ROCHESTER INSTITUTE OF TECHNOLOGY
MICROELECTRONIC ENGINEERING

Fluid Channels for Evaluation of MEMS Pumps and Gas Flow Sensors

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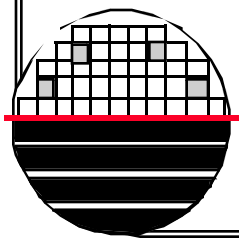
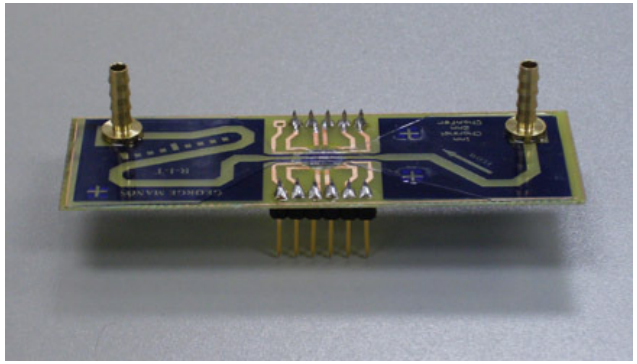
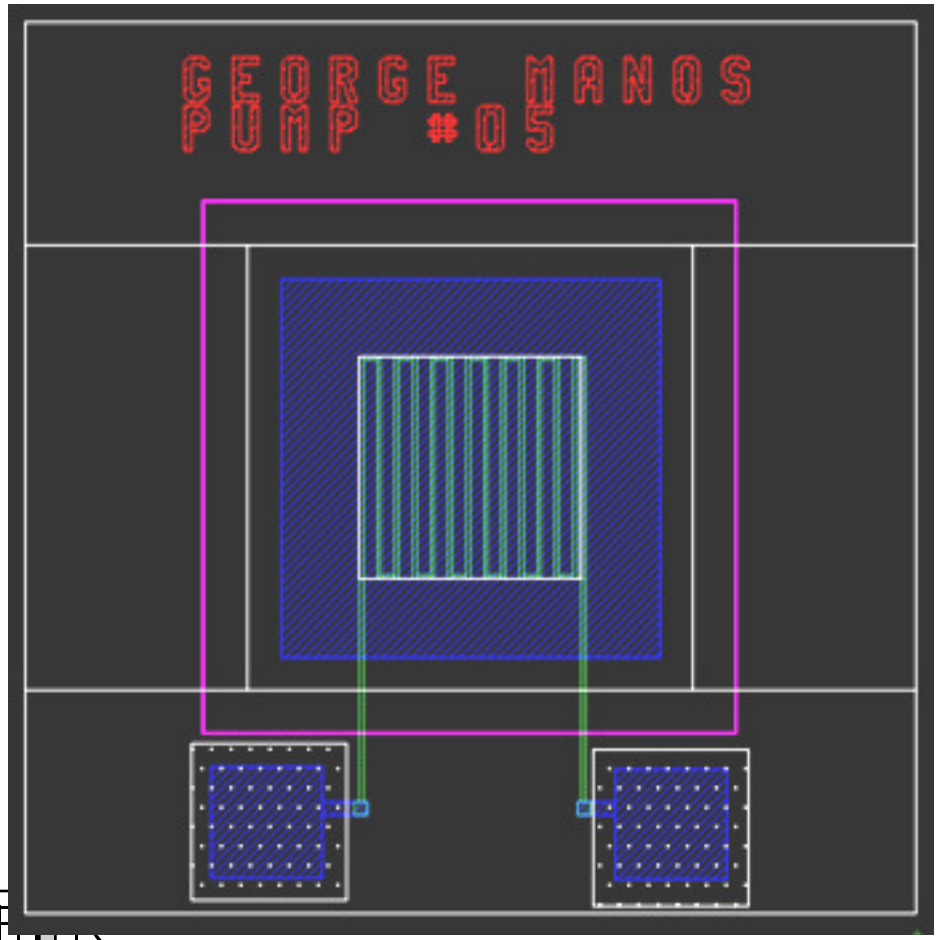


OUTLINE

Mems pump design
Mems gas flow sensor design
Waver dicing
Universal Pump Test Assembly
Fabrication Procedure
PCB fabrication
Epoxies
Pin Strip Headers
Channel Cover
Prototype Board for Drive Signals and Measurements
Measurements
Results
References



