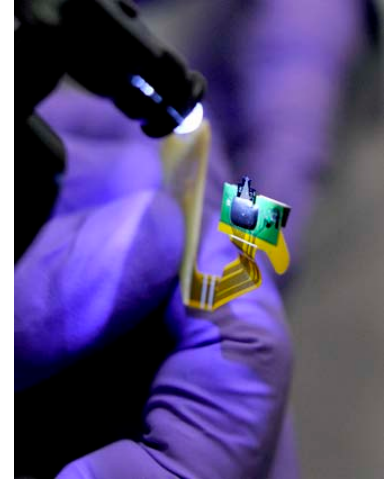


Active Pen™ Array Option

for multi-probe, multi-ink applications

NanoInk’s Active Pen™ Arrays allow advanced control of direct nanoscale materials deposition, by adding the ability to individually actuate pens in an array. Using thermal bimorph technology, pens can extend and retract from the writing surface. Control of active pen x, y and z motion over the surface is integrated into NanoInk’s InkCAD™ software, allowing the user to design complex patterns in multiple layers.



With Active Pen Arrays you can:

- Write patterns with an inked pen and immediately inspect the area with an un-inked pen, preventing smearing and contamination of patterned features.
- Image a surface area using a clean tip, then write into that area with an ink of choice.
- Write nanoscale structures in one patterning job that consists of multiple functional ink materials, using individually coated active pens (i.e., rather than switching single pens for different inks).

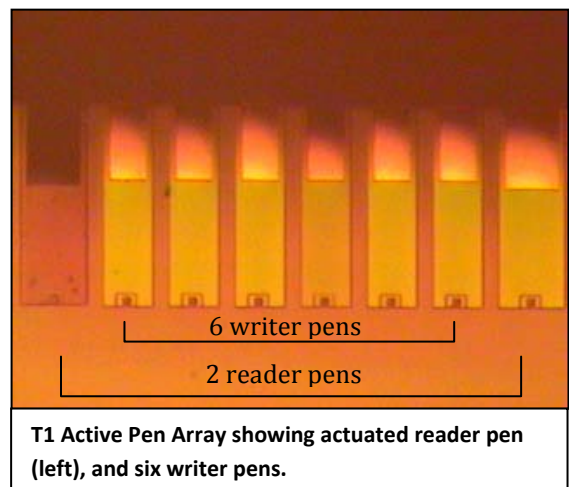
The Active Pen Array Option includes the active microfabricated pens and electronic modules mounted into the scanner that control the pens. The pen arrays are delivered fully mounted and electrically connected onto a flex circuit.

Table 1: Cantilever Specifications

Probe Type	Writer k (N/m)	Writer width (μm)	Writer length (μm)	Writer-Writer pitch (μm)	Writer-Writer gap (μm)	Reader k (N/m)	Reader width (μm)	Reader length (μm)	Reader-Writer pitch (μm)	Reader-Writer gap (μm)
T1	0.18	30	150	40	10		40	150	45	10

Active Pen MEMS Hardware

- Operational Actuation Range: 500 nm to 10 μm
- Maximum Actuation Range: 20+ μm
- Recommended Operating Current: 15-40 mA
- Environmental Temperature for Operation: 20 - 30 $^{\circ}\text{C}$
- Tip Radius: 20 +/- 5 nm
- Actuation Direction: Towards Substrate
- Actuation Mechanism & Material: Thermomechanical Metallic Bimorph
- Cantilever Material: Silicon-rich Si_3N_4
- Cantilever Modulus: 123 GPa +/- 10%



Active Pen Electronics

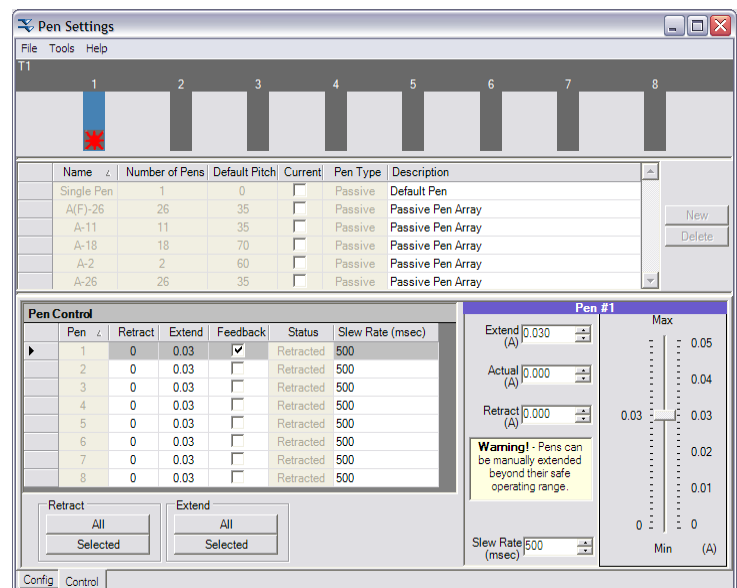
The Active Pen Array Option requires additions and modifications to the DPN 5000 system hardware that can only be carried out by NanoInk certified personnel. The electronic interface board between MEMS hardware and control software has the following features:

- Eight driver outputs are available in parallel
- Two ADC inputs are present
- Driver outputs type: Voltage to current configuration
- Maximum output current per driver output: 55mA for loads < 40 Ω
- Actuation slew rate: < 10 μ s
- Total actuation latency (all eight pens): < 30ms
- Pen to pen actuation latency: < 5ms

Active Pen Software

The Active Pen option requires installation of InkCAD™ 4.0 software. This version offers:

- Software support for separate reader/writer operation - integrated control for writing with one pen and imaging with a different pen.
- Support for multilayer writing with separate pens. Each layer can be drawn with a separate pen. Multi-pen design is fully integrated into the InkCAD design environment.
- Selective parallel writing. Choose which pens to draw within a layer
- Active Pen control dialog - individual pens can be manually manipulated and configured from this panel
- Tip to Tip Alignment Wizard - the nanoscale positioning between pens can be determined with this wizard. Results are used for reader/writer operations and multilayer writing with separate pens so that the user doesn't have to do any calculations. Just select the pen to use for writing - all positioning offsets are accounted for.



Item Name: Active Pen Array Option

Item Number: DPN-0204-01

Compatible with the NSCRIPTOR and DPN 5000 Systems

For more information including pricing, please contact NanoInk Sales Department at sales@nanoink.net or 1-847-679-NANO.

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