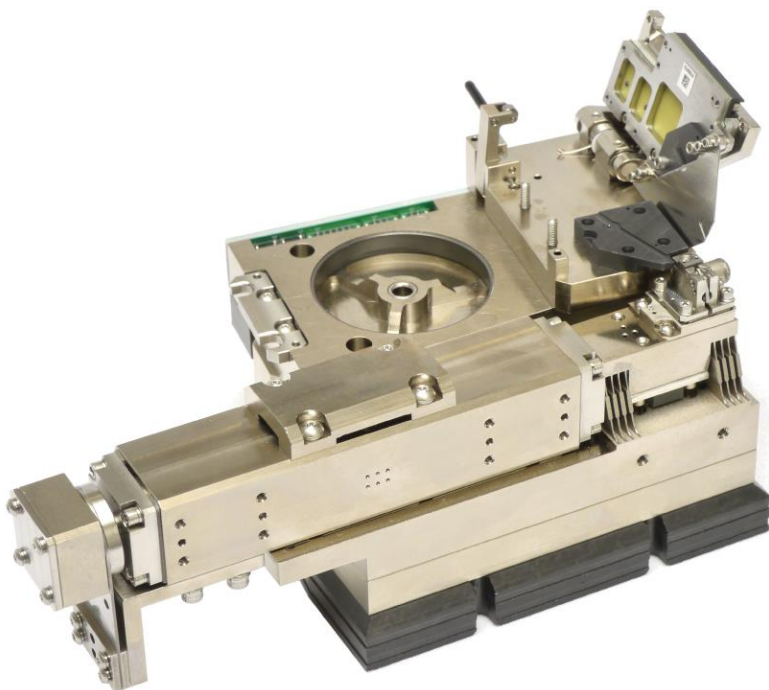


# PIEZO-SCALE CARTRIDGE (PSC) AND NEW SERVO-8 SYSTEM

for High-TPI Media and HGA Testing with V2002 Spinstand



Up to 2.7 kHz closed loop bandwidth<sup>1</sup>

Up to 1300 kTPI Estimated Capability<sup>2</sup>

At least 10x Times Faster Servo Writing<sup>3</sup>

New Servo-8 Control System

Down to 0.19 nm ( $1\sigma$ )  
NRRO in servo mode<sup>4</sup>

Down to  $\pm 0.35$  nm (pk-pk)  
positioning repeatability<sup>4</sup>

- At least **2x** times increase in Units Per Hour (UPH) media testing
- Better uniformity and accuracy of servo writing for high-TPI HGA testing
- High-bandwidth servo significantly reduces spindle warm-up time
- New servo tolerates damaged servo sectors<sup>5</sup>
- Up to **34  $\mu$ m** usable radial positioning range<sup>6</sup>
- **Automatic** closed loop adjustment software
- RRO compensation for both piezo-servo and micro-actuator loops up to the loop bandwidth
- For volume HGA testing Guzik Technical Enterprises recommends fully automated V2018 Spinstand, delivering same key performance parameters

# OVERVIEW

Guzik introduces the new generation of head mounting cartridge with *integrated glass scale – Piezo Scales Cartridge (PSC)* – targeted for media testing.

The servo writing capability of V2002 systems is limited to track densities below claimed spindstand capability due to low bandwidth of the Main Piezo actuator and possible rotation of the head mounting block against the glass scale during radial positioning.

New PSC cartridge, available as an upgrade for existing V2002 systems, addresses this limitation by introducing high-bandwidth closed-loop positioning system with piezo actuator and glass scale encoder installed in a close proximity to the head mounting block, down to less than 1 Inch from 5 Inch on V2002 main piezo stage. This brings the piezo-scales closed loop bandwidth of PSC cartridge up to 2.7 kHz from 120 Hz of V2002 Main Piezo<sup>1</sup>.

The improved piezo-scales closed loop bandwidth allows much more precise and repetitive positioning in piezo-scales closed loop mode, which is crucial for accurate servo writing. The V2002 system, upgraded with new PSC cartridge, allows writing servo with all modern high-TPI heads.

Another improvement over traditional PAC is the introduction of the *charge-based piezo actuator control*. In Servo-8 control system the piezo displacement is controlled by changing the piezo charge in the closed loop. The piezo charge control has big advantage over traditional piezo voltage control used in all previous Guzik spindstands: position has linear dependency on the piezo charge and has minimal hysteresis. The residual hysteresis is equal or less than 1% of the full piezo actuator stroke range. This allows increasing the closed loop bandwidth compared with voltage-controlled closed loop.

Having the scale on the cartridge eliminates the need for Main Piezo assembly, which is replaced with a solid metal part improving the rigidity of the head loader mechanism base.

As a result of these improvements, PSC cartridge increases the system testing throughput at least **two times** due to much faster radial positioning.

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<sup>1</sup> Compared to 120 Hz main piezo-scales closed loop bandwidth for V2002 Spindstand. 2.7 kHz piezo-scales closed loop bandwidth is achieved for 18 mm piezo models. Longer range piezo models have smaller bandwidth. See *Specifications* section for details.

