

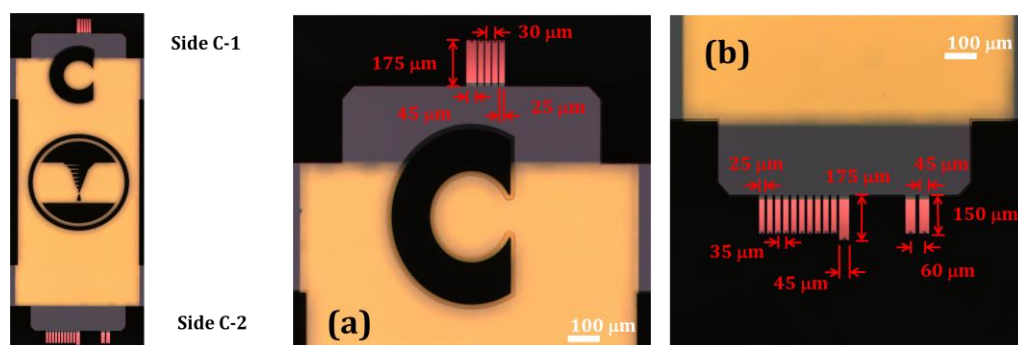
## DPN Pen Arrays: Types C, D, E, F, and M

### Introduction

Silicon nitride pen arrays are multi-pen arrays optimized for DPN applications using the NSCRIPTOR™, DPN 5000, and NLP 2000 Systems. To provide greater versatility the pens feature two different cantilever configurations. Available pen arrays include: Types C, D, E, F, and M.

### Type C Pen Arrays

Side C-1 contains an array of 5-cantilevers with 4-cantilevers designed for multi-patterning, referred to as “Writer” pens. A wider cantilever designed for laser alignment and imaging, is known as a “Reader” pen. Side C-2 consists of 2 different arrays. Pen array C-2a (on the left) is similar to C-1, but is a stiffer array of 10 Writer pens and 1 Reader pen. Pen array C-2b (on the right) is a simple 2-cantilever array.



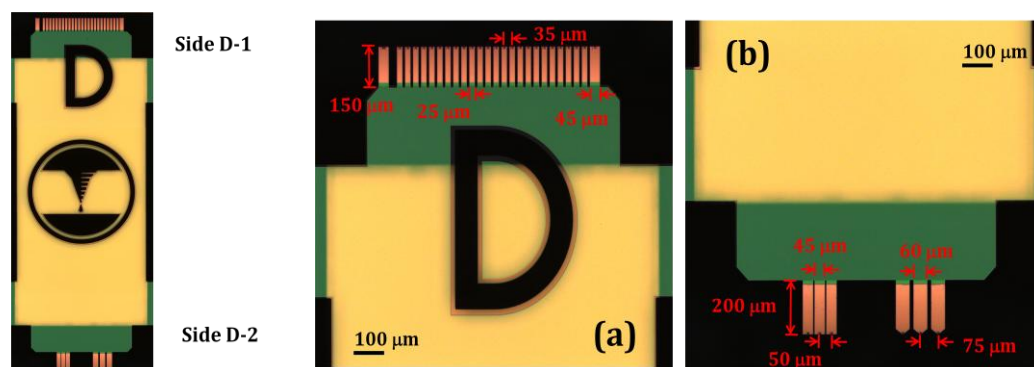
**Figure 1:** Left) Optical microscope image showing a Type C pen array chip. Right) Optical microscope images of Type C pen array cantilever configurations and their measurements. (a) Side C-1 has 4 Writer pens and 1 Reader pen. (b) Side C-2 has a 2-cantilever array on the right and on the left is an array of 10 Writer pens and 1 Reader pen.

### Type D Pen Arrays

Side D-1 contains a 26-cantilever array featuring 24-cantilevers designed for patterning, referred to as “Writer” pens. Located on the left and right edge of this array are 2 “Reader” pens designed for laser alignment and imaging. The width of this array also helps in achieving better surface leveling. Side D-2 contains 2 different 3-cantilever arrays, each with different spring constants, widths, and pitches.

