TOSHIBA MACHINE

Introduction of Ultra-precision 5-axis milling machine

Outline;

1. Our concept
2. Milling / Turning kinematics
3. Case study

LCWS 2019 Accelerator Parallel Sessions, 30 / Oct. / 2019

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TOSHIBA MACHINE CO.,LTD
Nano Processing System Div.

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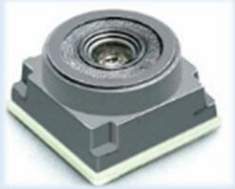
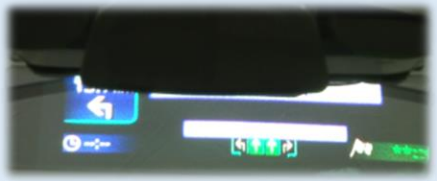
Our domain



LED parts

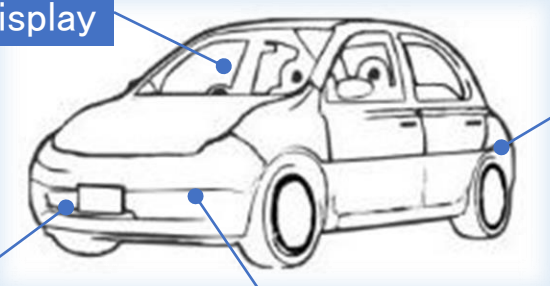
Camera module

Smartphone device



Automotive optics part

Head-up display



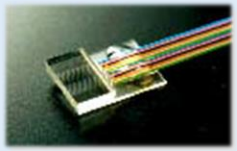
Reflector

Sensor

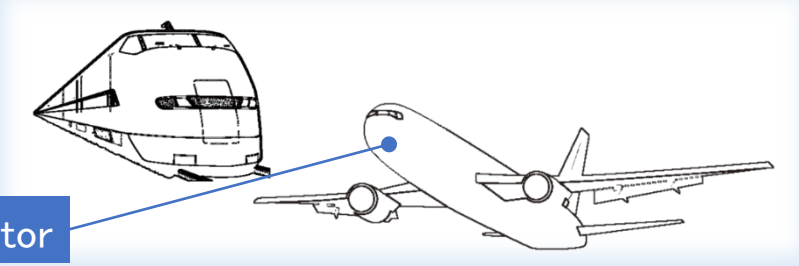
Head-lite

Pick-up lens

Computer device



Precision parts and mold



Optical connector

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Achievable accuracy

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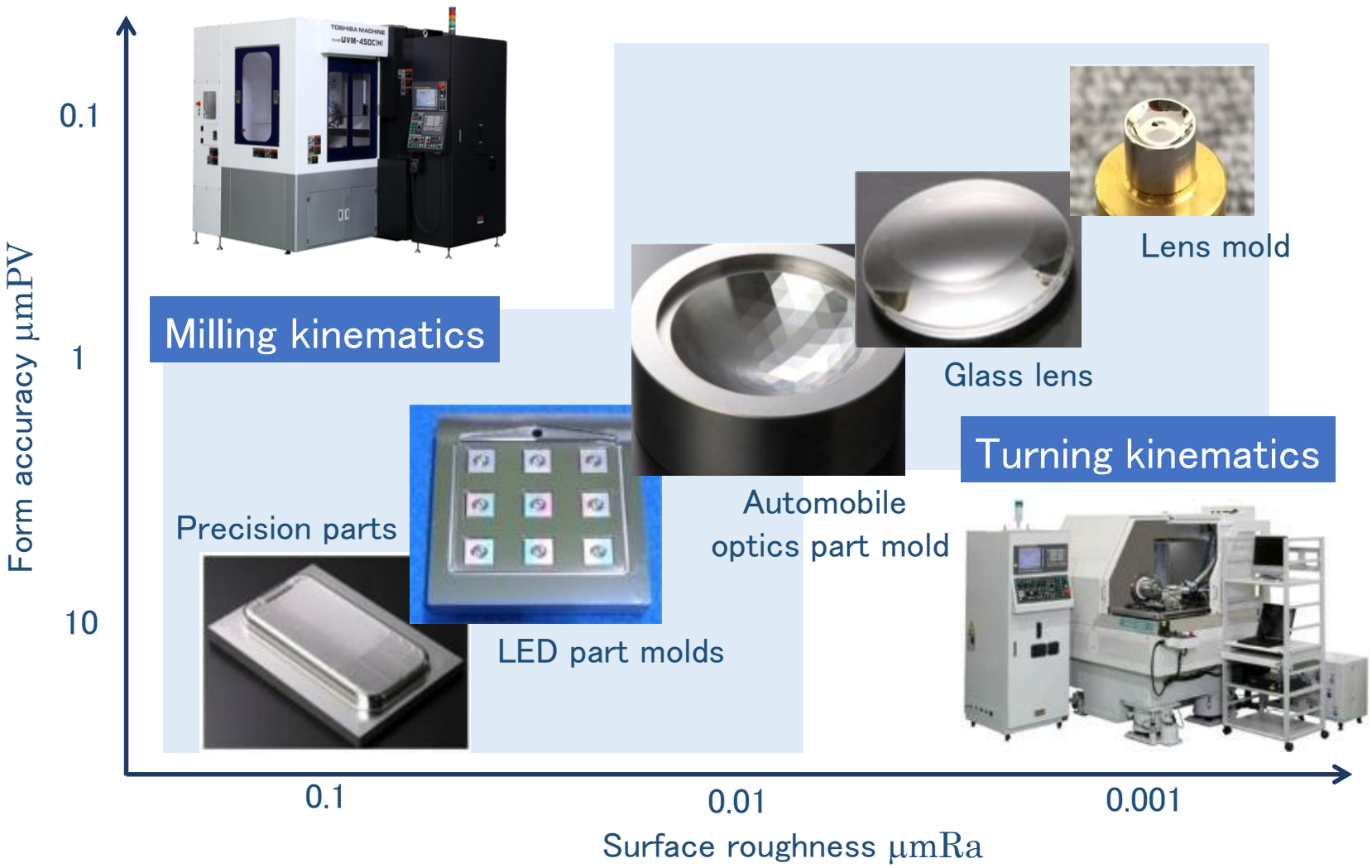

