

Bruker Hysitron TI Premier

Standard Engineering and Performance Specifications



Normal Loading (Standard Quasistatic Testing)

Load Noise Floor: <75nN (*improved to <20nN with Performech II controller*)
Normal Force Bit Resolution: <1nN
Maximum Force: 10mN
Minimum Contact Force: See minimum in-situ imaging force for value
Maximum Load Rate: >50mN/s

Normal Displacement (Standard Quasistatic Testing)

Displacement Noise Floor: <0.2nm
Normal Displacement Bit Resolution: <0.006nm
Thermal Drift (at room temperature) : <0.05nm/s
Maximum Displacement: 5µm (can be extended to provide 15µm upon request)

Digital Control Module – supplied as standard (*Performech II upgrade available*)

Controller Architecture: Embedded DSP and dedicated FPGA for each bank of ADC and DAC for parallel operation
External Communication Connectivity: USB 2.0 and above
ADC Sampling Rate: 78,000/sec simultaneous
DAC Resolution: 16 bit (20 bit with oversampling)
DAC Sampling Rate: 78,000/sec simultaneous
Total Number of DIO: 16 IN and 16 OUT

**Can support up to two upgrade options*

X and Y Translation Motorized Stage Specifications

Travel: 50mm x 150mm
Sample stage dimensions: 115mm x 100 mm
Step Resolution: 50nm
Maximum Translation Speed: 4.5mm/s
Usable X travel range varies depending on the optics and transducer combination.

Z Translation Stage Specifications

Travel: 50mm
Step Resolution: 3.1nm
Maximum Translation Speed: 1.9mm/s

In-situ SPM Imaging

Minimum Imaging Force: 70nN

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Scan Rate: 0.1Hz – 3.0Hz

Scan Resolution: 256 lines per image (*increased to 4,096 lines per image with Performech II controller*)

Maximum Scan Volume: >60µm x 60µm x 4µm

Tip Positioning Accuracy: +/-10nm

Data Acquisition Specifications

Maximum Number of Data Points per Curve: 131,072

Maximum Number of Loading Segments: 2,000

Open Loop Data Acquisition Rate: 15,000 points/sec

Closed Loop Data Acquisition Rate: 15,000 points/sec

Feedback loop rate in closed loop operation: 78 kHz

Top Down Optics Specifications

Optical Resolution: < 3µm

Optical Magnification: 10x

Apparent Magnification: 48x - 600x

Maximum Field of View: 1558µm x 1178µm

Minimum Field of View: 66µm x 50µm

Optical Image Stitching: Manual stitching of unlimited number of optical images after programming stage moves (automated with Performech II upgrade)

Scanning Wear Specifications

Adjustable Wear Track Size from 1µm to 60µm

Scan Velocity: ≤360µm/s

Normal Load Range: 100nN - 1mN

Passive Vibration Isolation Platform

Load Range: 50 to 108 lbs (22 Kg to 49 Kg)

Vertical natural frequency of 1/2 Hz or less can be achieved over the entire load range.

Horizontal natural frequency is load dependent. 1/2 Hz or less can be achieved at or near the nominal load.

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Optional Upgrade Items

Lateral Loading and Displacement (Scratch Testing Option)

Load Noise Floor: $<3.5\mu\text{N}$
Lateral Force Bit Resolution: $<50\text{nN}$
Maximum Force: 2mN
Displacement Noise Floor: $<2\text{nm}$
Lateral Displacement Bit Resolution: $<0.02\text{nm}$
Thermal Drift (at room temperature) : $<0.05\text{nm/s}$
Maximum Lateral Displacement: $15\mu\text{m}$

nanoDMA III Specifications

Frequency Range: $0.1\text{Hz}-300\text{Hz}$
Maximum Dynamic Force Amplitude: 5mN
Maximum Quasi-Static Force: 10mN
Maximum Dynamic Displacement Amplitude: $2.5\mu\text{m}$
Maximum Quasi-Static Displacement: $5\mu\text{m}$
Displacement Noise Floor: $<0.2\text{nm}$

Extended Force Transducer

Maximum Force: 30mN
Normal Force Bit Resolution: 3nN
Minimum Contact Force: See minimum in-situ imaging force for value
Maximum Load Rate: $>50\text{mN/s}$

Electrical Contact Resistance (nanoECR)

