

Photomask Basics for Stanford users

For more quotes or more information on Stanford 1X contact plates or 5X ASML Stepper Reticles please contact Bill Martin who is the sales rep for Compugraphics and Advance Reproductions.

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Or

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Data

GDS is the primary language accepted by all mask shops!

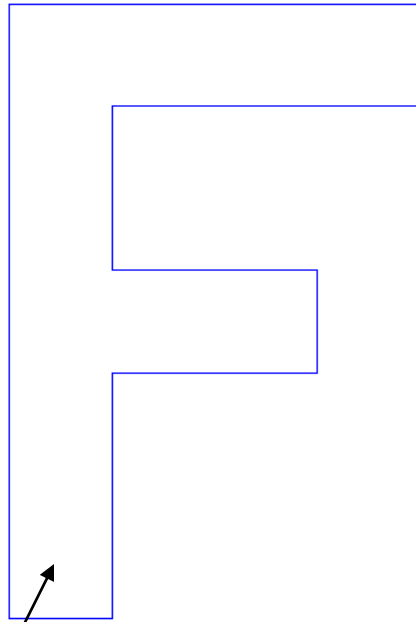
ACAD R13 – 2008 is accepted by most mask shops.

Compugraphics will charge to convert to GDS.

Advance Reproductions can accept clean ACAD data.

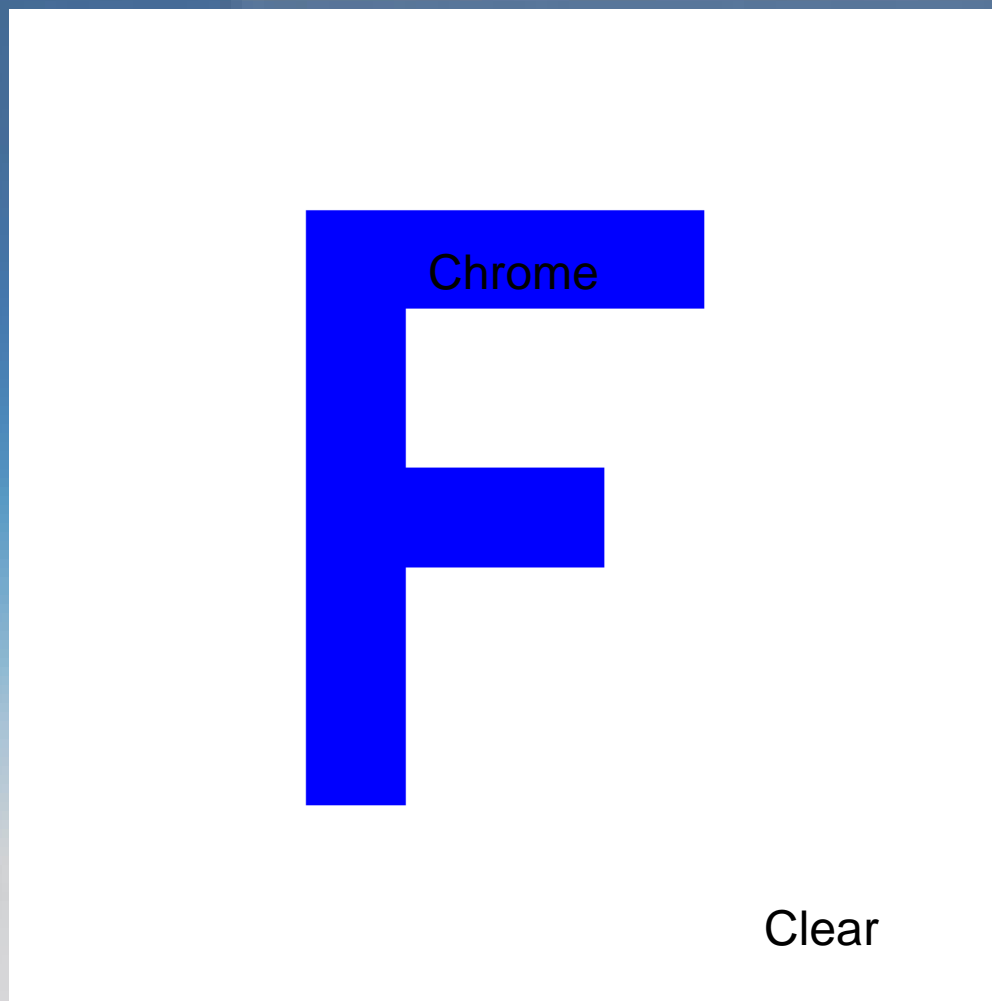
DXF is accepted by most mask houses but usually contains numerous errors on conversion and conversion fees may be added.