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Our concept 1

Self-manufactured machine tool components

Finishing process with skilled technique

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Our concept 2

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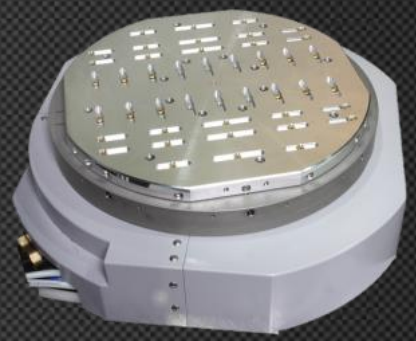
for milling tool

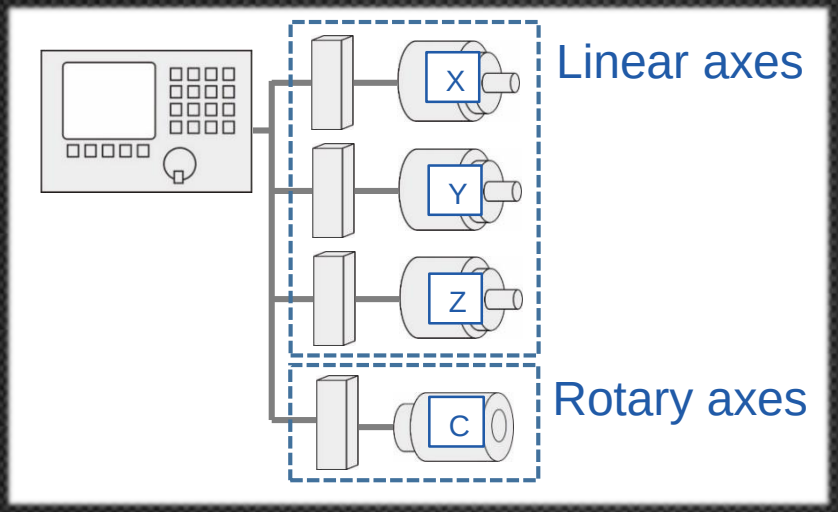


for heavy load work

for grinding tool

for precise cutting

Self-manufactured and self-development for key components



Integrating system with up-dated technologies

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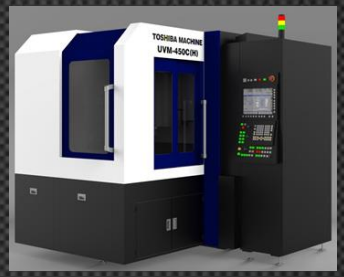
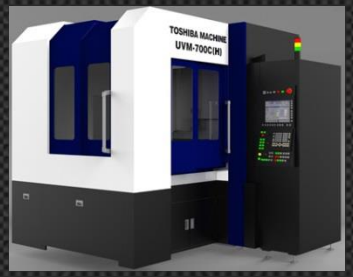
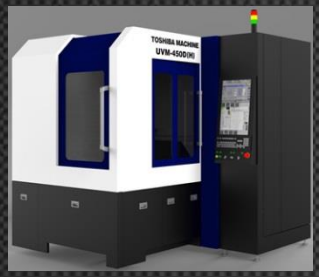
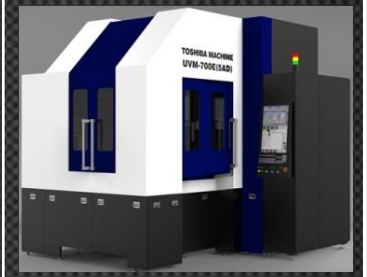
UVM : Milling kinematics