PUMP DEISGNS

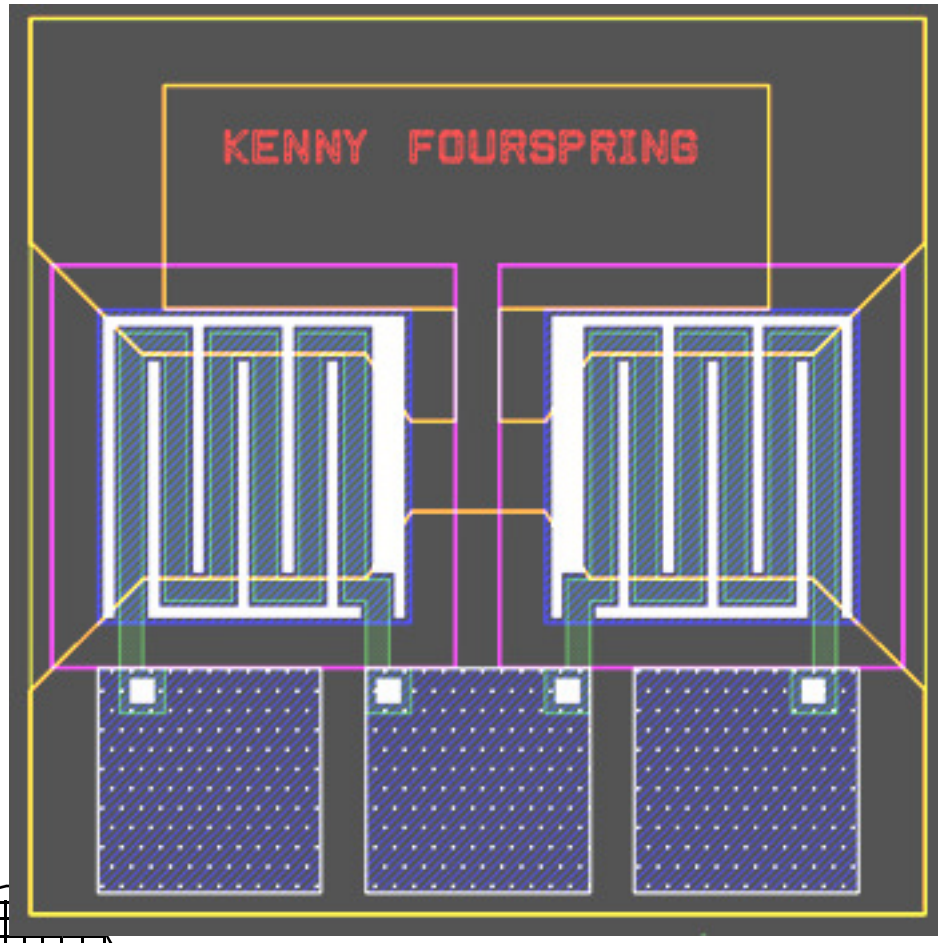


4mm x 4mm chip
2mm wide flow channel

2 Pads
2mm center to center pads
Pad size 800µm x 800

Street between die 500µm
Saw blade makes 200µm cut

PUMP DESIGNS

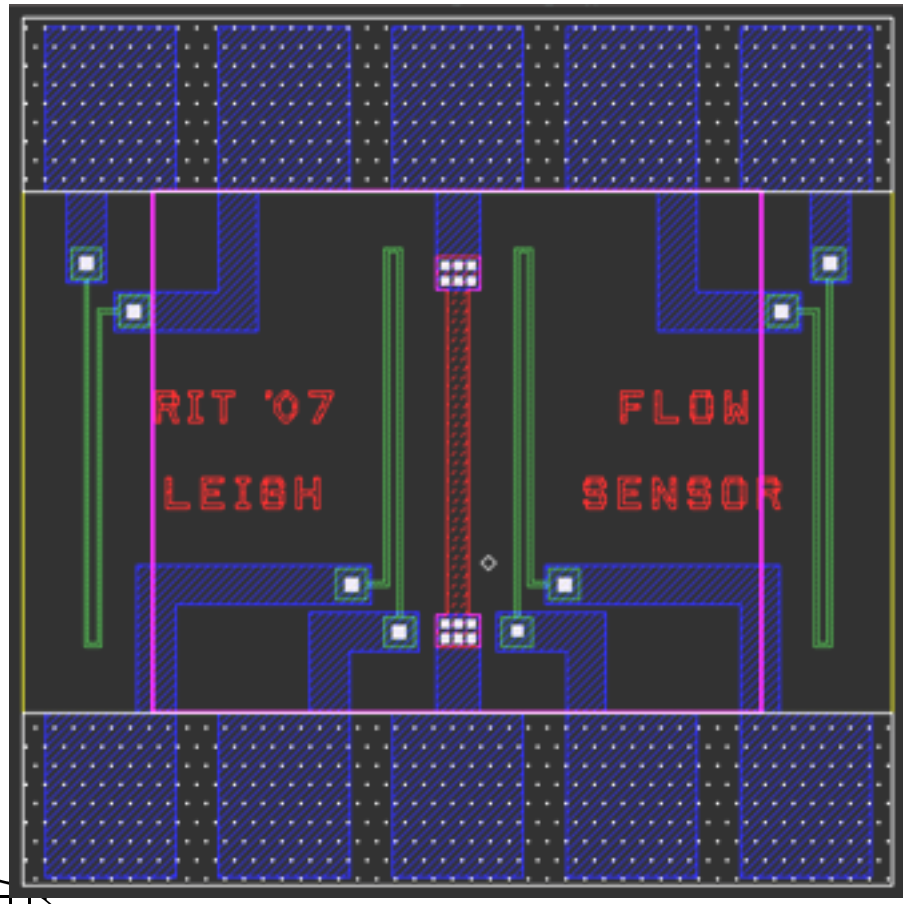


4mm x 4mm chip
Custom shaped flow channel

3 pads
1.2mm center to center pads
Pad size 1mm x 1mm

Street between die 500µm
Saw blade makes 200µm cut

GAS FLOW SENSOR DESIGN

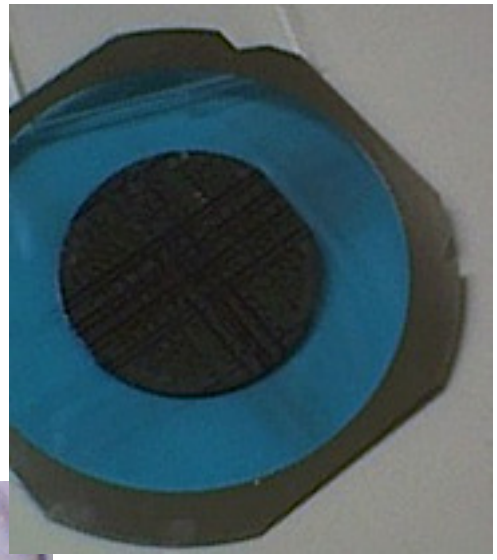


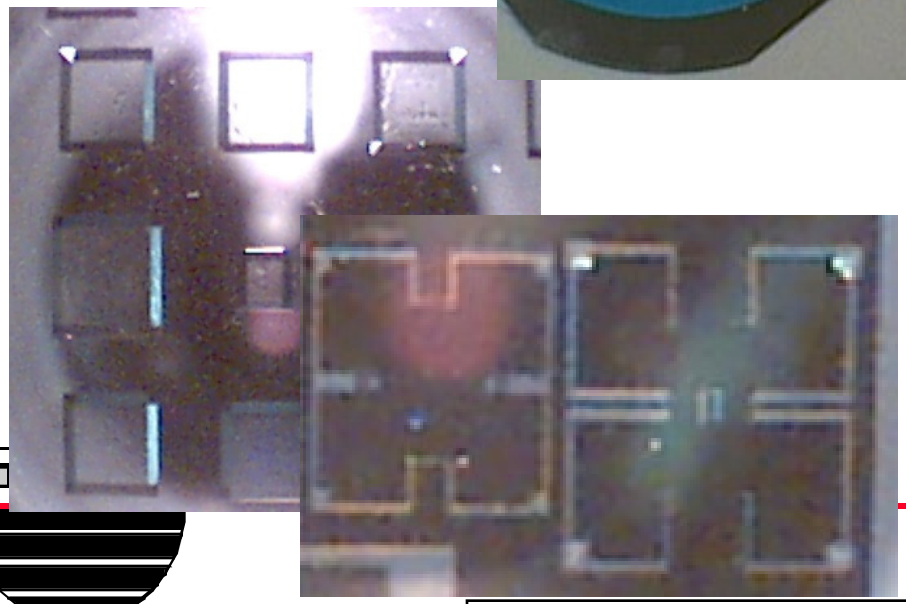
4mm x 4mm chip
2mm wide flow channel

10 pads
800µm center to center pads
Pad size 600µm x 600µm

Street between die 500µm
Saw blade makes 200µm cut

K&S 780 WAFER SAW

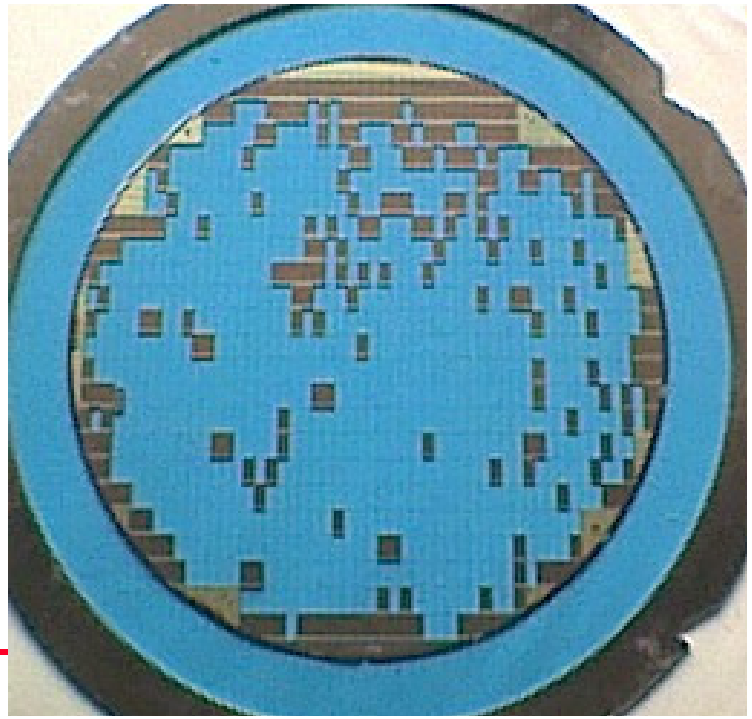




TAPES FOR DICING

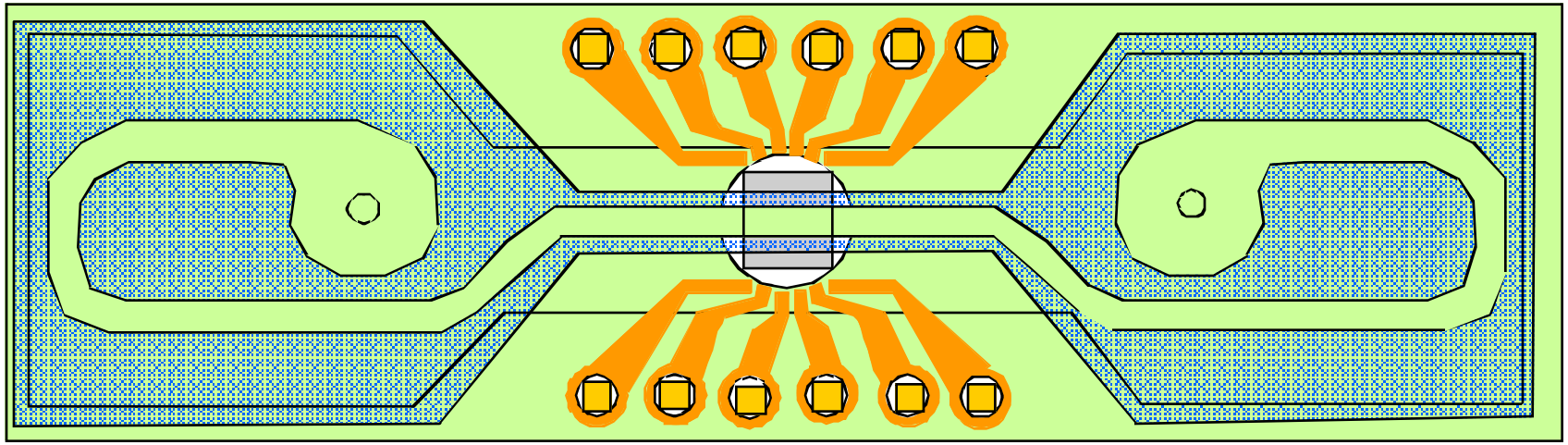
Nitto Denko Corporation (http://www.nitto.com)
Lintec Corp., Tokyo, Japan

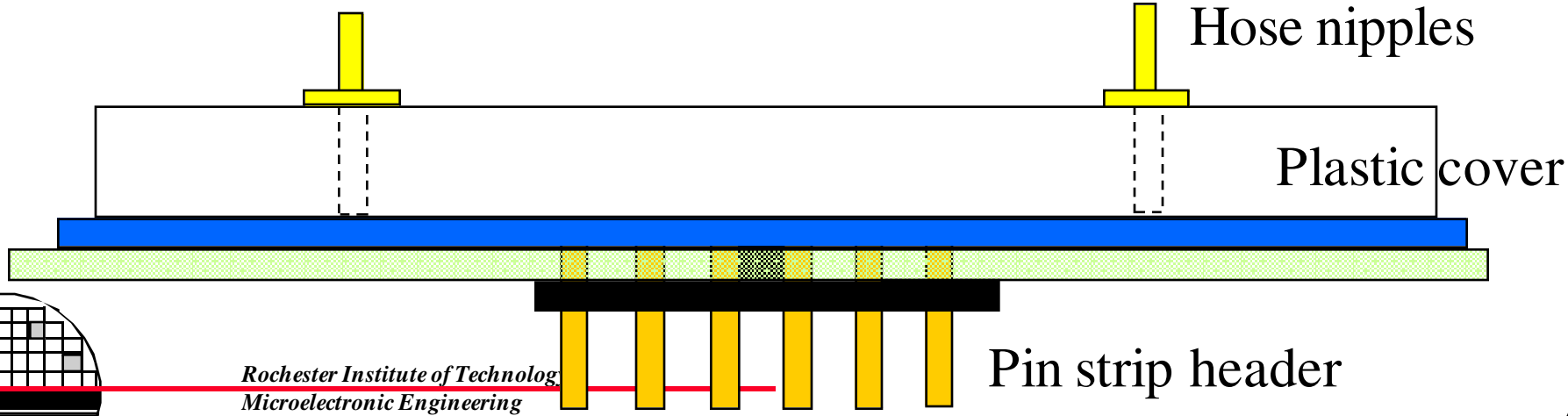
UV Light Release ADWILL T-5782, 200 mm x 10 m roll
Extra Sticky, ADWILL G-19, 200 mm x 10 m roll