## DPN Pen Arrays: Types C, D, E, F, and M

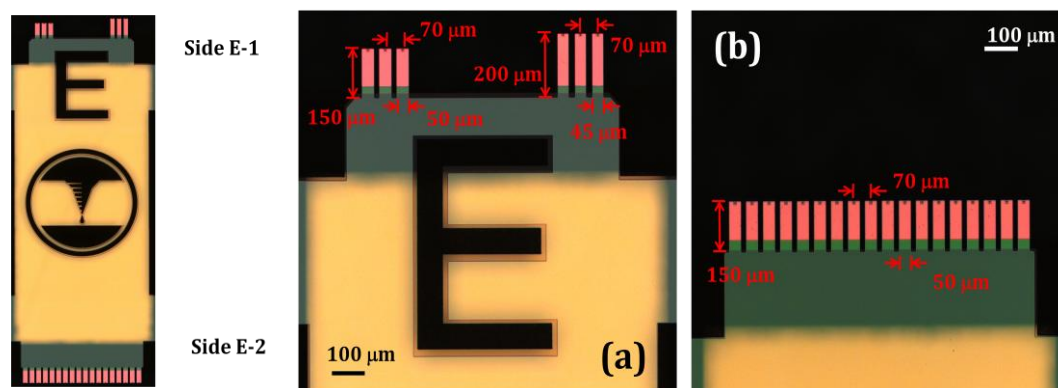
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**Figure 2:** Left) Optical microscope image showing a Type D pen-array chip. Right) Optical microscope images of Type D pen array cantilever configurations and their measurements. (a) Side D-1 has 24 Writer pens and 2 Reader pens. Side D-2 has 2 different 3-cantilever arrays.

### Type E Pen Arrays

Side E-1 contains 2 different 3-cantilever arrays. Pens E-1a (to the right) are longer and narrower with a lower spring constant. Pens E-1b (to the left) are shorter and wider with a higher spring constant. Side E-2 contains an 18-cantilever array for multi-patterning with the same properties as the E-1b pens.



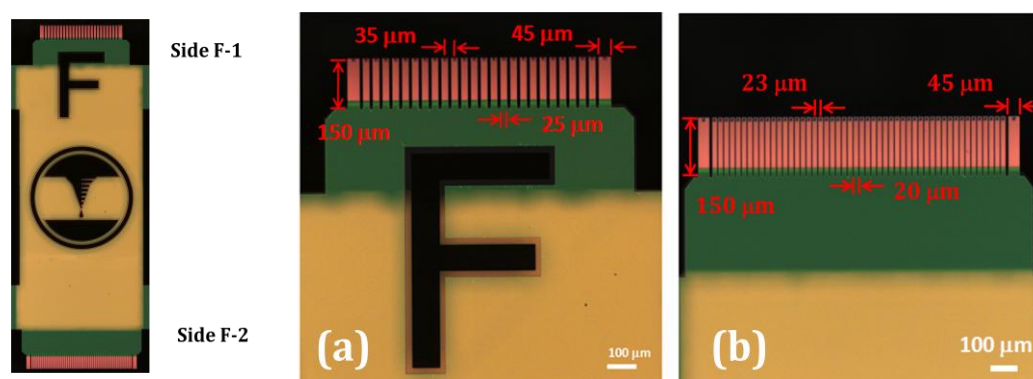
**Figure 3:** Left) Optical microscope image showing a Type E pen-array chip. Right) Optical microscope images of Type E pen array cantilever configurations and their measurements. (a) Side E-1 has 2 different 3-cantilever arrays. (2b) Side E-2 has an 18-cantilever array.

## DPN Pen Arrays: Types C, D, E, F, and M

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### Type F Pen Arrays

Side F-1 contains a 26-cantilever array featuring 24-cantilever tips designed for patterning, referred to as “Writer” pens. On the left and right edge of the Writer Pen Array is a “Reader” pen designed for imaging. Side F-2 has a similar configuration, but with a 52-cantilever array featuring 50 Writer pens and 2 Reader pens. The multiple pens of the F-1 and F-2 sides are higher density pen arrays with lower spring constants making them ideal for high throughput patterning and easy array leveling on the substrate of interest.