UVM series main specification

	 UVM-450C(H)	 UVM-700C(H)	 UVM-450D(H)	 UVM-700E(5AD)
spindle Speed	6,000～60,000 min^{-1} (Option ～40,000 min^{-1} (High stiffness, High torque type))		6,000～60,000 min^{-1}	
stroke (X Y Z)	500×450×200 mm	810×800×350 mm	570×525×250 mm	810×800×350 mm
working area	450×450 mm	700×700 mm	500×500 mm	Φ500 mm
max table load	100 kg	400 kg	100 kg	200 kg
min. least input	0.01 µm			
CNC controller	FANUC30i-B			
machine size	2,100 mm×2,240 mm ×2,240 mm	2,550 mm×2,580 mm ×2,420 mm	2,260 mm×2,120 mm ×2,400 mm	2,870 mm×2,700 mm ×2,750 mm
machine weight	4,800 kg	5,600 kg	4,800 kg	9,700 kg

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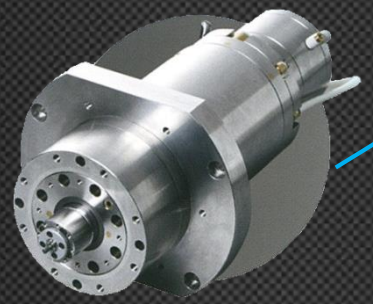
Technologies of UVM series

Aerostatic bearing spindle ABC-35M and ATC



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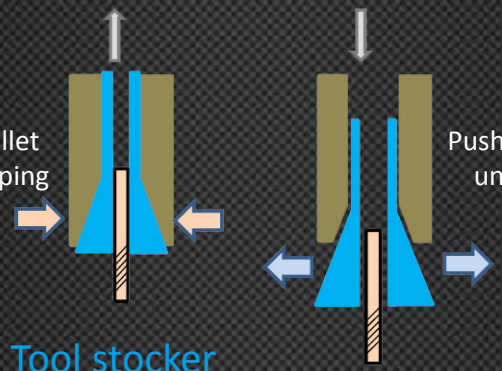
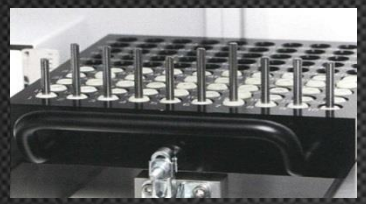
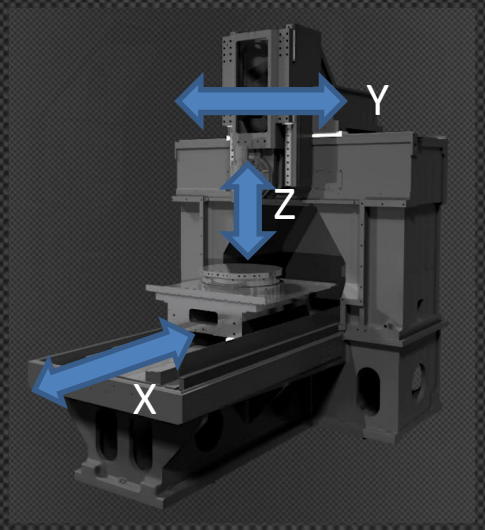
In-house manufactured



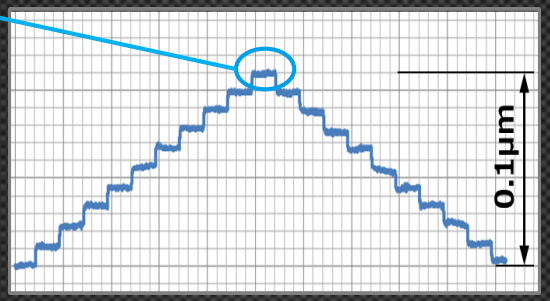
50 Tool stocker



High-Precision 3 axes Linear motor drive



almost no backlash



X axis 0.01um step

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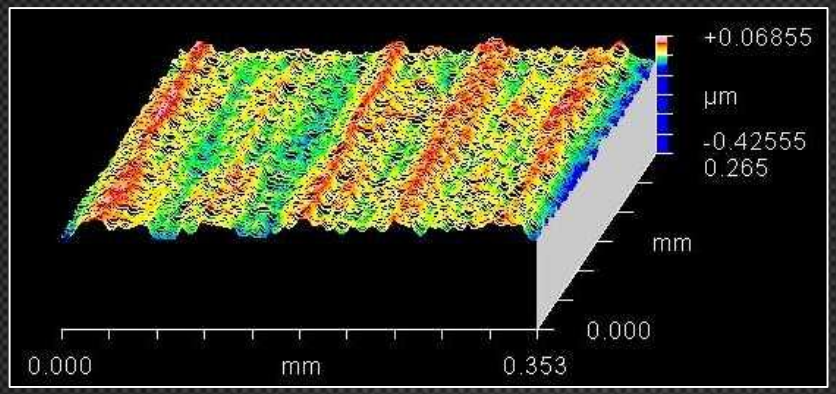
Case study