<sup>2</sup> Estimation based on “NRRO ( $1\sigma$ ) = 1% of track width” criterion, with optional Servo Improvement Package, typical value for 7200 RPM product

<sup>3</sup> With comparable servo quality on V2002 system with PAC cartridge

<sup>4</sup> With optional Servo Improvement Package, typical value for 7200 RPM product

<sup>5</sup> Can tolerate up to 10% of invalid servo sectors per revolution

<sup>6</sup> With 60 mm piezo; piezo options available: 18 mm, 40 mm, and 60 mm for optimal combination of mechanical bandwidth and positioning range

## POSITIONING IMPROVEMENTS

Highly linear glass scale position feedback combined with low actuated mass and highly linear piezo actuator allows significantly faster micro positioning. Improved positioning speed and settling time leads to 2x time improvements for offset scan operations (such as track profile measurement and band erase procedure) compared to PAC. Servo writing and capturing is up to 3x times faster compared to previous generations of servo control system.

Improved positioning in non-servo mode reduces the negative effects of the radial thermo-drift during servo writing, which in turn improves the quality of written servo as written signal is more uniform and less distorted across the servo range. It also produces better servo capturing results: servo capturing with “*Regular*” quality setting on PSC systems delivers similar servo performance as servo capturing with “*Best*” quality setting on V2002 PAC systems. This translates into more than **10x** time reduction for servo writing and capturing procedure to achieve the best servo quality.

Faster servo writing together with high-bandwidth RRO compensation in servo mode reduces the negative effects of increasing RRO and rotation center drift during spindle warm-up period. This greatly decreases spindle warm-up time required for normal servo operation from hours to minutes.

## SERVO-8 CONTROL SYSTEM

*Servo-8* control system introduced together with PSC implements advanced positioning control schemes and RRO compensation with all servo closed loop modes: piezo-servo mode and micro-actuator mode.

New servo control scheme implemented in *Servo-8* now can operate with non-zero amount of damaged servo sectors (as opposed to the traditional servo control scheme, which requires all servo sectors to be decoded during servo writing and capturing). This greatly lowers the probability of failures during servo writing and capturing due to local media defects and enables testing media with defects in servo zone.

*Servo-8* is accompanied with advanced closed loop tuning software which provides automatic adjustment of charge closed loop, piezo scales closed loop, and micro-actuator closed loop. Interactive loop setup GUI is available for piezo-servo closed loop adjustment.

Advanced servo diagnostics software is developed for *Servo-8* which allows visualization of servo defect map and servo capturing results.

*Servo-8* requires new set of spinstand electronics, which includes Servo Controller 8, Piezo Driver 8, and Coldfire 8 boards installed in the Spinstand Control Box (SCB). For micro actuator control the Micro Actuator Driver 8 board is required.

# SPECIFICATIONS<sup>1</sup>

## Micro-Positioning Mechanism

<b>Actuator Type</b>	Piezo element		
<b>Available Piezo Sizes</b>	<b>18 mm</b>	<b>40 mm</b>	<b>60 mm</b>
<b>Usable piezo range (typical)</b>	13 um	20 um	34 um
<b>Piezo-Scales Closed loop Bandwidth (typical)</b>	2.7 kHz	2 kHz	1.6 kHz
<b>Micro-Positioning Encoder Type</b>	Heidenhain glass scale encoder and embedded servo		
<b>Local Micro-Positioning Accuracy of Glass Scale within Piezo Range</b>	±0.3 nm		
<b>Hysteresis</b>	Closed loop system, no hysteresis		

## Servo Subsystem

*(all servo performance parameters are typical values, measured for 7200 RPM, 2.5" product on standard-performing HGAs)*

<b>Servo Revision</b>	Servo Revision 8	
<b>Servo Closed loop Bandwidth</b>	<b>18 mm piezo</b>	2.5 kHz
	<b>40 mm piezo</b>	1.7 kHz
	<b>60 mm piezo</b>	1.2 kHz
<b>Servo Non-Repeatable Runout</b>	0.19 – 0.35 nm, 1 $\sigma$	
<b>Servo Position Repeatability</b>	±0.35 – ±0.7 nm	
<b>Integral Servo Accuracy within Servo Range</b>	±0.5 nm	
<b>Servo Resolution</b>	0.02 nm	

<sup>1</sup> Specifications are subject to change without notice

<b>Damaged Servo Tolerance</b>	<b>Max. Sequential Damaged Servo Sectors</b>	2.5% of rev. or 5 <i>(whichever is smaller)</i>
	<b>Max. Total Damaged Servo Sectors</b>	10% of rev.

## Timing Performance

*(all performance parameters are typical values, measured for 7200 RPM, 2.5" product)*

<b>Servo Writing Speed<sup>1</sup></b>	4 sec per um <i>(for 13 nm servo pitch)</i>	
<b>Servo Erase Speed</b>	< 13 ms per track	
<b>Non-servo Seek Time, ms</b>	<b>100 nm</b>	2.2 ms
	<b>1000 nm</b>	3.6 ms
<b>Servo Seek Time, ms</b>	<b>100 nm</b>	2.9 ms
	<b>1000 nm</b>	4.2 ms

<sup>1</sup> Including capturing with "Regular" servo capturing quality setting

# SYSTEM UPGRADE REQUIREMENTS AND ORDERING INFORMATION

Guzik V2002 systems have to be converted to HDR configuration with UP14 first. Then the Spinstand Control Box is upgraded with a new set of Servo-8 boards: Servo Controller 8, Piezo Driver 8, and Coldfire 8. Finally, mechanical upgrade of main piezo assembly is performed.

For compatibility verification and upgrade quotation please contact [sales@guzik.com](mailto:sales@guzik.com). For faster response please provide RWA and Spinstand EEPROM Dump information.



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