensively turn concepts into three-dimensional prototypes, eliminating costly outsourcing. Parts that could take days to get back from a service provider can now be manufactured in hours\*\*. Multiple concept iterations can be produced in a variety of materials just as quickly – a handy option during product development. Best of all, proprietary concepts are kept in-house.

For the ultimate in performance milling, the MDX-650 offers the power, the precision and the versatility that make it the obvious choice.

\* The MDX-650 mills a variety of materials, from resin, chemical woods, and ABS to light metals such as aluminum, brass and copper.

(When using the Rotary Axis Unit, the MDX-650 cannot mill light metals.)

\*\* Production time varies depending on the size and type of milling materials.

## The MDX-650 – State-of-the-Art *Industrial Design Tool*

## DAC-FFP

Digital AC Servo / Feed Forward Processing

## High Speed and Accuracy

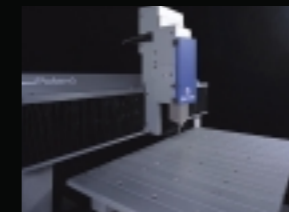
Digital AC Servo (DAC) brushless motors on the MDX-650's X-, Y-, and Z- axes generate high speed and high torque for smooth, steady milling. These brushless motors help extend motor life to a robust 8,000 hours and further reduce motor maintenance.

Feed Forward Processing (FFP) is a predictive technology that anticipates tool path, produces greater accuracy, faster speed, increased energy efficiency and higher torque. The result: More precise milling.

## The Fine Details

The MDX-650 features a large 650mm x 450mm (25.59" x 17.71") work area\*. Variable spindle speed of 3,000 to 12,000 rpm, a lengthy Z travel of 155mm (6.1") and accuracy of within 0.001mm/step (0.000039"/step) enable the MDX-650 to cut prototypes, patterns, dies and molds quickly and with amazing accuracy.

\*The max. work area of the MDX-650 varies with the combination of options. Refer to the specifications on the back.



## Increased Productivity

The MDX-650 comes with these convenient and time-saving functions:

- Rotating Speed and Feed Dial: Adjusts rotation speed or feed speed during milling... Simply pause the milling, turn the dial and then press "enter" to resume milling.
- Repeat Milling Data Buffer: Temporarily stores cutting data for multiple production lots by simply pressing the "copy" button.
- Spindle Life Display: Indicates spindle wear. Users can easily identify and replace worn spindles for consistent, high-quality output.



## Versatile Performer

- The High Torque Spindle quickly and easily mills a variety of materials, making it the perfect choice for rapid prototyping.
- The High Precision Spindle creates smoother, high-resolution molds.
- The optional Automatic Tool Changer (ATC) allows for unattended operation, from roughing through finishing.
- The MDX-650's optional Rotary Axis Unit, when used with the MODELA Player 4 software, automatically mills two- or four-surface parts.



## Enhanced Safety

Safety is an important feature of the MDX-650. The following come standard:

- A large, conveniently located emergency stop switch for instant shut-down.
- A spindle interlock switch that prevents machine operation when the spindle cover door is open.

An optional safety cover prevents access to the cutting mechanism during operation and also reduces noise and prevents swarf and dust from escaping.



## Fully Automated Production

### Cutting the Time and Cost of Product Development Automatic Tool Changer

The optional Automatic Tool Changer (ATC) adds unattended milling capability to the MDX-650 for enhanced productivity. Once you preset the tools, the MDX-650 automatically changes up to four tools\* of different sizes and shapes while providing complete milling from roughing through finishing. The tool length offset and the automatic measurement features simplify the operation to automatically find the Z origin position when using tools of different lengths. The ATC also supports tool change commands from industrial standard NC codes. The ATC comes standard with a high-precision ATC spindle.