Mirror finishing without polishing

With single crystal diamond end mill

Mirror surface model parts

- Machine : UVM-450C(H)
- Material : Brass
- End mill :
  R0.5mm single crystal diamond
- Spindle speed : 60,000 min^{-1}
- Machining time : 10 h



Surface roughness : 17 nm Ra

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5 axis machining

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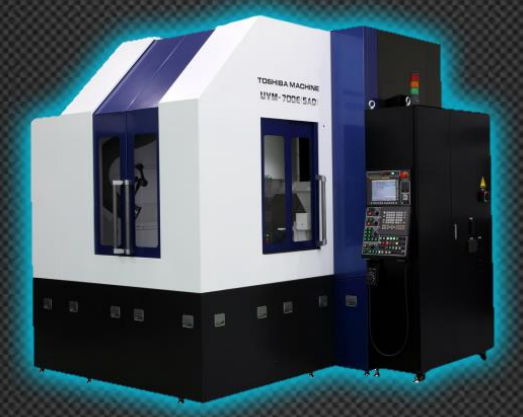
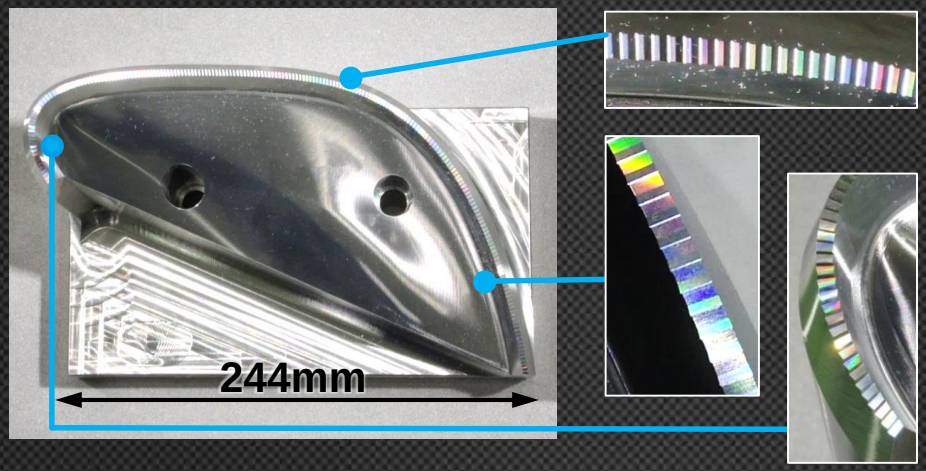
Large sized mold without polishing

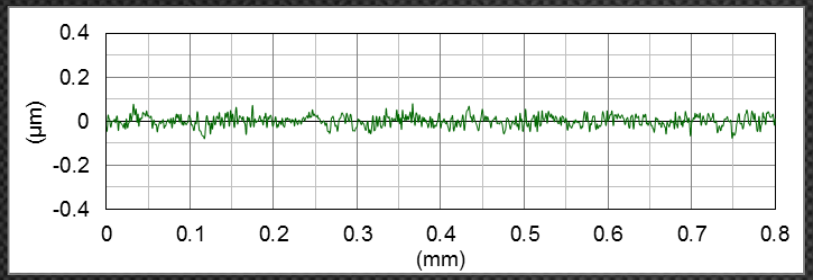
Clearance lamp mold for light guide function





- Machine：UVM-700E(5AD)
- Work piece：NAK 80 40HRC
- End mill for finishing：R0.1 cBN ball nose
- Spindle speed：60,000min^{-1}
- Machining time：54 h