Tone of the mask



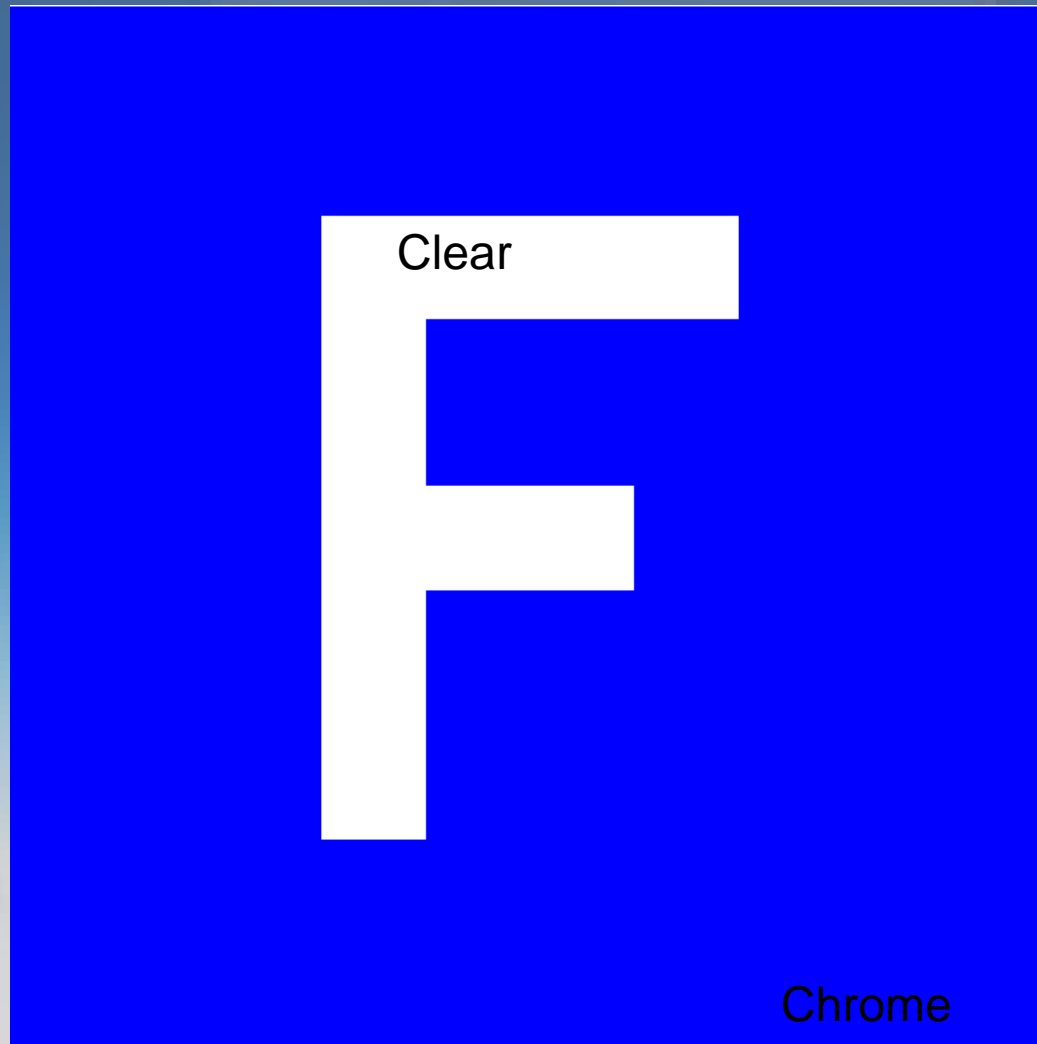
Digitized data (Closed Polygons)

