

Fast Tool Servo Module for Precision Lathes

KC FTS-400 & FTS-600

Machines Non-Rotationally Symmetric Surfaces

- **12 Nanometer RMS Surface Finish**
- **Up to 600 micrometer stroke available**
- **600 Hz Servo Bandwidth**
- **Industrial Reliability**



The Fast Tool Servo (FTS) Module from Kinetic Ceramics, Inc. incorporates the latest piezoelectric positioning technology to achieve optical quality machining performance. When used with a single point diamond turning lathe, the FTS routinely achieves 12 nanometer RMS surface finishes on aspheres, toric off-axis spheres and other “free form” optical surfaces with superior dynamic range, speed and reliability.

A World-Leader in Piezo Technology

The model **KC FTS** Fast Tool Servo is a patented* design from the most experienced piezoelectric actuator company in the world. Kinetic Ceramics manufactured their first piezo stacks in 1966, called **PIEZOMOTOR**[®] actuators, and today this team has more than 60 years of combined experience. All piezo manufacturing processes are maintained in-house including processing powder, forming disks, firing ceramics, plating electrodes, actuator assembly and final testing. The result is a fast tool servo system with the unmatched performance and reliability.

Proven Performance and Reliability

More than two hundred KC FTS systems are in service today as **VARIFORM**[®] attachments to **Optoform**[®] lathes from Precitech, Inc. These systems operate “24/7” in contact lens manufacturing facilities worldwide providing outstanding surface form and finish with high-throughput. Only Kinetic Ceramics offers this cost-effective combination of precision, throughput and reliability.

* US Patent **6,040,653**

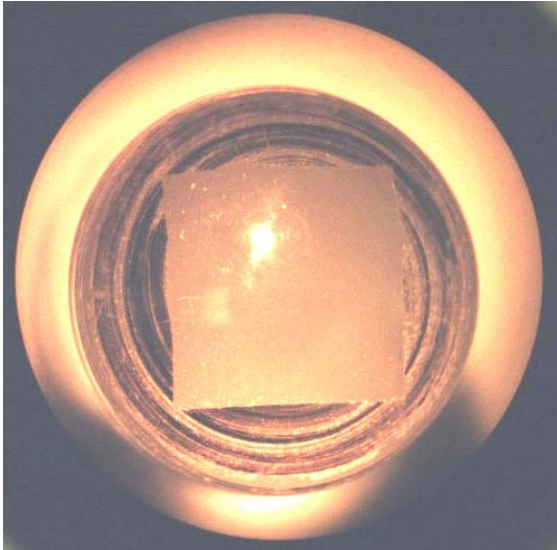
[®] **PIEZOMOTOR** is a registered trademark of Kinetic Ceramics Inc.

[®] **VARIFORM** and **OPTOFORM** are registered trademarks of Precitech, Inc.

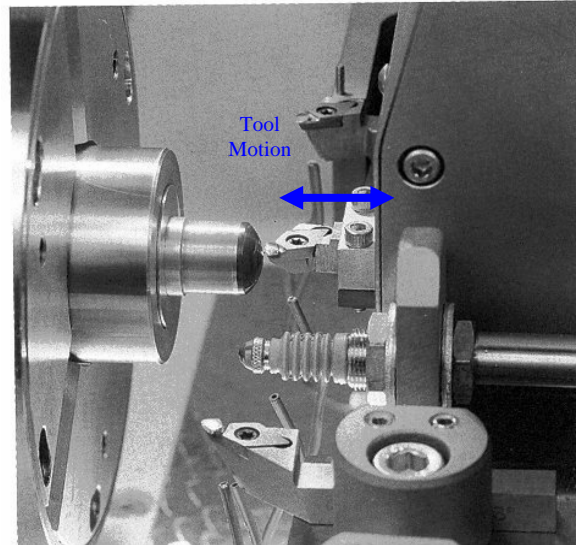


Fast Tool Servo Module

Unmatched Machine Tool Performance



A square feature cut on a spherical surface.