（Rough+semi-fin）11.5 h+（fin） 42.5 h



Surface finishing : 19 nm Ra

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ULG : Turning kinematics

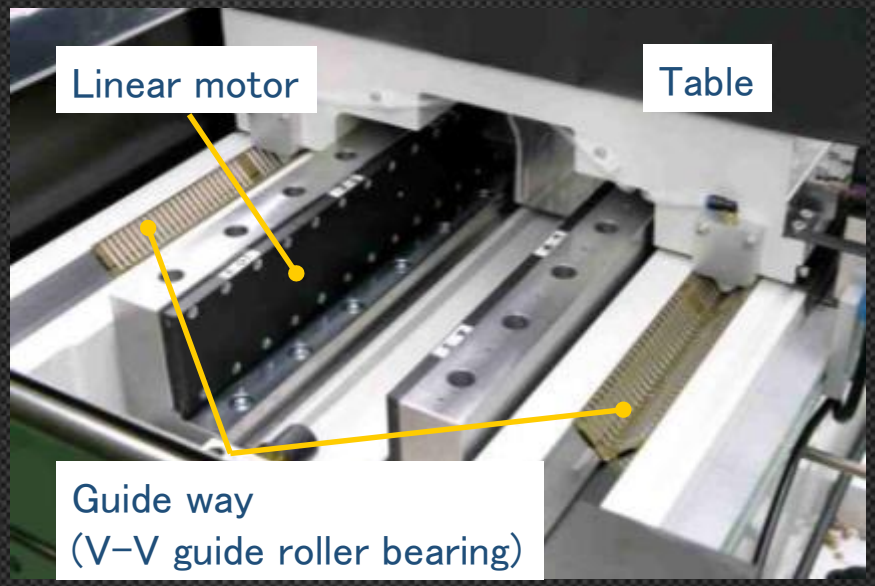
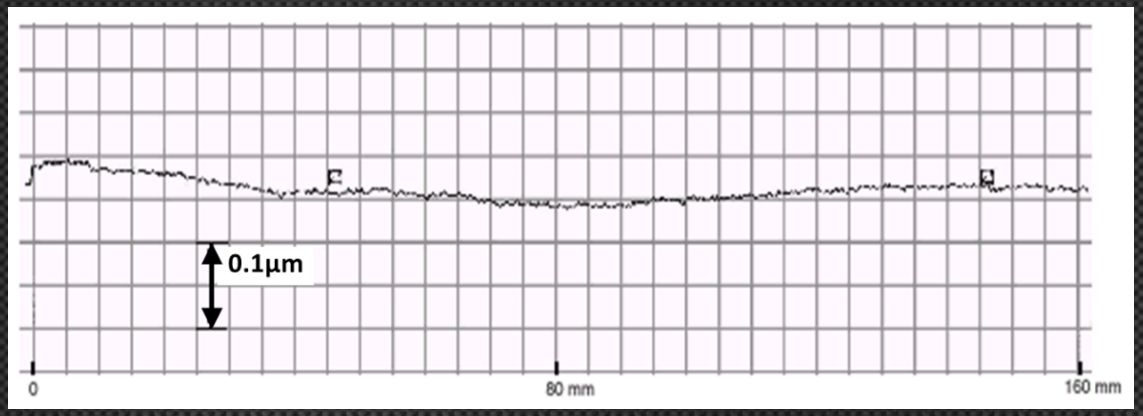