Tone of the mask



Digitized data = Dark

Tone of the mask



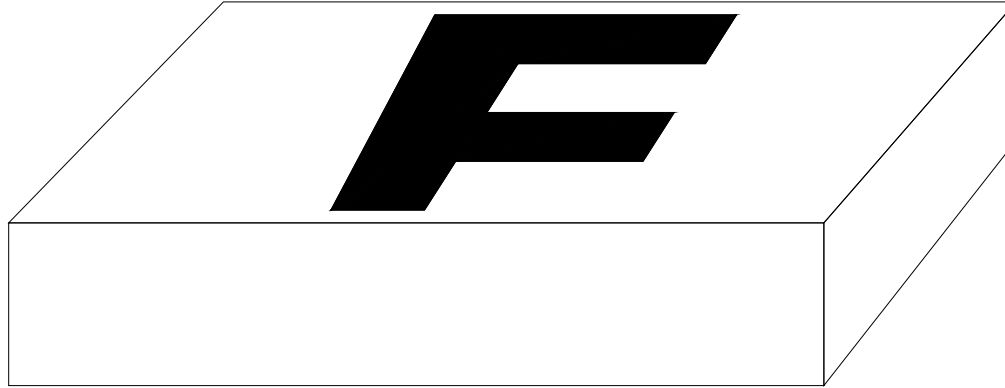
Digitized data = Clear

Parity of the mask



Right Reading Chrome Down = Wrong Reading Chrome up
All Frontside Contact masks.
All ASML 5x Stepper Reticles.

Parity of the mask



Right Reading Chrome Up = Wrong Reading Chrome Down
Used for Backside masks only.