UNIVERSAL PUMP TEST ASSEMBLY

1” by 3” PCB 0.0125” thick with 0.005”copper





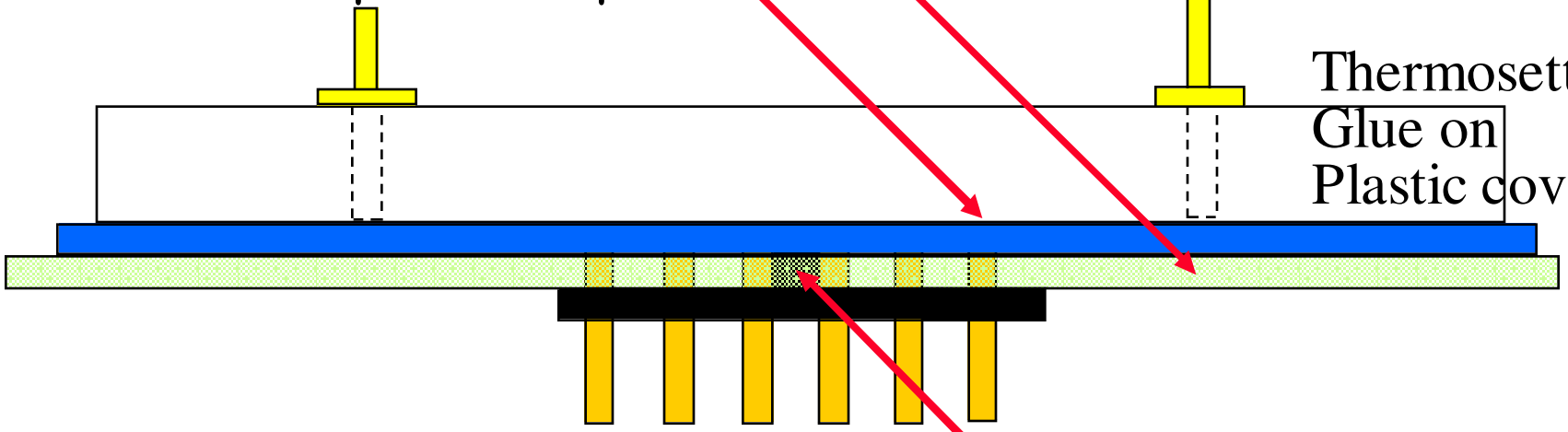
CROSSECTION

1” by 3” PCB 0.0125” thick with 0.005”copper

Photoresist (film) channel walls
Thickness 50µm to 125µm

Hose nipples

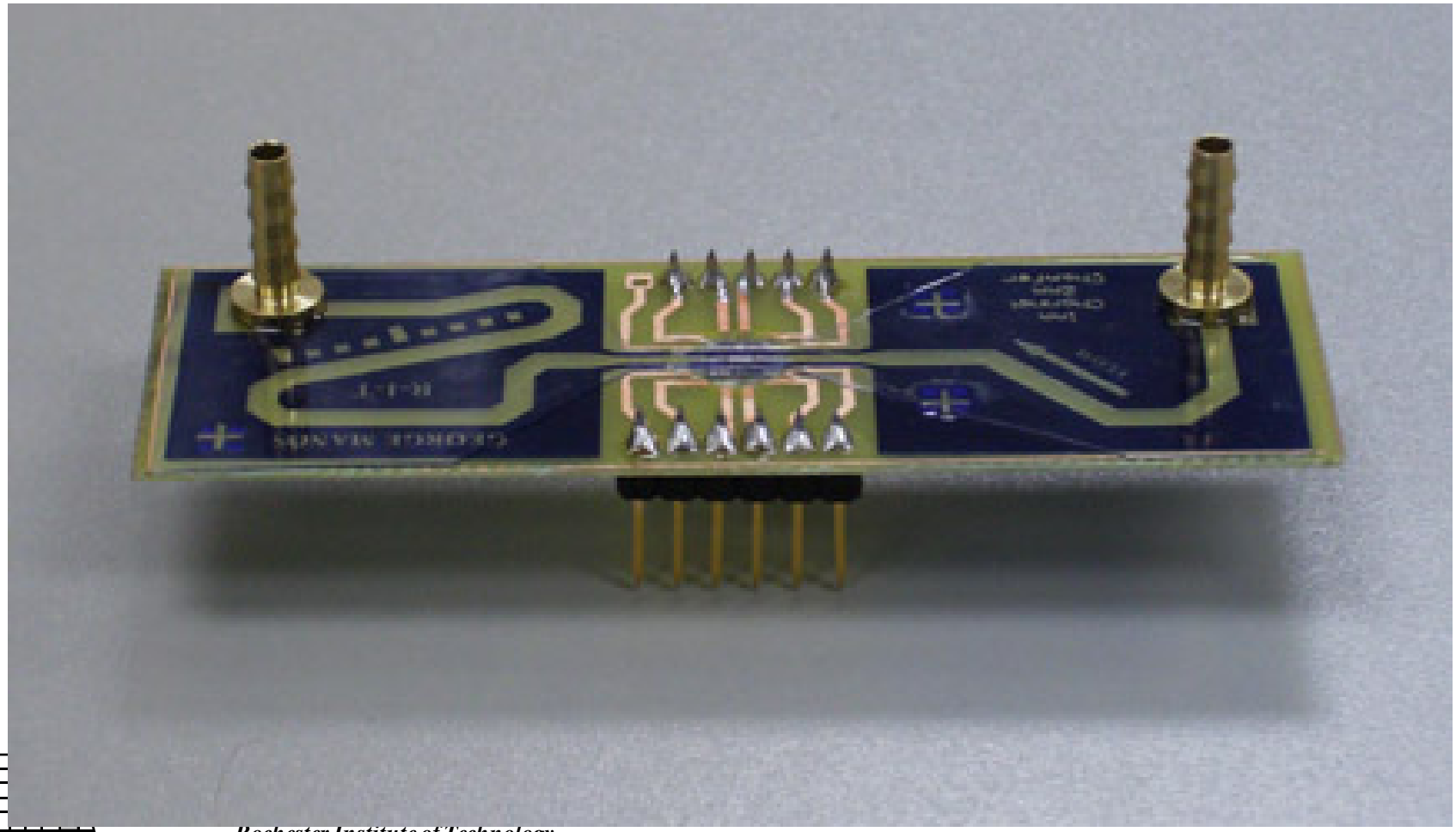
Thermosetting
Glue on
Plastic cover



Pin strip header

MEMS chip mounted flush with PCB surface, wire bonds from MEMS chip to copper traces

AFTER WIRE BONDS, HEADER AND NIPPLES



PUMP TEST ASSEMBLY FABRICATION

1. Make printed circuit board (See next page)
2. Drill holes for pins and big hole (holes) for microchips
3. Mount chip or chips using blue dicing tape to temporarily hold chip
4. Epoxy chips in place (thermally conductive epoxy?)
5. Remove blue dicing tape
6. Apply sheet photoresist
7. Align and expose photoresist
8. Develop photoresist
9. Hard bake photoresist
10. Cut and laminate plastic channel cover
11. Wire bond MEMS chip to copper traces
12. Drill holes for fluid input and output in cover
13. Epoxy hose nipples
14. Fill with fluid using syringe and test pumping action
15. Gas flow sensors may need heat sink on back of assembly

MAKE COPPER BOARD

Clean Board with 400 grit sand paper or very fine steel wool using Soap, Water and Blow Dry

Spin Coat with Positive Photoresist (S1813), 1500 rpm

Bake in Oven 100C 15 min.

Place Transparency on Board and Flatten with Glass Plate

Flood Expose, (10 sec = ~ 100mj/cm2)

Develop in CD-26 Developer (~1 min, overdevelop to ensure clear)

Bake in Oven 140C 15 min

Etch in Mixture of Water, H2O2, HCl (3:2:1)

Strip Resist in Acetone, Rinse in Water

Drill

Cut Board into Individual Packages Using Shear in Machine Shop

EPOXY MATERIALS

Master Bond Inc
154 Hobart St.
Hackensack, NJ 07601

(201) 343-8983
Offers over 100 different epoxy products, adhesives, sealants and coating.

Product Name	Mix Ratio	Viscosity RT, cps	Set-up time, RT	Cure Schedule	Applications
EP21TDCS					Silver Epoxy 20 grams min. sample $230
EP21TPND	100/100	thixotropic	30min	48hrs@RT+2hrs@200F	Polysulfide modified, Fuel and oil resistant sealant
EP30LTE	100/10	17,000	30min	24hrs@RT+3hrs@200F	Exceptionalyy low coefficient of expansion, low shrinkage
EP30	100/10	2000	25min	24hrs@RT+2hrs@200F	Clear system for optical and fiber optic bonding
EP77M-F	100/100	paste	8min	1hr@150F+8hr@300F	Electrically conductive silver filled epoxy
EP121AO	100/80	50,000	15hrs	3hrs@200F+9hrs@200F	Thermally conductive potting and encapsulation
SuperGel#7	100/100	500	3hrs	60hrs@RT+3hrs@200C	Soft resilient, transparent epoxy gel
SteelMaster 43HT	100/20	Thixotropic	25 min	24hr@RT+2hr@200C	Machinable, stainless steel filled

http://www.masterbond.com

PHOTOSENSITIVE FILMS

http://www.rayzist.com/

SR3000™ Self-Stick Resist - Sheets						"SELF-ADHESIVE REDEFINED"
Thickness	595 sq in	5 Sheets 8.5" x 14"	1190 sq in	10 Sheets 8.5" x 14"	2975 sq in	25 Sheets 8.5" x 14"
3 mil	$.063	$37.49	$.058	$69.02	$.053	$157.68
4 mil	$.068	$40.46	$.063	$74.97	$.058	$172.55
5 mil	$.073	$43.44	$.068	$80.92	$.063	$187.43

Also ImageOn from
RIT Bookstore 12”x10’x0.002” thick
for $18

PC BOARD, ELECTROPLATE MOLD, SAND CARVING MASK

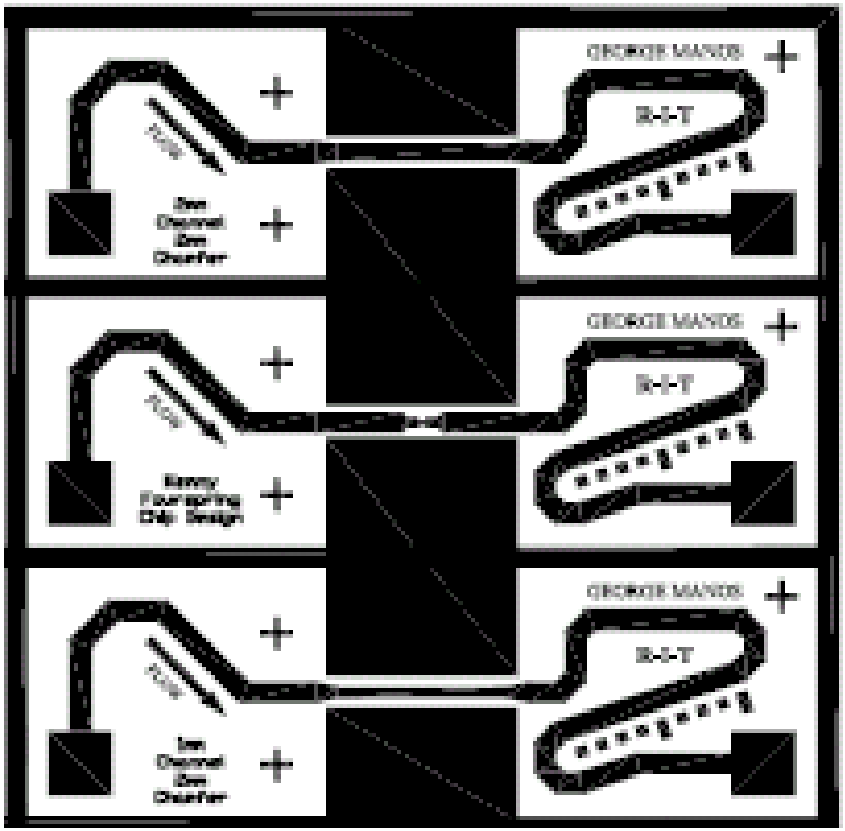
http://www.photobrasive.com
PhotoBrasive Systems
4832 Grand Avenue
Duluth, MN 55807
1-800-643-1037