Photo of drive system

Step response for 0.5nm
at the actual cutting position



Straightness sample
of guide-ways

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Case study

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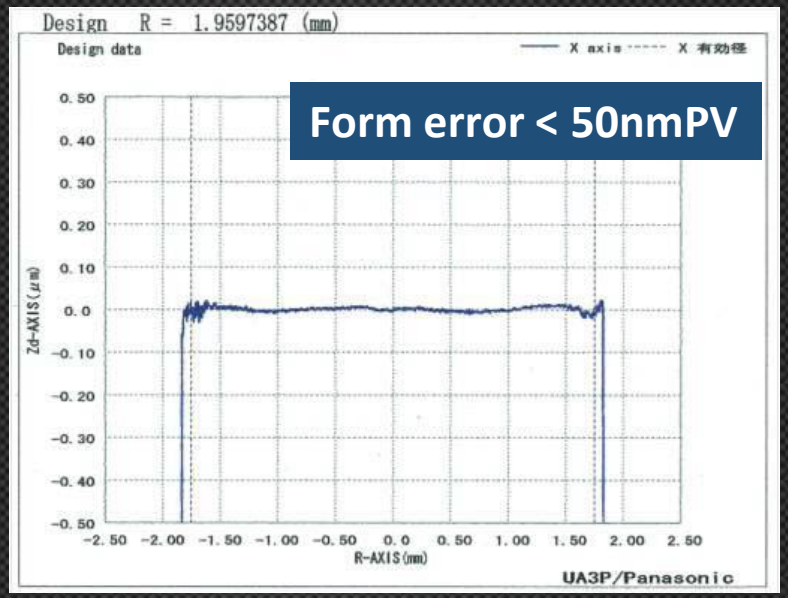
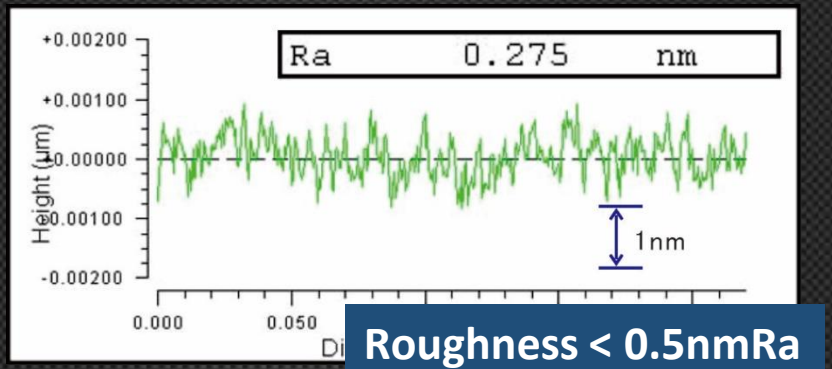
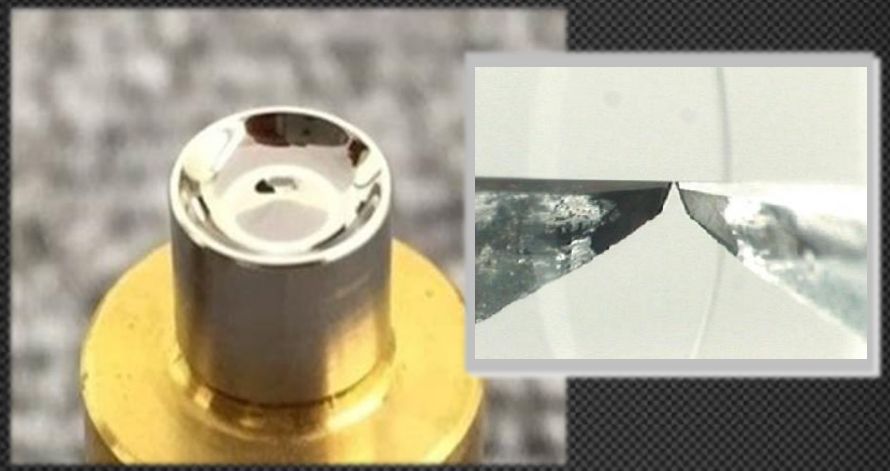


Overview of ULC-100F(S)
X-Z configuration
0.1nm operating resolution





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5 axis machining

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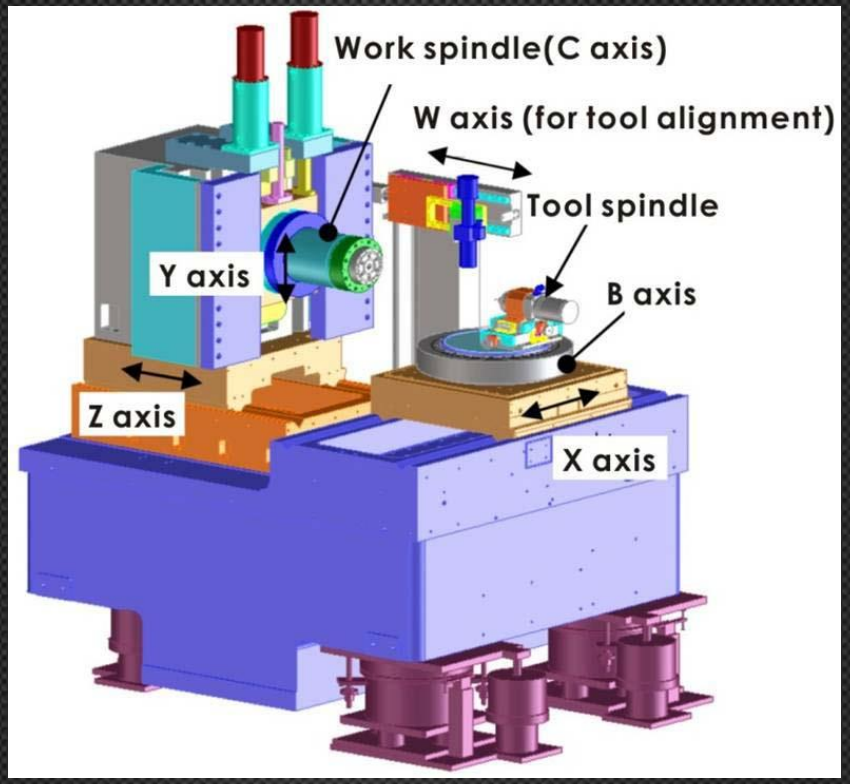

Mechanical structure
of ULG-100D(5A)

Integrated thermal controller

Main specifications

Control axis	X,Y,Z,B,C
Resolution	1nm on linear axis 0.00001deg on rotary axis
Drive system	Liner motor driven with core
Spindle	Work spindle (C-axis) Rotary table (B-axis) Tool spindle