Address unit or grid

0.125um = \$

0.1um = \$

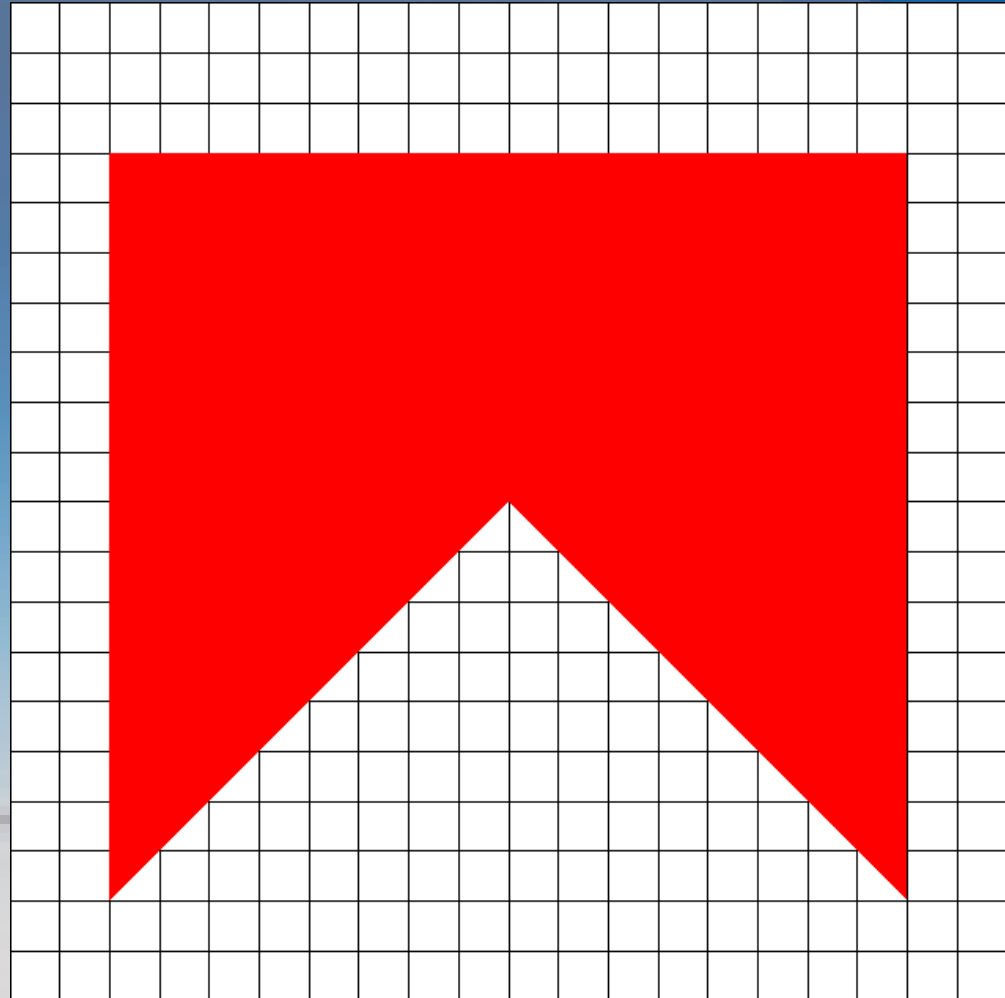
0.0625um = \$\$

0.05um = \$\$\$+

0.003125 = \$\$\$\$

0.025um = \$\$\$\$\$

**Use 0.125 or 0.1um
whenever possible to
keep cost down.**