Fast Tool Servo cutting a convex surface

Product Features

- Solid-State PIEZOMOTOR actuators offer the greatest stroke, force and reliability.
- Dual actuators maximize stiffness and achieve inherent thermal compensation.
- “Tee” mechanical amplifier increases travel while maximizing resonant frequency.
- FTS servo head is compact and robust.
- Parallel flexures insure a straight tool path.
- Position sensor measures tool location.
- “Charge” control high-voltage amplifier “linearizes” piezo actuator response.
- 1500-watt drive amplifier produces 850 volts peak output.
- 600 Hz closed-loop servo accepts analog position commands from lathe controller.

Customer Benefits

- Create non-rotationally symmetric optical surfaces with 12-nanometer RMS surface finish.
- Move tool 400 or 600 micrometers with closed-loop precision.
- Hold tool with maximum stiffness.
- Move tool with 600 Hz servo bandwidth at spindle speeds of greater than 6000 RPM.
- Thermally insensitive to piezo stack heating.
- High thermal efficiency – typically no active cooling is required.
- Easy system integration with precision lathe.
- No heat or magnetic fields from voice coils or motors.
- Reliable operation on 24/7 schedule.
- Machine both polymers and metals.



Fast Tool Servo Module

FTS System Specifications

Tool Travel (under closed-loop servo control)	FTS-400 400 microns minimum FTS-600 600 microns minimum
Linearity	+/- 0.25 dB from 0 to 200 Hz
Bandwidth	600 Hz for small signals. (Limited by mechanical resonance/servo gain.) 200 Hz for 200 um stroke (300 um for FTS-600) 100 Hz for 400 um stroke (600 um for FTS-600)
Tool Stiffness	120 N/um (Closed loop control)
Position Noise Floor	8 nanometers
Surface Finish	12 nanometers RMS typically achieved with Optoform Lathe (6 nanometers RMS contribution compared to lathe without FTS)
Typical Spindle Speed	6000 RPM
Environment	
Operating Temperature	63° F to 77° F (17° C to 25° C)
Storage and Transport Temperature	0° F to 150° F (-18° C to 65° C)
Relative Humidity	25% to 65 % (non-condensing)

FTS Servo Head Specifications:

Open Loop Stroke FTS-400	>400 microns
FTS-600	>600 microns
Static Stiffness	1.2 Newton's/micrometer (Open Loop)
First Resonant Frequency	1000 Hz nominal
Weight:	5 pounds
Material	Stainless Steel
Exterior Finish	Brushed
Internal Protection	Shop air pressurizes housing.
Mechanical Interfaces	<i>See interface drawing.</i>
Size:	5.35" H x 4.63" D x 2.3" W
Standard Toolholders	12 degree R: P/N: 8000-001 45degree L: P/N: 8000-002 Straight: P/N: 8000-003
Tool post	P/N 8000-011
Mounting Fasteners	4 x No. 8 SHCS
Electrical Interfaces	
Sensor	Lemo 6 Pin
Piezo Drive	Lemo 5 Pin



FTS Servo Head



Fast Tool Servo Module

FTS Control Amplifier



FTS Control Amplifier

Closed-Loop Servo Control

Inner "Charge" Loop	Removes piezo hysteresis and linearizes response of actuator. Increases system bandwidth.
Outer Position Loop	PID Linear Feedback Loop controls tool location using position sensor. Factory Calibrated and Optimized.
Position Command	Analog voltage from precision lathe controller.
Input Command Signal	+/- 10 Volts (Differential)