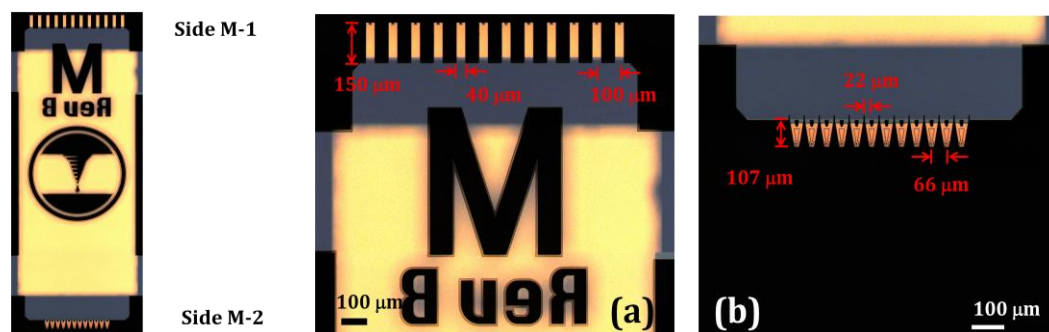
**Figure 4:** Left) Optical microscope image showing a Type F pen-array chip. Right) Optical microscope images of Type F pen array cantilever configurations and their measurements. (a) Side F-1 has 26-cantilevers: 24 Writer pens and 2 Reader pens. (b) Side F-2 has 52-cantilevers: 50 Writer pens and 2 Reader pens.

### Type M Pen Arrays

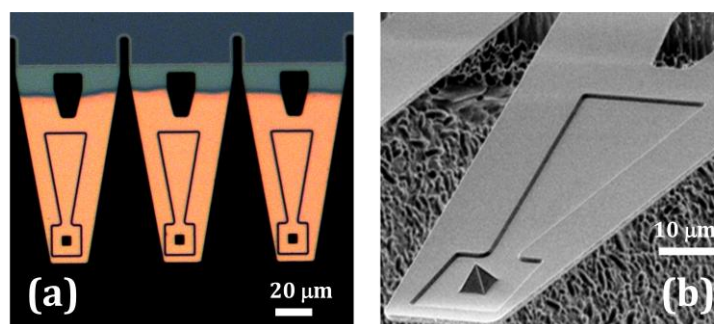
Side M-1 contains 12 “diving board” shaped cantilevers with a pitch of 100 μm and Side M-2 contains 12 modified “A-frame” cantilevers with a higher stiffness and spring constant designed specifically for patterning more viscous inks such as DNA solutions. Side M-2 pens are further modified to have a recessed area surrounding the tip in order to increase loading of material and extend printing times. Multiple cantilever arrays allow the tips to be loaded with different inks for multiplexing.

# DPN Pen Arrays: Types C, D, E, F, and M

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**Figure 5:** Left) Optical microscope image showing a Type M pen-array chip. Right) Optical microscope images of Type M pen array cantilever configurations and their measurements. (a) Side M-1 has “diving board” shaped cantilevers. (b) Side M-2 has “A-frame” shaped cantilevers.



**Figure 6:** Left) Optical microscope and FESEM images of Side M-2 pens. (a) Close-up optical microscope image of the “A-frame” shaped cantilevers. (b) FESEM image illustrating the recessed area surrounding the pen tip.

## Inkwell Arrays

For simple and easy transfer of ink materials to the pen tips, NanoInk has designed various configurations of Inkwell array chips to match available pen arrays. (Please refer to the inkwell datasheets for details or contact NanoInk.)

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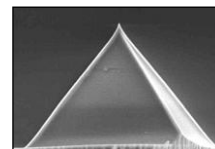
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### Nominal Dimensions of DPN Pen Arrays: Types C, D, E, F, and M

Pen Type	Reader k (N/m)	Reader Length (μm)	Cantilever Width (μm)	# Writer Pens	Writer k (N/m)	Pitch (μm)	Writer Length (μm)	Writer Width (μm)
C-1	0.061	175	45	3	0.034	30	175	25
C-2a				2	0.097	60	150	45
C-2b	0.061	175	45	10	0.054	35	150	25
D-1	0.097	150	45	24	0.054	35	150	25
D-2a				3	0.041	50	200	45
D-2b				3	0.055	75	200	60
E-1a				3	0.041	70	200	45
E-1b				3	0.108	70	150	50
E-2				18	0.108	70	150	50
F-1	0.097	150	45	24	0.054	35	150	25
F-2	0.097	150	45	50	<0.03	23	150	20
M-1				12	0.4	100	150	40
M-2				12	0.6	66	107	22

Note: Tip radius ~15 nm

**Figure 7:** FESEM image of the probe tip with a radius of ~15 nm.



### Ordering Information

Item Name: Pens, Type C, D, E, F, or M

Part #: PEN-0016-03 (Type C); PEN-0017-03 (Type D); PEN-0019-03 (Type E); PEN-0020-03 (Type F); PEN-0300-02 (Type M)

Compatible with the NLP 2000 System, DPN 5000 System, and NSCRIPTOR™ DPN System

Learn more about NanoInk products and services at [www.nanoink.net](http://www.nanoink.net). Or call us at 847-679-NANO (6266).