Ultra Blue
10”x12” Qty 10 sheets 6 mil thick for $98
Negative working resist, developed in water
Self adhesive to substrate

Also special waterproof films for inkjet printers
8.5” x 11” Qty 10 sheets for $18

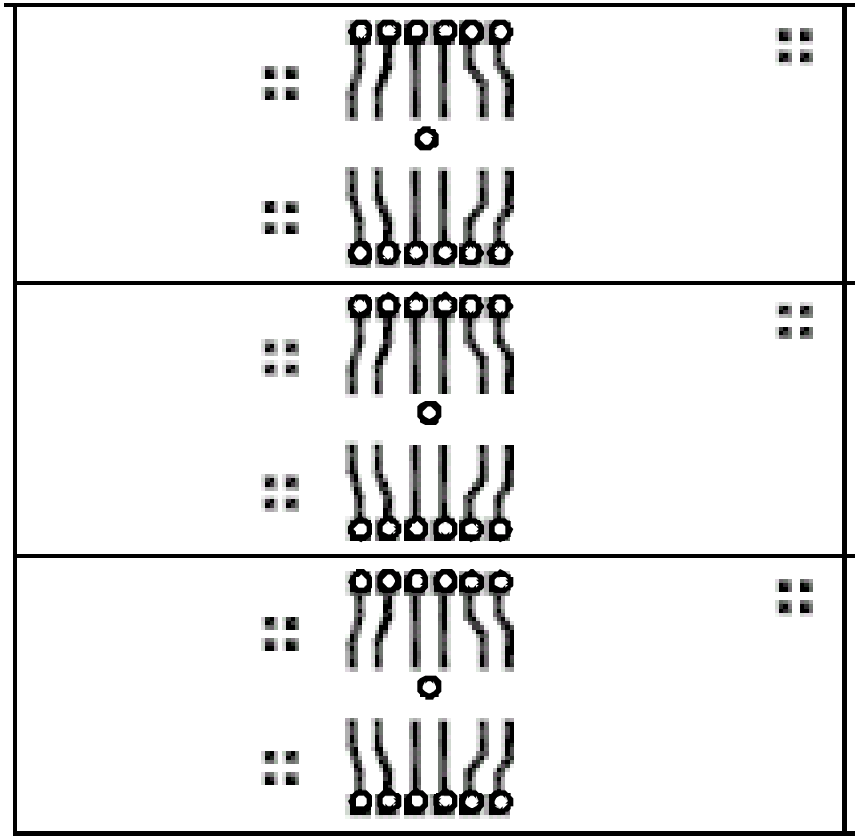
CHANNEL ARTWORK

Fluid
Alignment keys to match PCB



PCB ARTWORK

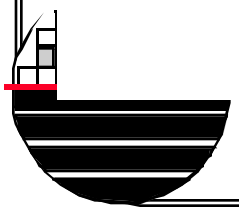
PCB
Donuts for drill hole alignment
Alignment Keys to match channel



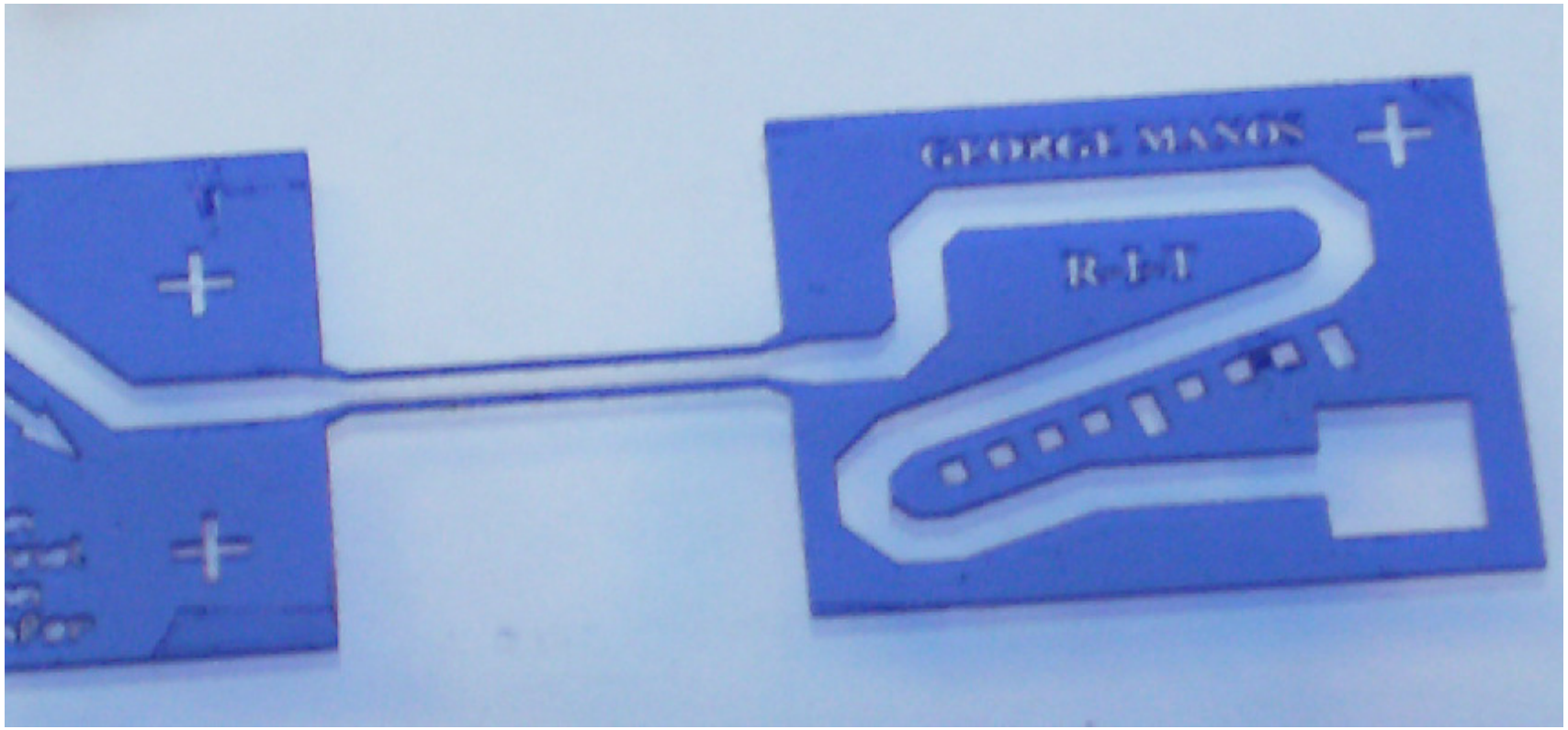
ImageOn Ultra Rapid Dry Film Resist

ImageOn Processing –negative working resist, 50µm Thick

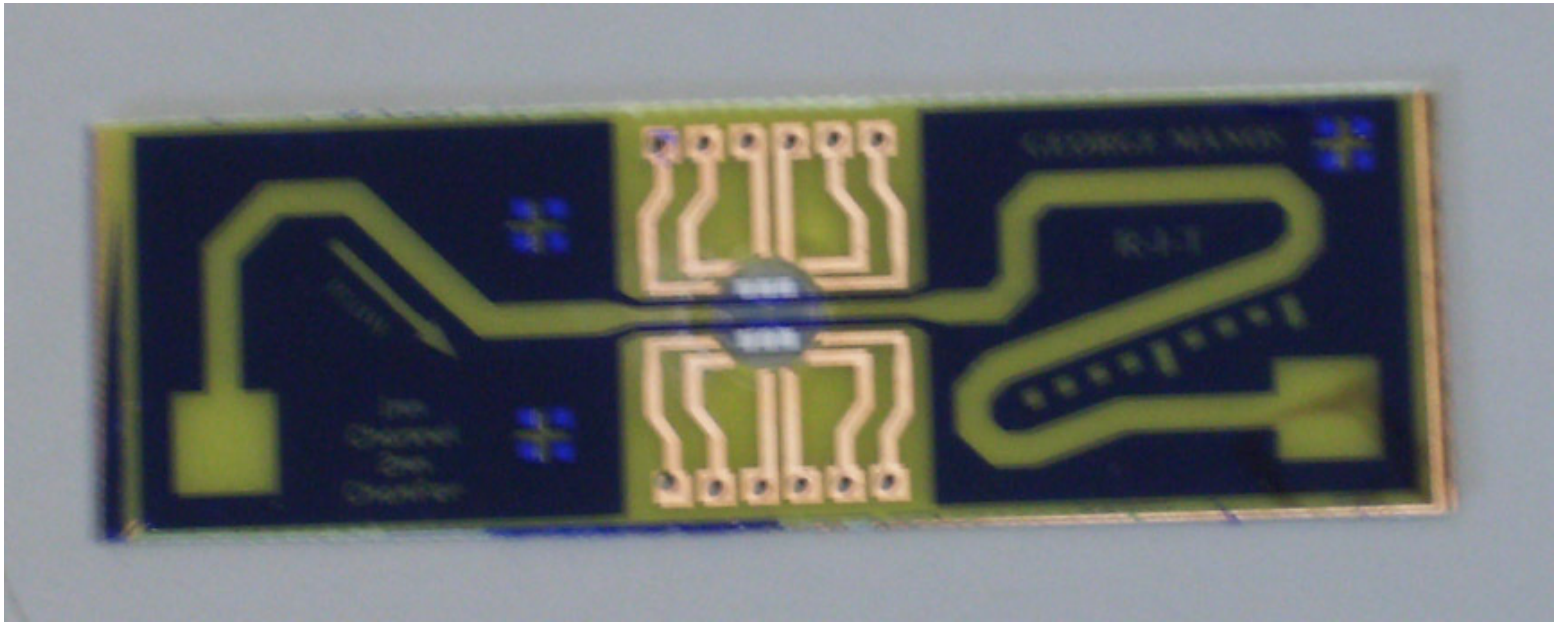
Wet Substrate
Remove mylar film from the non-shiny side of the resist
Place resist on the wet substrate
Remove water from center to edge, remove top mylar film
Repeat to get 100, 150, 200 µm total thickness
Heat cure the resist to improve adhesion???
Expose: Dose = ~50 mj/cm2,
Iradiance = 3.5mW/cm2 x 15 sec
30 for 100µm, 45 for 150µm, etc.
Remove top mylar film
Develop for 60sec in CD26 (develop 15 sec, spray DI water,
repeat every 15 sec until clear
Rinse with water and dry
Hard bake