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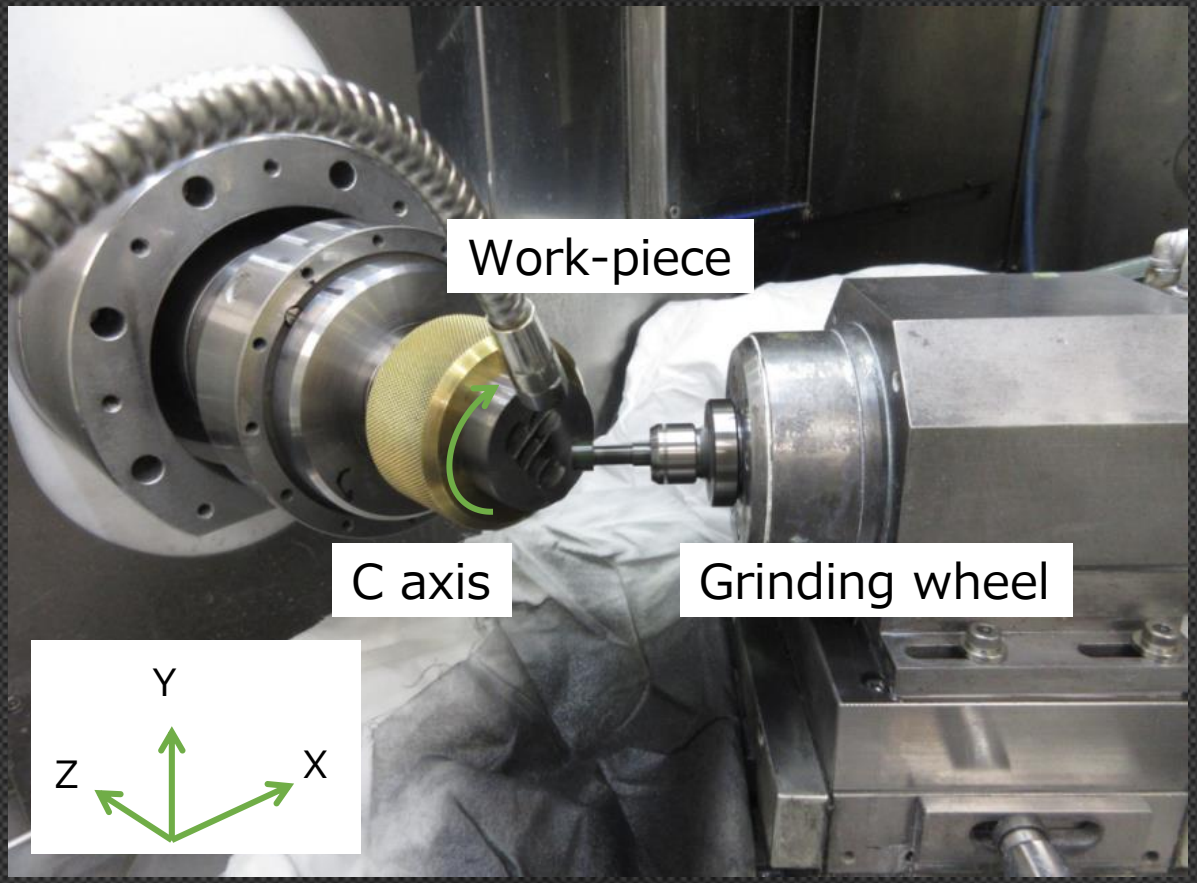
Case study



Toric shape lens-array, Rx=12,Ry=20
Tool Diamond wheel #3000
Work material Tungsten carbide