Current measurement noise floor:	20 pA^*
Current measurement resolution:	5pA^*
Voltage measurement noise floor:	$10\text{ }\mu\text{V}^*$
Voltage measurement resolution:	$5\mu\text{V}^*$
Maximum Current (software limited):	10mA^*
Maximum Voltage (software limited):	10V^*
Electrical measurement rate:	Up to 4kHz^*
Maximum load:	10 mN
Load Resolution:	$<1\text{nN}$
Load noise floor:	$\leq 30\text{nN}$
Displacement Resolution:	0.02nm
Displacement noise floor:	0.2nm
Shielded System Enclosure:	Yes
Auxillary Data Channel Acquisition:	Yes

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*See Keithley 2602 System Sourcemeter® document for further system specifications

Active Vibration Isolation Platform

Frequency Range: 1.0-200Hz Active. Beyond 200Hz Passive
 Transmissibility: <0.017 above 10Hz and decreasing rapidly beyond 100Hz
 System Noise: <50ng per root Hz from 0.1-300Hz
 Static Compliance: 14.0µm/N vertical, 28µm/N horizontal
 Correction Forces: 16N vertical, 8N horizontal

xSol 400°C, 600°C, 800°C Heating Stage

Temperature range: ambient to 400°C, 600°C, or 800°C
 Temperature resolution: 0.1°C
 Temperature accuracy: 2.2 °C or greater than 0.75%
 Maximum Temperature Ramp Rate 20 °C/min
 Maximum drift rate ≤2nm/sec
 Displacement Noise Floor ≤1.0nm
 Measurement window: A minimum of 2mm diameter
 Maximum thickness of the sample: 5mm for thermally conductive and 2mm for non-conductive sample

Notes: *Equipment Rack Requirement: 90 mm*

Additional Floor Space Requirement: 310 mm wide x 420 mm deep x 640 mm tall

Compatible with and supports all standard functions of the following transducers: Standard 1-D, Standard 2-D, nanoDMA

Note Regarding Testing at Elevated Temperatures:

Complex chemical and physical interactions may occur during nanomechanical testing at elevated temperatures. It is the customer's responsibility to understand the potential interactions between the tip and sample at elevated temperature in order to assess tip material suitability and maximize tip life. Hysitron has the ability to manufacture probes from a wide range of specialty materials per customer requests, based on the customer's understanding of tip/sample interactions

Multi-Range Nanoprobe Specifications

Bandwidth: 500Hz

Max Load	Load Noise Floor	Max Displacement	Displacement Noise Floor
500mN	≤ 3.0 µN	80µm	0.5nm
1N	≤ 7 µN	80µm	0.5nm
2N	≤ 14 µN	80µm	0.5nm
5N	≤ 35 µN	80µm	0.5nm
10N	≤ 70 µN	80µm	0.5nm

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High Load Scratch Option Specifications

1.2	High Load Scratch Option	
1.2.1	Normal Load	
	(a) Maximum Load	1N, 2N, 5N, 10N (customer specified)
	(b) Load noise floor	TBD not to exceed 0.0008% of the full scale
	(c) Load resolution	0.000014% of the full scale
1.2.2	Normal displacement	
	(a) Maximum displacement	80μm
	(b) Displacement noise floor	0.6 nm
	(c) Displacement resolution	<0.01nm
1.2.3	Lateral Load	
	(a) Maximum load (X and Y axis)	5N
	(b) Load noise floor (X and Y axis)	50μN
	(c) Load resolution (X and Y axis)	0.000014% of the full scale
1.2.4	Lateral displacement	
	(a) Displacement noise floor	0.6nm
	(b) Displacement resolution	<0.02nm
	(c) Maximum scratch length (X or Y axis)	3 mm
	(d) Scratch test directions	+X, -X, +Y, or -Y
1.2.5	Maximum tip to sample plate distance	35 mm

Performech II™ Controller Upgrade

Normal Loading (Standard Quasistatic Testing)

Load Noise Floor: <20nN

Minimum Contact Force: <70nN

Maximum Displacement: 5μm

Data Acquisition Specifications

Open Loop Data Acquisition Rate: 38,000 points/sec

Closed Loop Data Acquisition Rate: 38,000 points/sec

Option Support

Support for 3 or more options.

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Electrochemical Nanoindentation (ECNI) cell

Fluid cell sample holder specifications

Minimum sample size: 5mm

Maximum sample size: <54 mm (see image and description below)

Active area in contact with fluid: 5 mm diameter

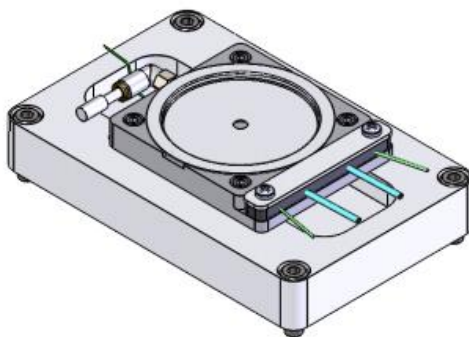
Maximum submersion depth: 7 mm maximum including sample thickness (from the sample mounting block at the bottom of the 5mm hole to the very top of the 25 mm ring is 7 mm)

Electrode and fluid connections

Electrode connections: 3 electrodes in total.