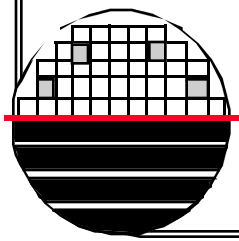


150µm DEEP CHANNELS

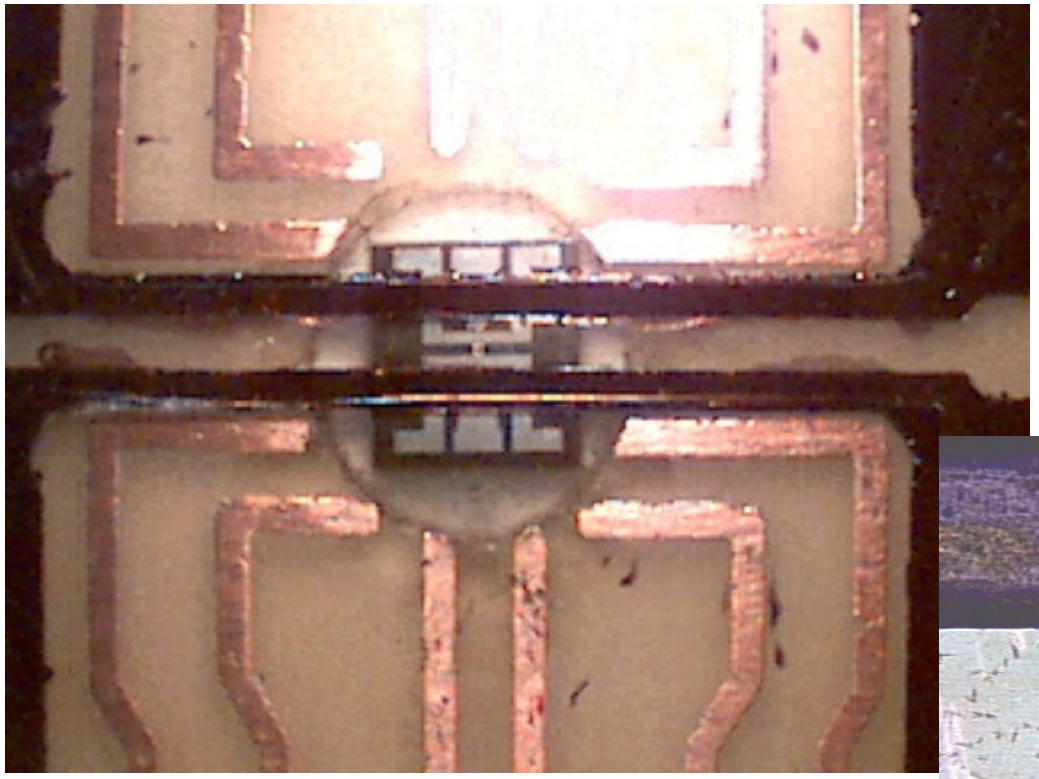


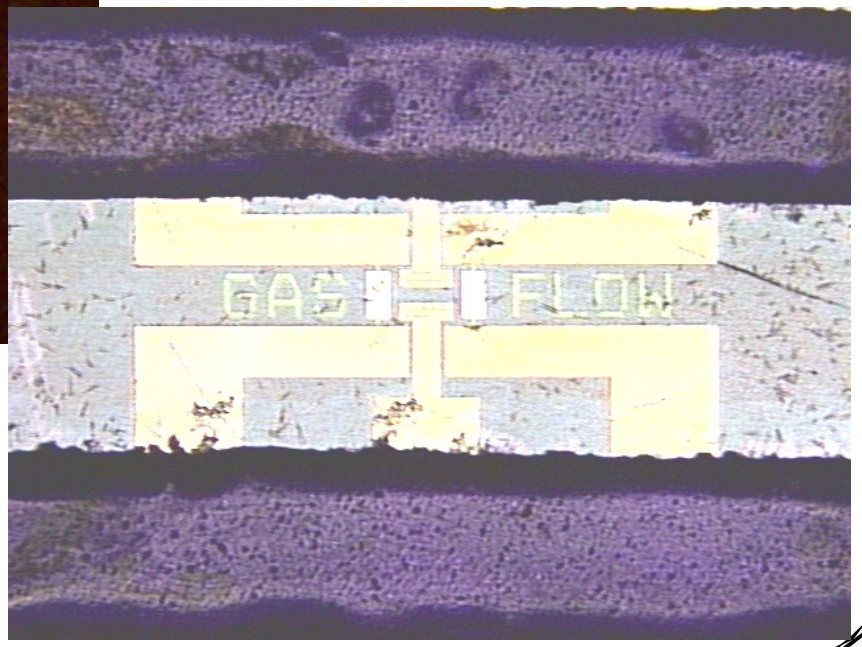
AFTER CHANNEL (NO TOP COVER) DEFINED





Fluid Channels





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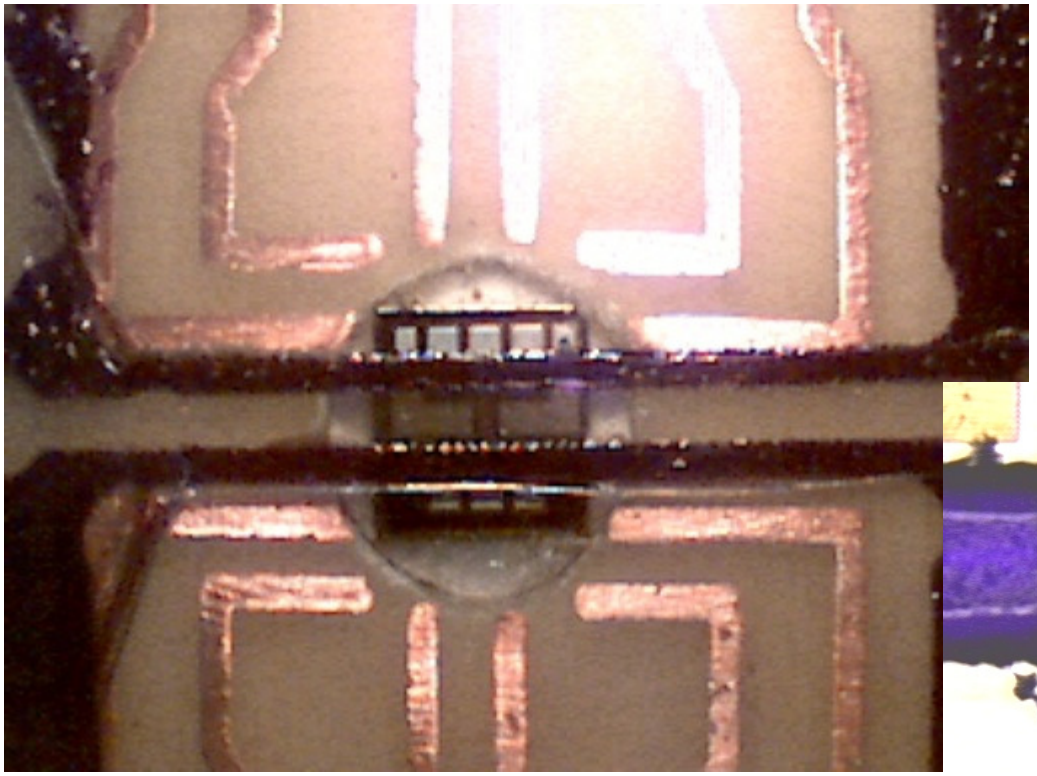