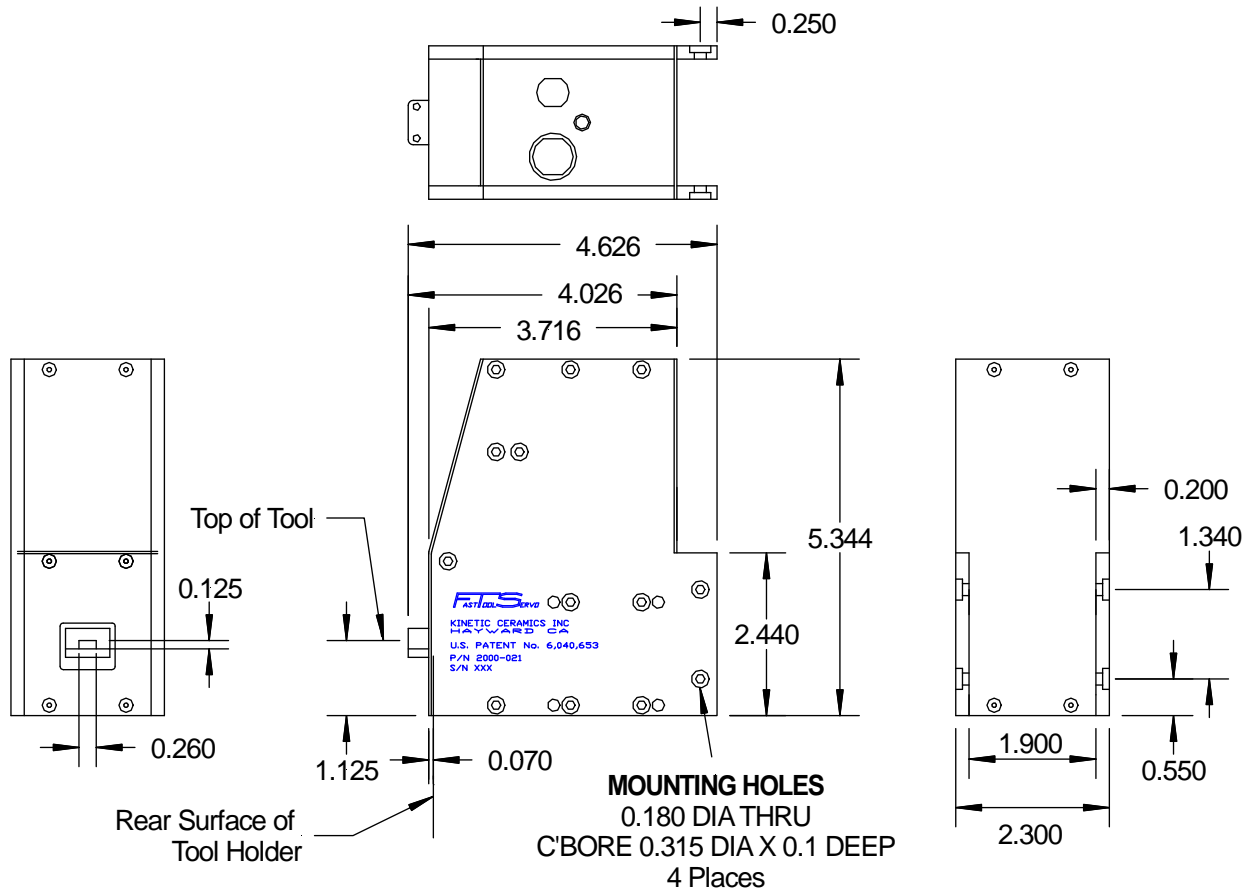
Drive Amplifier

Number of Channels	Two
Maximum Voltage	+/- 425 volts/Channel
Maximum Current	1.0 Amps/Channel
Maximum Power	1500 Watts
Electrical Connectors	
Control Signal	9 Pin Sub D Type
Sensor	Lemo 6 Pin
Piezo Actuators	Lemo 5 Pin
Input Power	Standard 3-Prong IEC Type
Input Power	90-230 VAC +/- 10% 50 – 60 Hz
Input Power Fuse	110 VAC: 10 Amp Slow Blow 220 VAC: 10 Amp Slow Blow
Chassis Size:	12 x 18 x 24 inches
Weight:	70 pounds



Fast Tool Servo Module

Servo Head Mechanical Interface Drawing



Ordering Information for KC FTS Fast Tool Servo Module

Specify 110 volt or 220 volt factory setting

Product is CE tested.