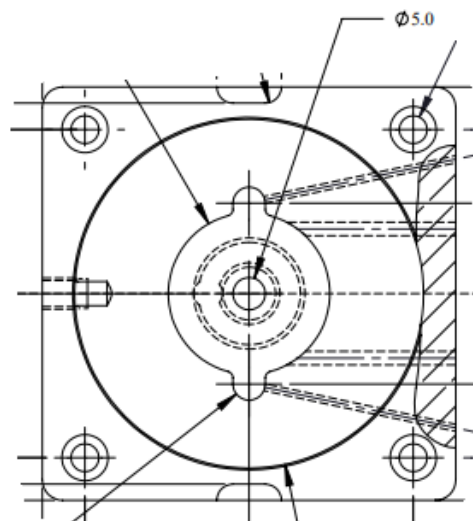
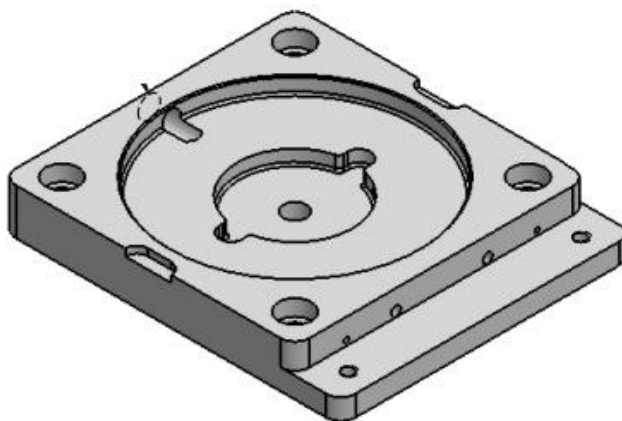
Fluid connections: 2 tubes in total

The 3 green wires shown on the drawing are the 3 electrodes, the two blue tubes on the drawing are the tubes for fluid exchange:



Cell description and working principle

In the very center of the EC cell is a 5mm through-hole. The second "ring" (with the two small cavities on opposite sides) is designed to hold the fluid during routine operation, however, the largest topmost "ring" is 54mm in diameter therefore it is possible to fit a sample this large in the cell.





Facility Requirements for Instrument Installation

Acoustic Noise

Should be no more than 75dB for TI Premier environment.

Floor Vibration

Allowable Vibration:

1. The maximum allowable vibration periodic amplitude in the velocity spectrum is:
Below VC-C (with extended low frequency limit)
 - * 100 $\mu\text{m/sec}$ RMS at 1.0 Hz
 - * 12.5 $\mu\text{m/sec}$ RMS at 8.0 Hz
 - * 12.5 $\mu\text{m/sec}$ RMS at 100 Hz
2. The peak acceleration (maximum or minimum) in a time wave form to be less than .001 g.
3. The RMS acceleration of the time wave form for an entire 1 hour test to be less than 50 μg .

Power Requirements

The system is designed for a specific voltage. Depending on the geographical location of the instrument the system will run either on 110 VAC (60 Hz) or 220 VAC (50 Hz). The maximum current required at any time will not exceed 15 A for the 110 VAC system and 8 A for the 220 VAC system. The instrument electronics rack does come equipped with its own surge protection/power strip, however, if numerous options have been ordered there may not be space on the supplied power strip for all options and additional wall outlet(s) will be required.

TribolIndenter® system		
	110 VAC	220 VAC
Maximum power consumed	1540 VA @ 14 A	1540 VA @ 7 A
Rated input voltages	110 VAC \pm 10%	220 VAC \pm 10%
Rated input frequencies	50/60 Hz \pm 5%	50/60 Hz \pm 5%

If a heating/cooling stage has been purchased for the TribolIndenter® system an additional 4.5 A at 110 VAC and 2.5 A at 220 VAC will be required.

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HVAC Requirements

Maximum environmental humidity is specified at 45%

Room must have suitable cooling capability to maintain a constant temperature (between 17 Degrees C and 25 Degrees C) while not varying by more than +/- 5 Degrees C during normal operation.