# 3D Milling Machine
# MDX-650

## *A Revolutionary New Concept in Product Design*

**Roland**

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# 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, 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, tooling board, 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.

# Roland

# 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 25.59″ x 17.71″ (650mm x 450mm) work area*. Variable spindle speed of 3,000 to 12,000 rpm, a lengthy Z travel of 6.1″ (155mm) and accuracy of within 0.000039″/step (0.001mm/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.

## Versatile Performer

- The High Precision Spindle creates smooth, 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.

## 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.

## 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.

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## 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 industry 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.

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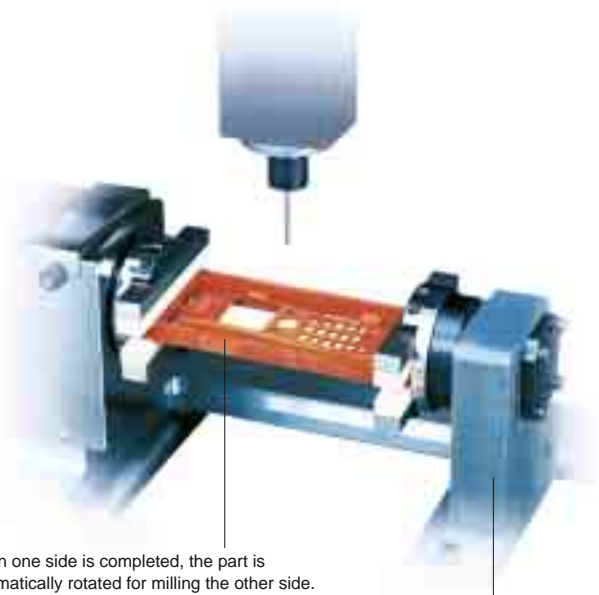
When one side is completed, the part is automatically rotated for milling the other side.

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

# No Finishing Required

## High Precision Spindle

The High Precision Spindle's reduced tool vibration produces a smooth, highly-detailed mold or part with no post-finishing required. For added versatility, commercially available ISO15488 collets can also be used.

## High-Precision ATC Spindle

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

High Precision Spindle
ZS-650TY

# 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 verifies 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 SRP Tooling Board.

Male and female molds milled from aluminum

## 3D Milling Machine MDX-650A SPECIFICATIONS

| | |
|---|---|
| T-slot (XY) table size | 27-1/2 x 18-7/8 in. (700 mm x 480 mm) |
| Max. cutting area* | 25-9/16(X) x 17-11/16(Y) x 6-1/16(Z) in. (650 mm (X) x 450 mm (Y) x 155 mm (Z)) |
| XYZ motor | AC servo motor |
| Feed rate | X, Y, Z-axis: Max. 3-3/8 in./sec. (85 mm/sec.) |
| Acceleration | 0.3G, 0.1G, 0.05G |
| Software resolution | [When RML-1 has been selected] 0.00039 in./step (0.01 mm)   [When NC codes has been selected] 0.000039 in./step (0.001 mm)   Note that the measurement unit for positioning coordinates is 0.00039 in./step (0.01 mm). |
| Mechanical resolution | 0.000039 in./step (0.001 mm) |
| Spindle motor | DC brushless motor   Max. 400W |
| Revolution speed | 3000 to 12000 rpm  (Variable manually or by the command set) |
| Tool chuck | Collet or Cutter holder system |
| Positioning accuracy | 0.00394 in. (±0.1 mm) / 11-13/16 in. (300 mm)   (Under no-load conditions) |
| Repeat accuracy | 0.00197 in. (±0.05 mm)  (Under no-load conditions) |
| Origin-point reproducibility (when the power is switched on/off) | 0.00315 in. (±0.08 mm) |
| Possible table load weight | [0.3G] 26.5 lb. (12 kg) or less   [0.05G] 44.1 lb. (20 kg) or less |
| Interface | Parallel (in compliance with the specification of Centronics)  Serial (under RS-232C standard) |
| Buffer size | 2 Mbyte   (Replot buffer: [RML-1]  /  [NC codes] (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 | 264.5 lb. (120 kg) / 36-5/8(W) x 42-3/4(D) x 34-5/16(H) in.  (930 mm (W) x 1085 mm (D) x 870 mm (H) ) |
| Operation temperature / Operation humidity | 41 to 104° F  (5 to 40 ℃) / 35 to 80% (no condensation) |
| Accessories | T-slot clamps: 4,  Spanner: 1 (3/8 in. (10 mm)), Z0 position sensor: 1, Power cord: 1, Belt for precision 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: 21-1/4(X) x 17-11/16(Y) x 6-1/16(Z) in. (540(X) x 450 (Y) x 155(Z) mm) 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 | 4-5/16 in. (110 mm) |
| Maximum tool diameter | 3/8 in. (10 mm) |
| 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 | 41 to 104° F (5 to 40℃) / 35 to 80% (no condensation) |
| Packed dimensions and weight | 31 (W) x 12-1/4 (D) x 9-1/4 (H) in. (785 (W) x 310 (D) x 235 (H) mm), 27.6 lb. (12.5 kg) |
| 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.

#### Rotary Axis Unit ZCL-650A SPECIFICATIONS

| | |
|---|---|
| Supported workpieces | Resins such as chemical wood and modeling wax (metal not supported) |
| Max. workpiece size | Items within range of maximum diameter 7-7/8 in.* x 16-1/8 in. (W) (diameter 200 mm* x 410 mm (W)) *Maximum clampable thickness is 2 in. (50 mm) |
| Clamping method | Set-screw type (Cylinders cannot be mounted.) |
| X-axis effective stroke | 15-1/8 in. (385 mm) |
| Z-axis effective stroke | 6-1/16 in. (155 mm) |
| Maximum angle of rotation | 1080 degrees (3 rotaions) |
| Maximum speed | 20 rpm |
| A-axis mechanical resolution | 0.0027 degrees (2.3 $\mu$m 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 | 4.84 in. (123 mm) from top surface of slider |
| Maximum workpiece weight | 17.6 lb. (8 kg) |
| Maximum workpiece moment of inertia | 0.02 kgm$^2$ |
| Unit weight / Unit external dimensions | 26.5 lb. (12 kg) / 28-9/16 (W) x 10-5/8 (D) x 6-11/16 (H) in. (725 (W) x 270 (D) x 170 (H) mm) |
| 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 |

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Built with precision. Backed with passion.