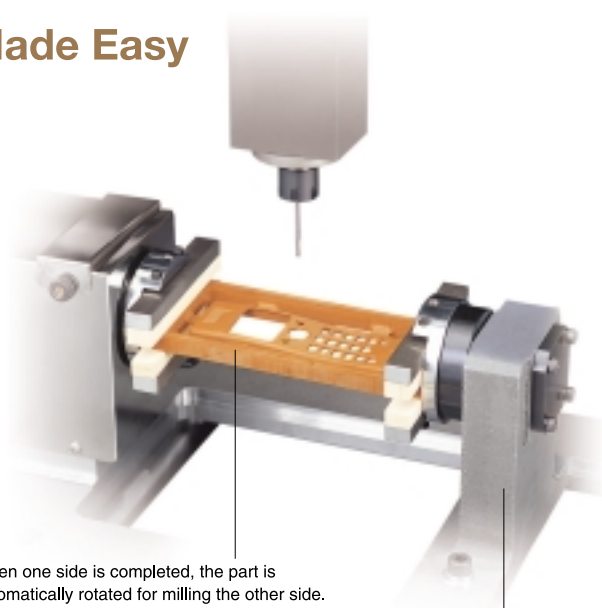
- \* Using an optional expansion magazine, the ATC can house an additional 4 tools -- up to 8 tools in total.
- \*\*An air compressor or other compressed-air supply is required to operate the ATC.



The MDX-650 with ATC automatically changes tools by specifying the tool's stock number from the included CAM software.

### Two- and Four-Sided Machining Made Easy Rotary Axis Unit

The optional Rotary Axis Unit expands the MDX-650's machining capabilities. The Unit, which supports milling on the X, Y, Z and A axes, is the perfect choice for prototyping items made from resin, chemical woods, ABS and other soft materials. The Rotary Axis Unit's angle control feature provides enhanced precision and tolerance. With the combination of the rotary axis unit and ATC, the MDX-650 provides fully automated production.



When one side is completed, the part is automatically rotated for milling the other side.

Adjustable holders secure the material being milled.

## Primary Options

	With Flat Table		With Rotary Axis Unit		With ATC Unit	With ATC Unit and Rotary Axis Unit
Spindle :	<b>ZS-650T</b> (dia.6mm collet included)	<b>ZS-650TY</b> (dia.6mm collet included)	<b>ZS-650T</b> (dia.6mm collet included)	<b>ZS-650TY</b> (dia.6mm collet included)	<b>Included in ATC Unit</b>	
Collet :	<b>ZC-5xxx series</b> (3, 3.175 (1/8"), 4, 5, 6, 6.35 (1/4"), 8, 10mm)	<b>EY16-xx series</b> (2.5-10mm)	<b>ZC-5xxx series</b> (3, 3.175 (1/8"), 4, 5, 6, 6.35 (1/4"), 8, 10mm)	<b>EY16-xx series</b> (2.5-10mm)	<b>YCC xx series</b>	
Tool Holder :					<b>15T-NDC xx series</b>	
Table Spacer :	<b>ZA-xxx series</b>					
Vacuum Adapter :		<b>ZAD-500T</b>				
Safety Cover :		<b>ZBX-650</b>				

## High Relief or High Speed

### High Precision Spindle

For extremely detailed projects, choose the MDX-650's High Precision Spindle. An excellent choice for milling metals, deep milling and high-speed milling, the High Precision Spindle's reduced tool vibration produces a smoother, more detailed mold. For added versatility, commercially available ISO15488 collets can also be used.



High Precision Spindle  
ZS-650TY

### High Torque Spindle

The MDX-650's high-torque spindle is ideal for rapid prototyping and for producing most dies and molds. With its 400W spindle motor, the MDX-650 can mill a wide range of materials, from wax, resin and chemical woods to light metals – such as aluminum, brass and copper – at a rate of 3,000 to 12,000 rpm.

### High-Precision ATC Spindle

A high-precision ATC spindle is included with the ATC, negating the need to purchase any additional spindles.

## Powerful Software Included

### MODELA Player 4 for Windows® 95/98/Me/NT® 4.0/2000 /XP

MODELA Player 4 is a CAM software application that accepts IGES, DXF\* and STL files exported from most popular industrial 3D CAD software programs. It is used to generate proportional 3D scaling, identify milling direction and to automatically generate and display the tool path. MODELA Player 4 supports tool changing when used with the Automatic Tool Changer (ATC) and automatic side cutting when used with the Rotary Axis Unit. It can also be used for 3D engraving. \*3D DXF compatible with AutoCAD® R12



MODELA Player 4

### Virtual MODELA for Windows® 95/98/Me/NT® 4.0/2000 /XP

Virtual MODELA simulates finished shapes and estimates production time. It also simulates suitable modeling/engraving depth before beginning milling, saving time and materials.



Virtual MODELA

The MDX-650 also supports industry standard NC codes. NC codes provide connectivity with a wide variety of commercial 3D and CAD/CAM software.



A wheel cover prototype



Small part prototype



A poured plastic part produced from a mold milled in chemical wood



Male and female molds milled from aluminum