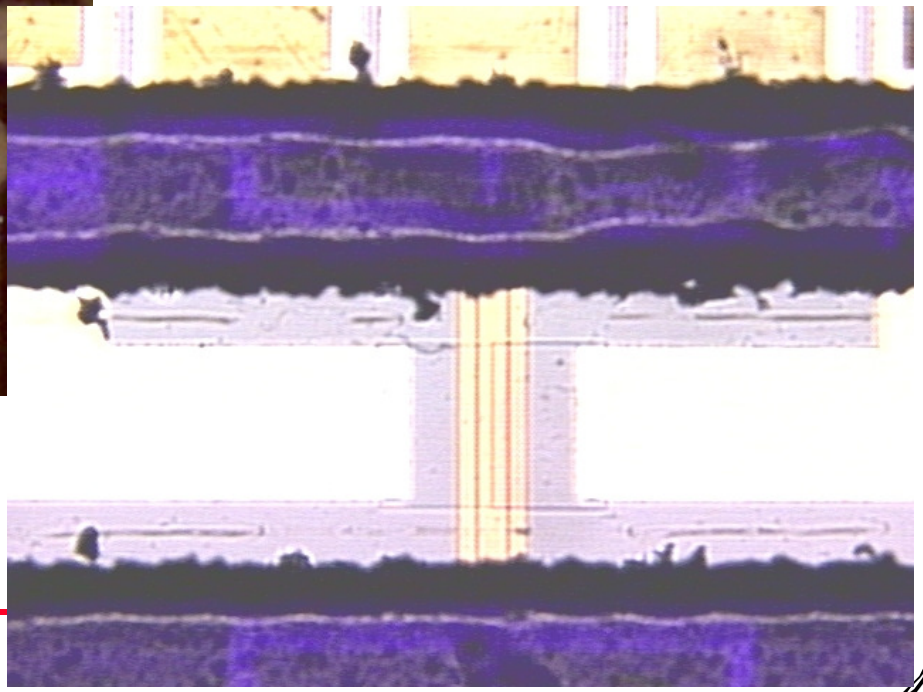

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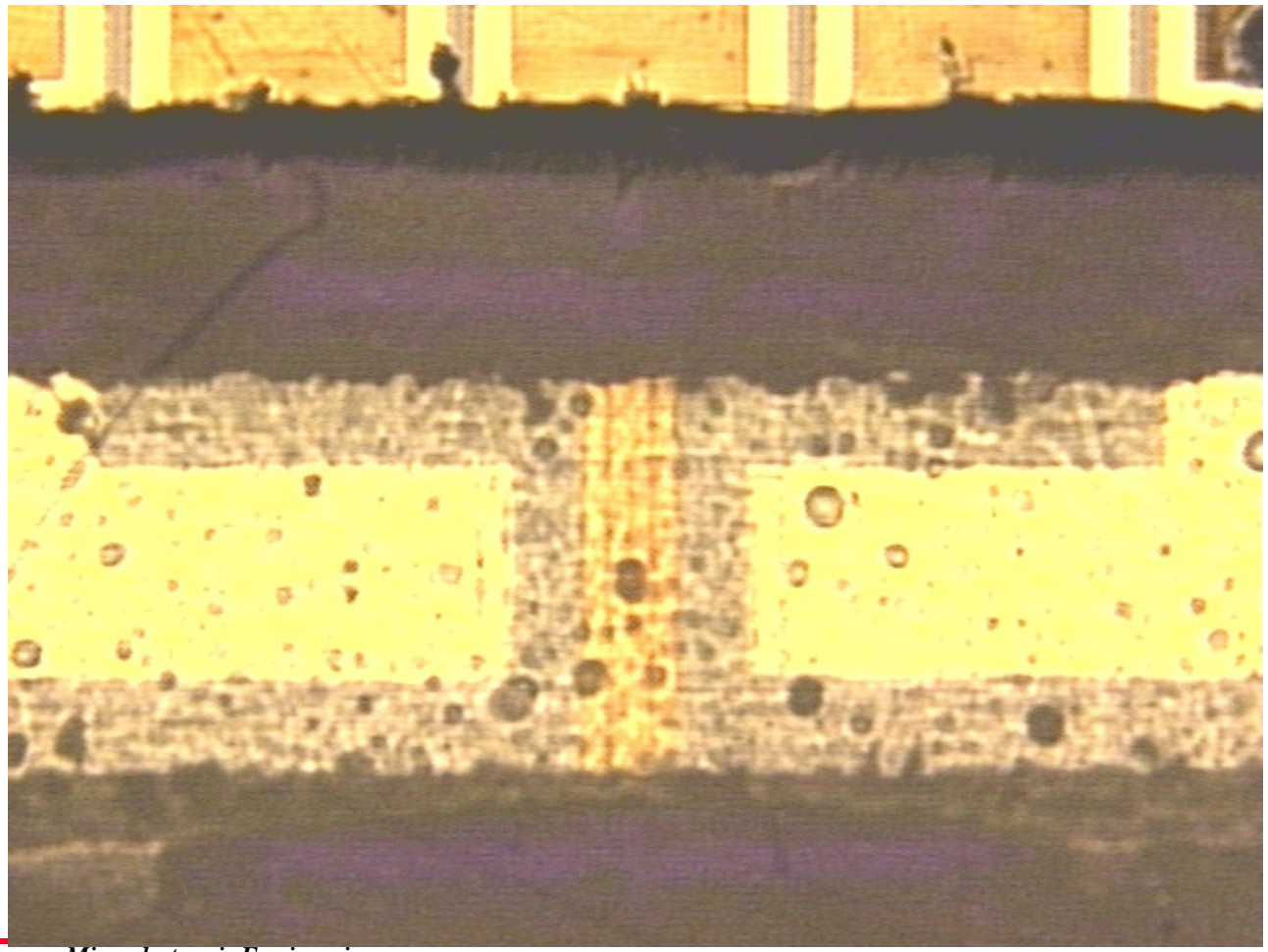


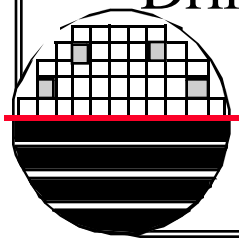
Microelectronic Engineering

THERMOSETTING GLUE ON PLASTIC COVERS

Plastic used for lamination of nametags, signs, etc. is plastic with a coating of thermosetting glue on one side. This plastic makes a good cover for the fluid channels.

Cut a piece of plastic the right size. Use exacto knife and trace the outline of the channel. Lay it over the channels. Lay a microscope slide or piece of glass to weigh down the plastic. Set it on a hot plate set to 150C. Watch the glue change from frosty to clear. Remove from the hot plate and allow to cool.

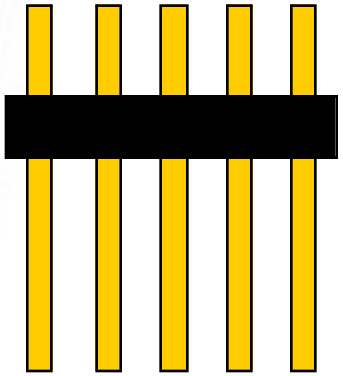
Drill a hole in the plastic for inlet and outlet port.



PIN STRIP HEADERS

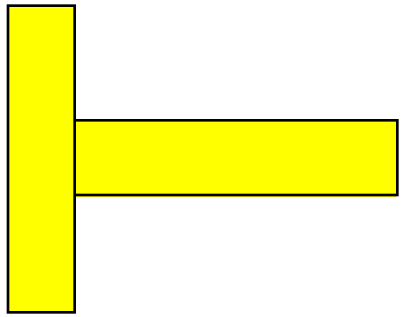
3M 929 Series Pin Strip Headers and Sockets
Dual Row and Single Row

0.1 inch center to center (2.54mm x 2.54mm)
0.05 inch center to center (1.27 mm x 1.27mm)
2mm center to center