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Case study -result-

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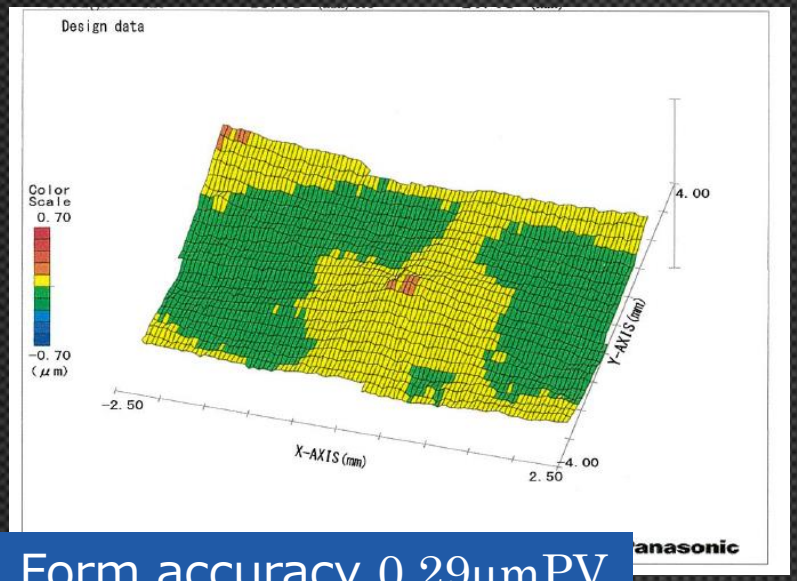
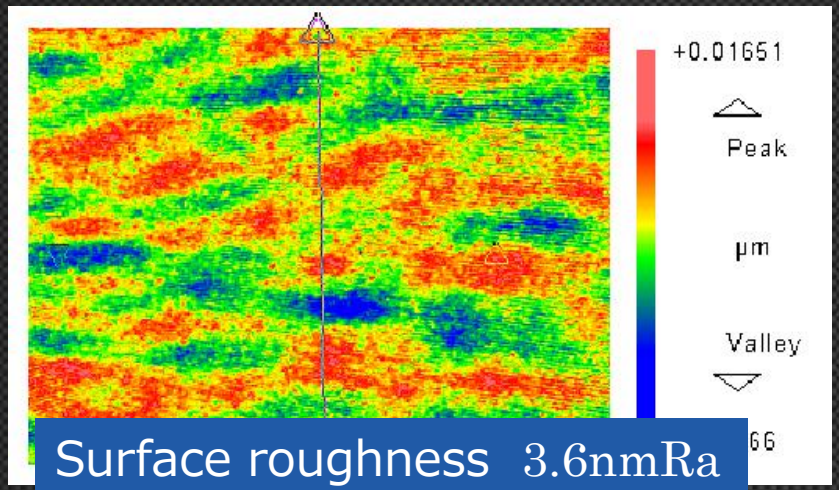
Work-piece after finish



Form accuracy 0.29μmPV



Surface roughness 3.6nmRa

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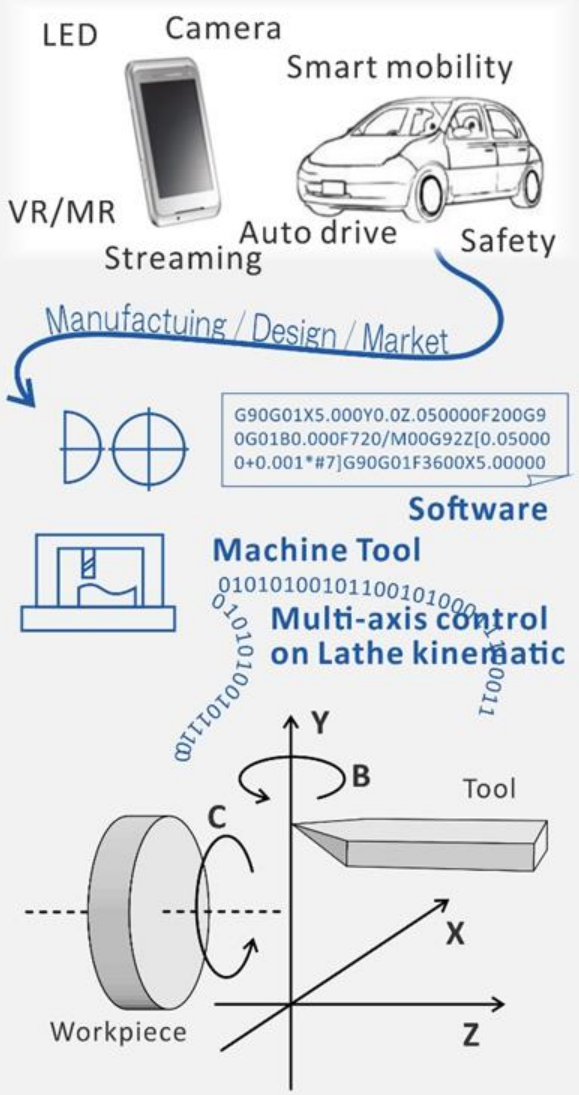

Why 5-axis milling is needed ?

- ✓ Set-up versatility
- ✓ Tool interfere with work-piece
- ✓ Single point cutting on freeform
- ✓ …

➡ NEW APPLICATION !

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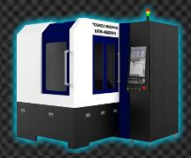
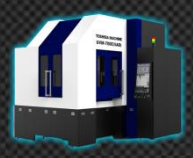
Machines manufactured by TOSHIBA MACHINE

Solution for parts machining, mould machining and moulding

Ultra Precision
Aspheric Generators





High Precision Machining Center

Giant machine
Tools

Die Casting
machines

Glass Molding
Press Machines

Injection Molding
Machine

Nano Imprinting Machines

Extruder Machines

Industrial Robots

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