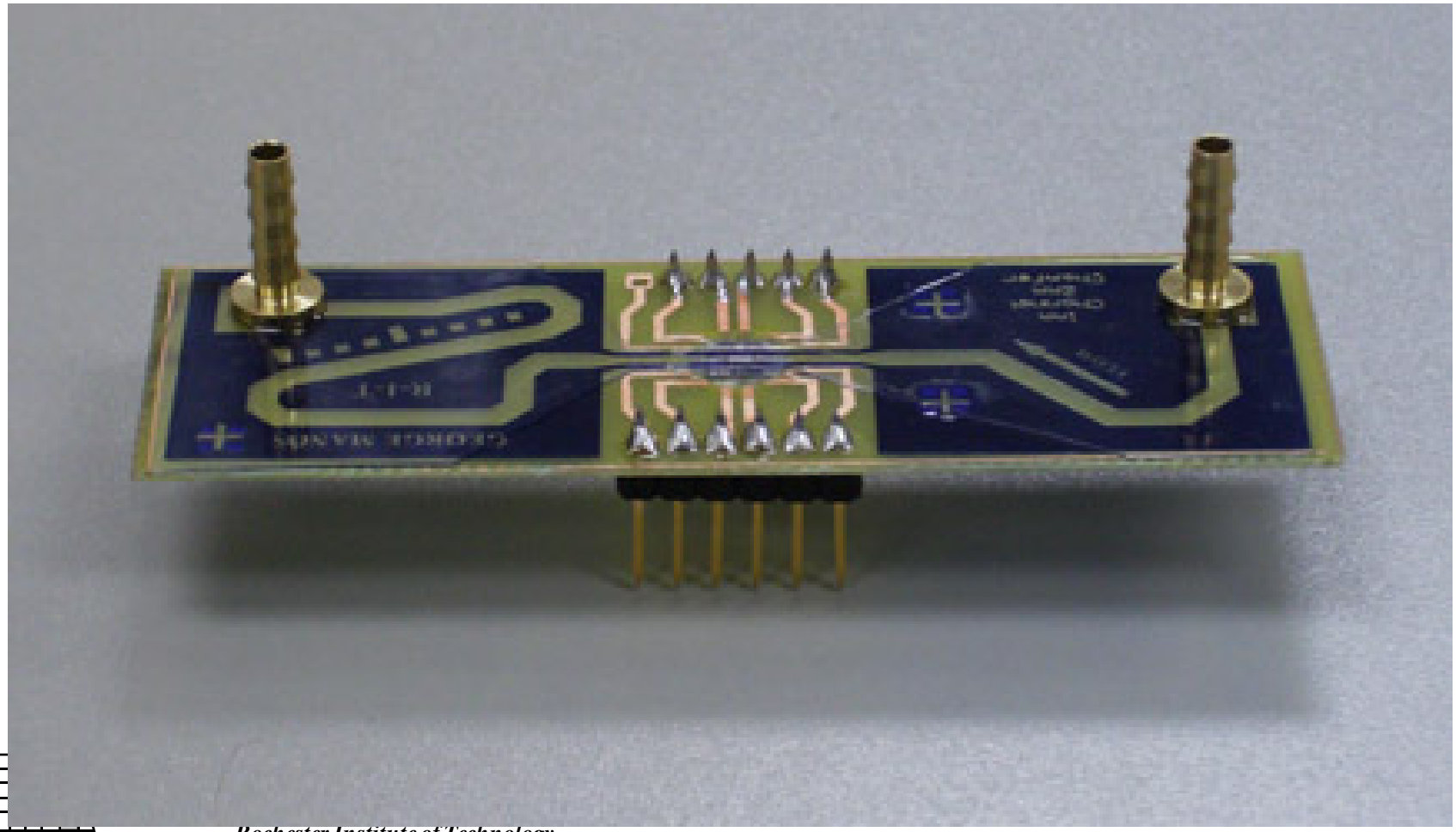
Break off any length desired

HOSE NIPPLES

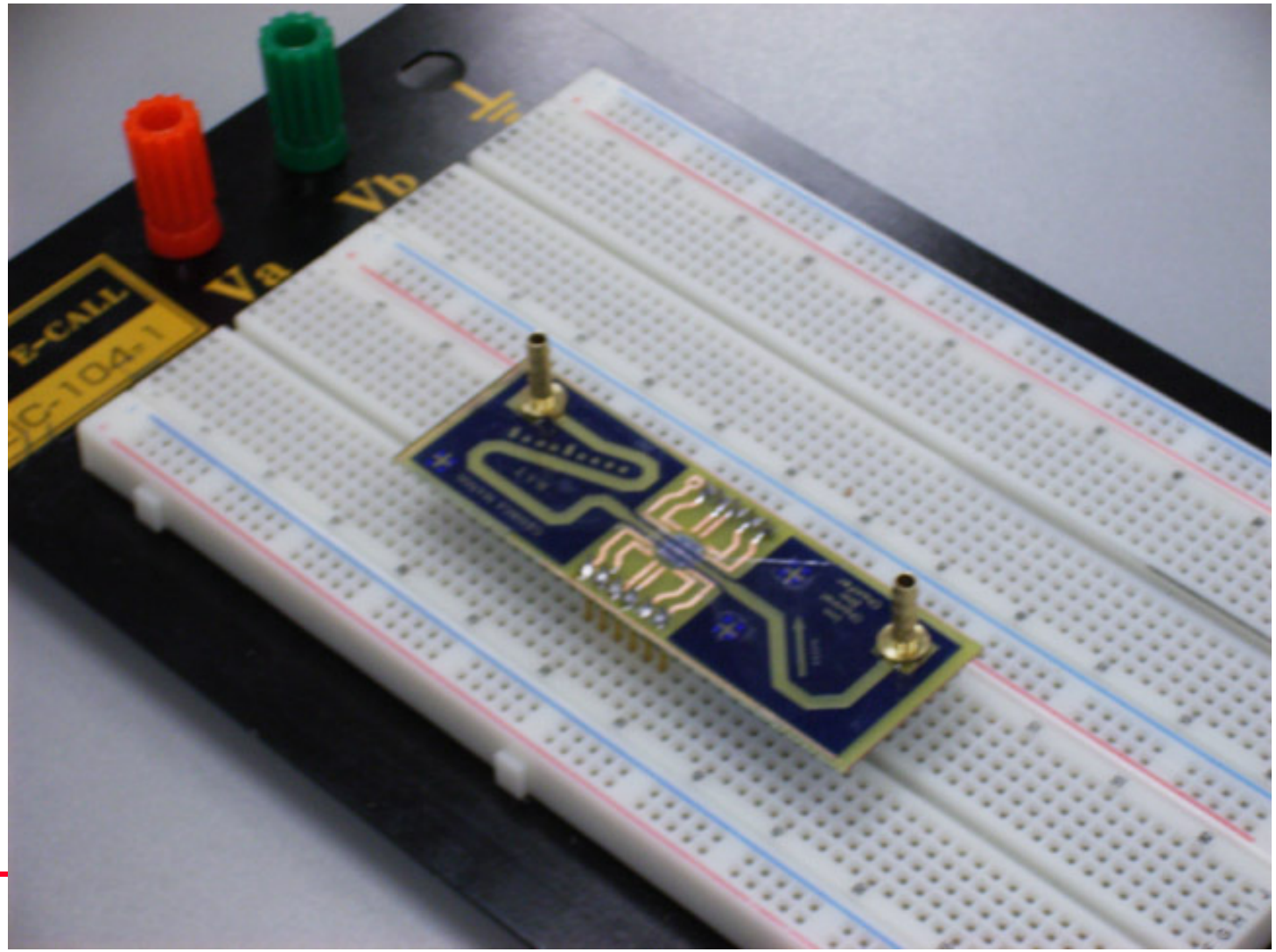


These are brass others are plastic and various sizes and shapes

AFTER WIRE BONDS, HEADER AND NIPPLES

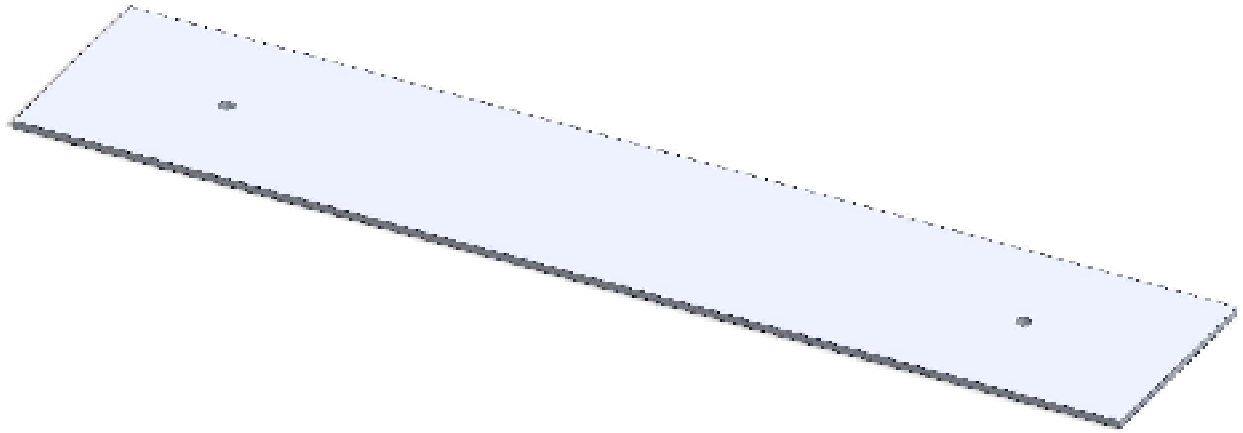


PROTOTYPE BOARD FOR DRIVE SIGNALS AND MEASUREMENTS

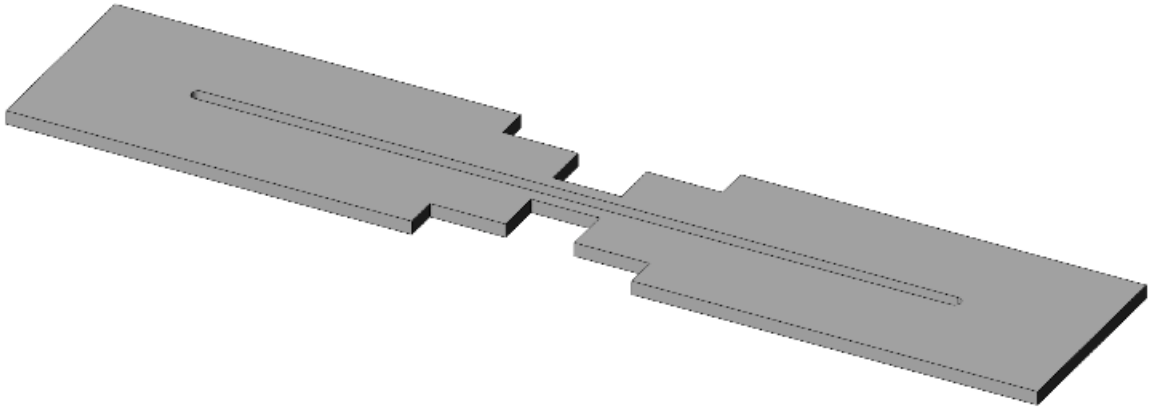


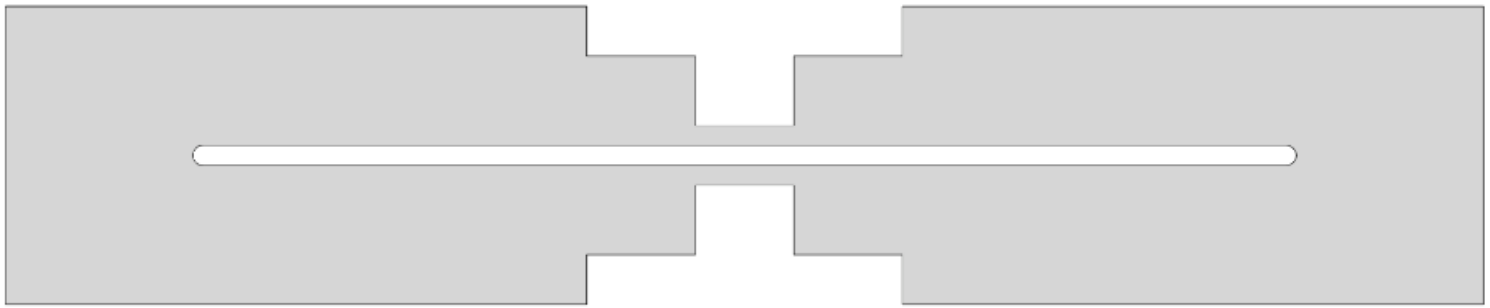
MEASUREMENTS

COVER

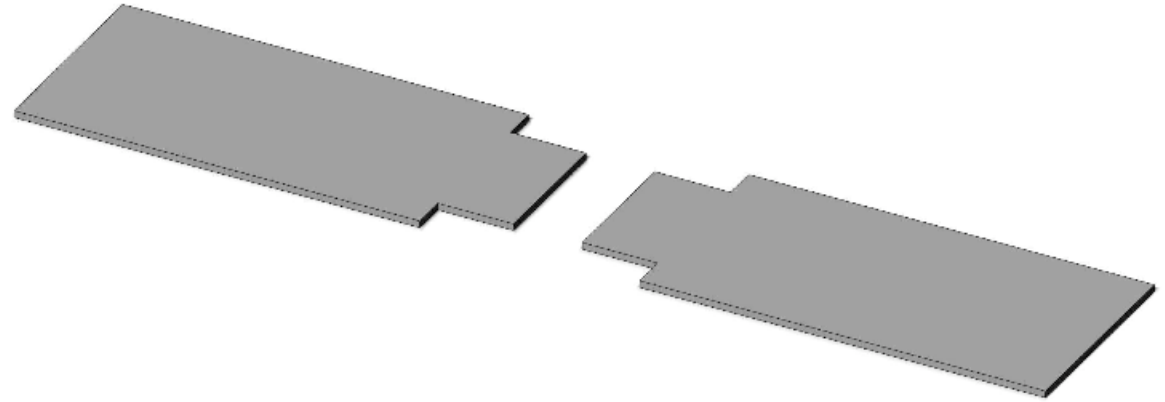


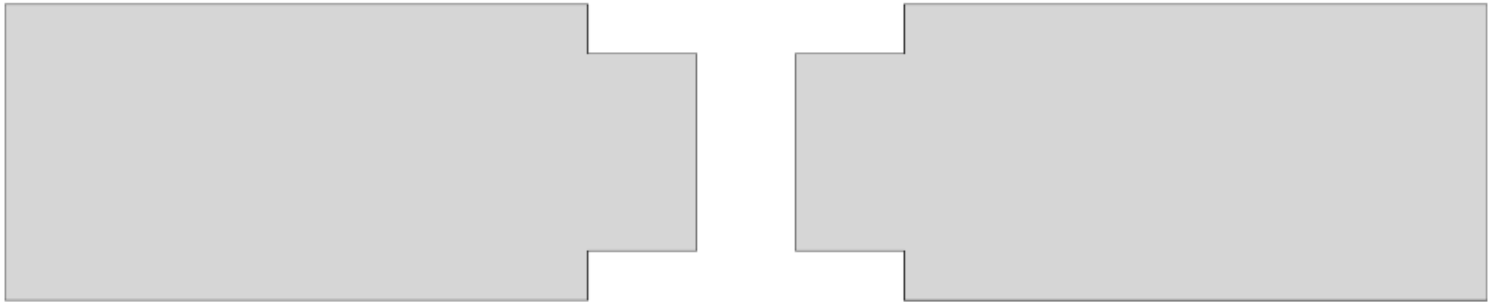
CHANNEL



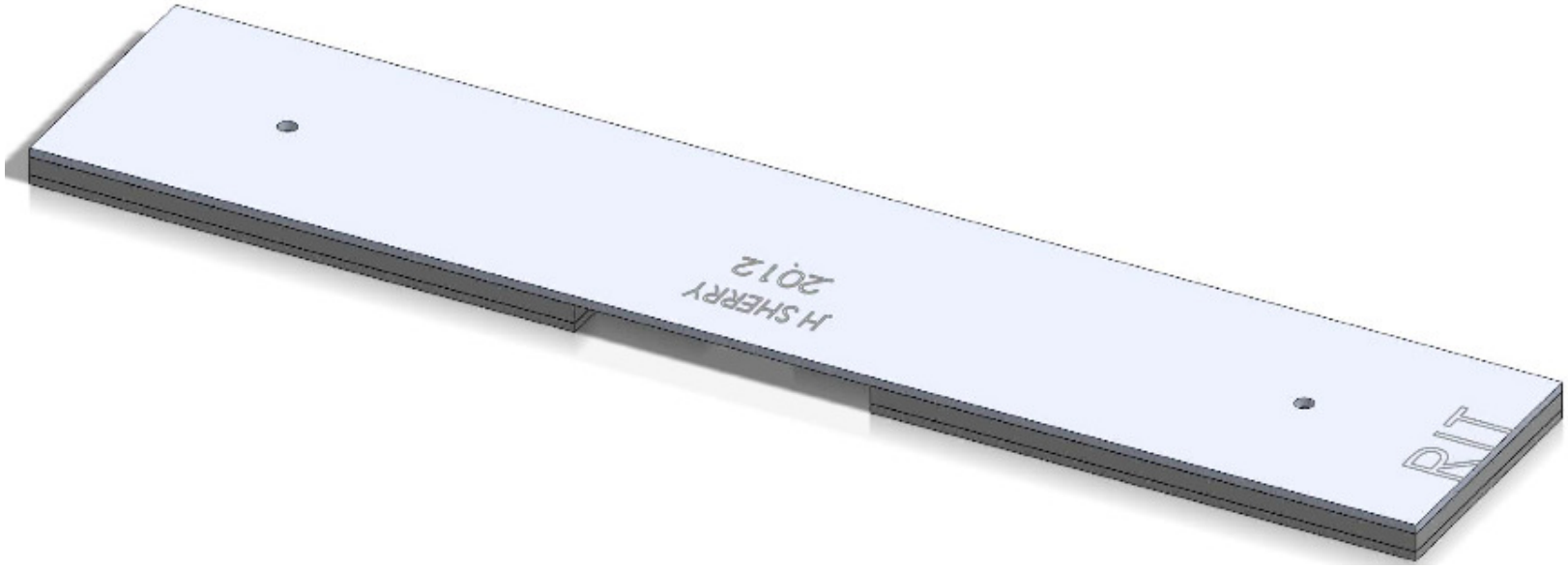


BOTTOM





COMPOSITE



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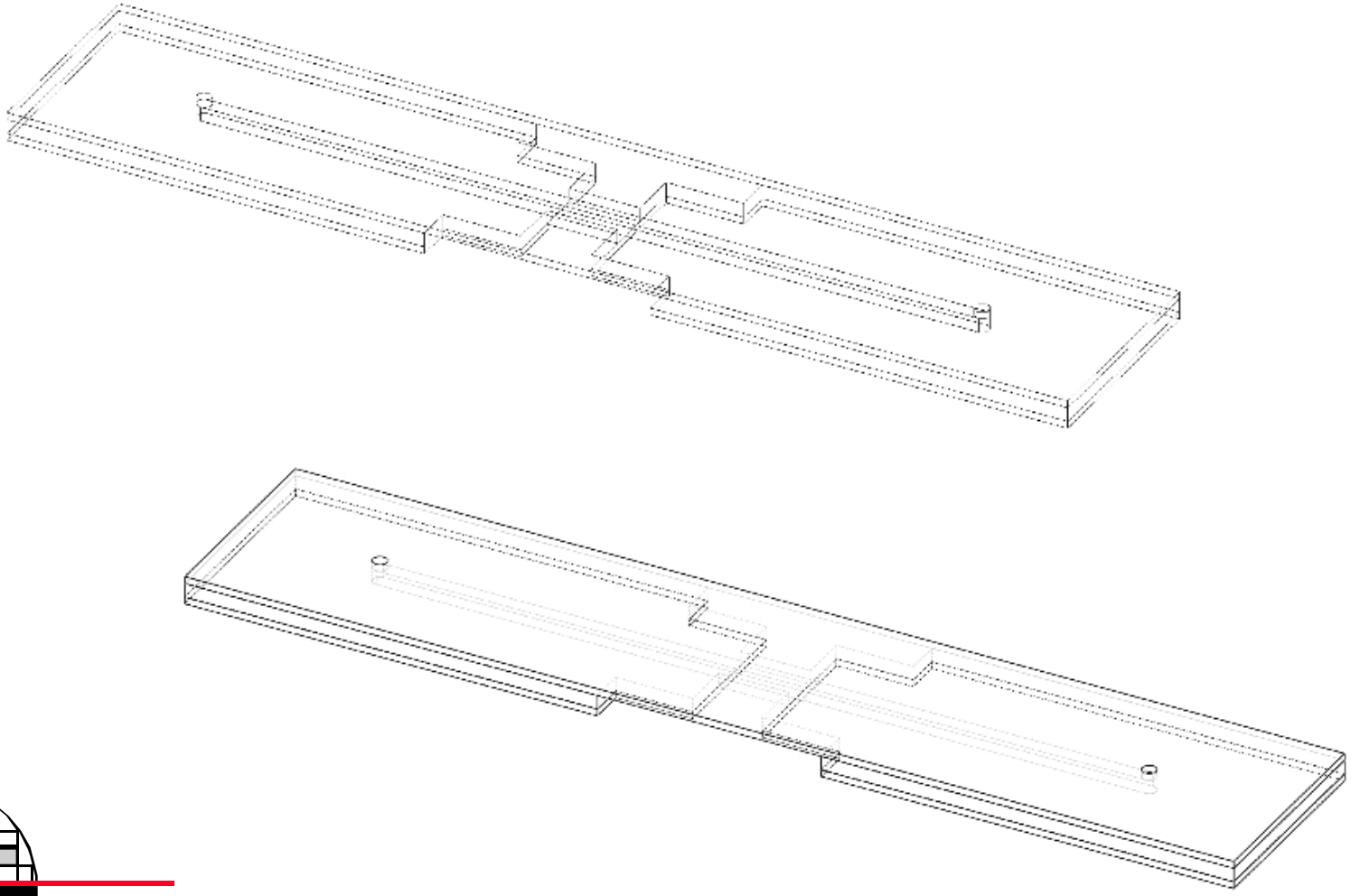

DIMENSION 3D PRINTER

dimension
#1 IN 3D PRINTERS

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3D PRINTERS

Dimension Elite Printer

(Soluble Support Technology)

Bring your ideas to life in every detail, starting at $29,900*

The Dimension Elite is ideal for printing intricate 3D product mockups and functional models of parts such as medical devices, mobile electronics and precision instruments. Just click "print" to prep the CAD file and print the model.

You'll get your models in hours, not days. And for the most efficient throughput, you can pack multiple models in the printer's build envelope.

Tough ABS*plus*™ Thermoplastic

Using ABS*plus*™ production-grade thermoplastic, the Elite prints models from the bottom up with precisely deposited layers of modeling and support material. There's no waiting for models to "cure" — they're hard right out of the printer. A water-based solution removes the support material to complete your detailed design. Then models can be drilled, tapped, sanded and painted.

The Elite 3D Printer runs quietly and unattended in an office environment. There are no noxious fumes or toxic materials that require special handling or venting.

Elite Specifications

Request a Sample Part

Get a real 3D model from a Dimension 3D Printer.

DIMENSION 3D PRINTERS ARE USED BY:

ELECTROLUX

READY TO START PRINTING?

We can help you choose the Dimension 3D PRINTER that's right for you.

SITE SEARCH

Dr. Denis Cormier
Brinkman Lab at RIT

DIMENSION 3D PRINTERS

HOME APPLICATIONS SUCCESS STORIES 3D PRINTERS COMPANY CONTACT FIND A RESELLER

DOWNLOADABLE WHITE PAPERS

Get the essential information on the uses and advantages of Dimension Printers in these concise reports:

How 3D Printing Fits into the Design Process

The Competitive Advantages of 3D Printing

Saving Time and Money with 3D Printing

Equipping Students with Design Tools

3D PRINTERS

FAQ

(Frequently Asked Questions)

- ⊞ What is 3D Printing?
- ⊟ How does the Dimension process work?

  Based on the patented Stratasys FDM® process, Dimension builds functional 3D models from the bottom up, one layer at a time with tough, durable acrylonitrile butadiene styrene (ABS) plastic.

  STL files are imported into Catalyst® EX Software which automatically slices and orients the parts and creates any necessary support structures. The software automatically plots a precise deposition path for Dimension to follow. ABS plastic (in filament form within auto-loading cartridges) is fed into an extrusion head, heated to a semi-liquid state and accurately deposited in layers as fine as 0.007-inch (0.178 mm) thick. After completion of the build, support structures are simply removed.

  ABS plastic is heated to a semi-liquid state and deposited in thin layers by a patented extrusion head.

  Catalyst software automatically determines when and where to deposit ABS or support material throughout the build process.

- ⊞ How does 3D Printing fit into the design process?
- ⊞ How durable is ABS?
- ⊞ Is post-processing required?
- ⊞ Are there any special facility requirements necessary to install a Dimension system?
- ⊞ Can more than one user process files and print parts on Dimension?
- ⊞ Where can I see a Dimension system?
- ⊞ What workstation operating system is required to run the system?

DIMENSION 3D PRINTERS ARE USED BY:

DURACELL

READY TO START PRINTING?

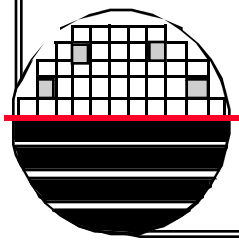
We can help you choose the Dimension 3D PRINTER that's right for you.

SITE SEARCH

RESULTS

A technique for creating flow channels has been developed.

MEMS fluid flow sensors, pumps and pressure sensors were successfully packaged.



REFERENCES

1. Electronic Packaging & Interconnection Handbook, 2nd Edition, Charles A. Harper, McGraw Hill, 1997.
2. Dans Crafts and Things, 352 Empire Blvd, Rochester, NY, for hobby tools, plastic, styrene tube, www.danscraftsandthings.com
3. Rayzist Supply, http://www.rayzist.com/
4. Epoxy, http://www.masterbond.com
5. http://www.photobrasive.com, PhotoBrasive Systems, 4832 Grand Avenue, Duluth, MN 55807, 1-800-643-1037