Address unit or grid

0.125um = \$

0.1um = \$

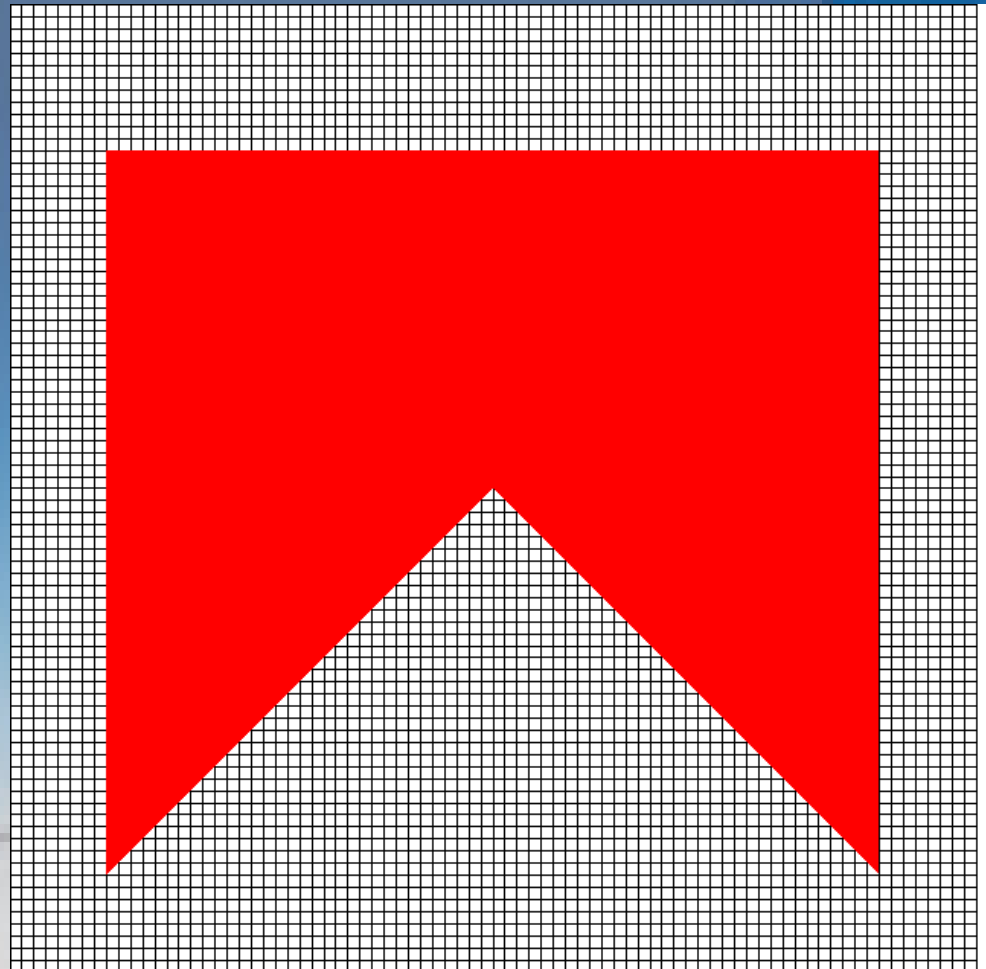
0.0625um = \$\$

0.05um = \$\$\$+

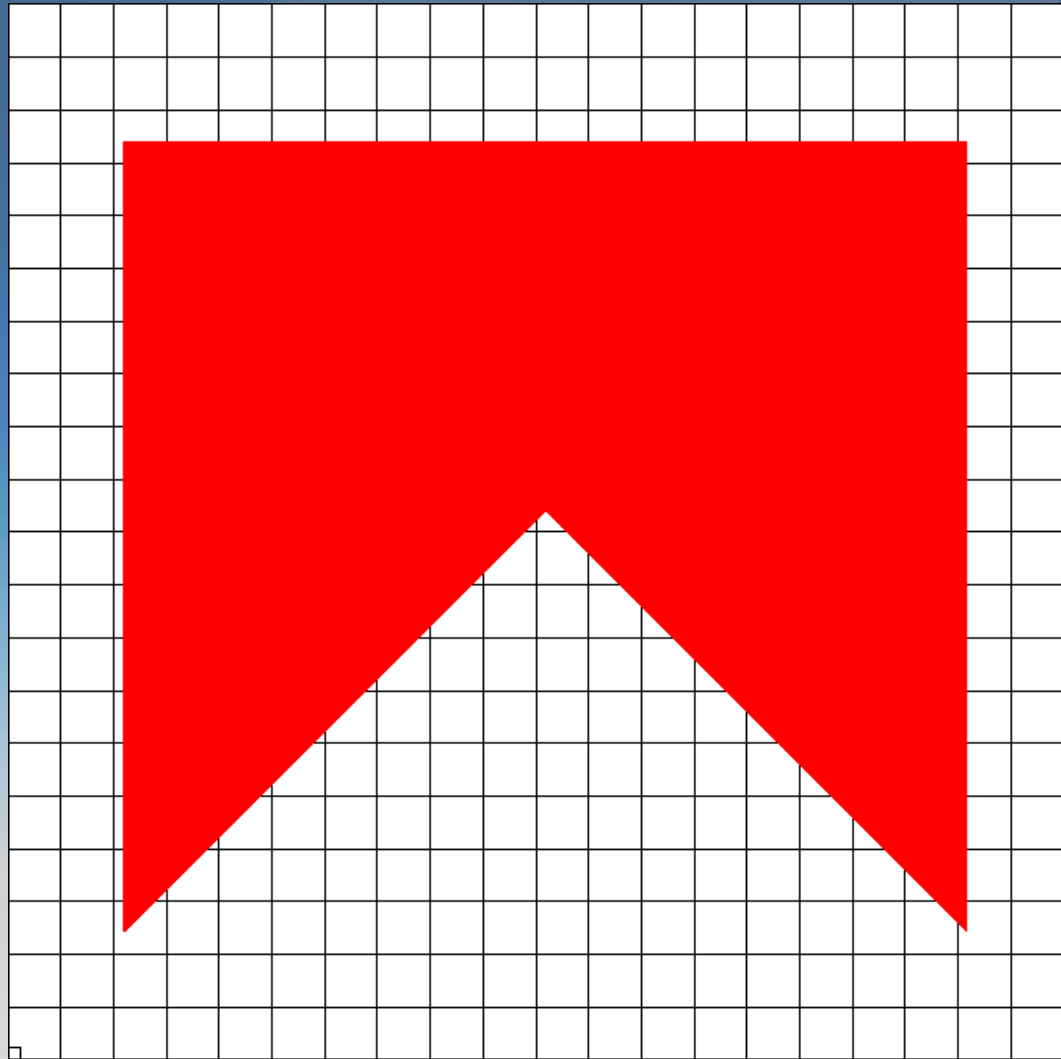
0.003125 = \$\$\$\$

0.025um = \$\$\$\$\$

**Smaller address units
take 4-10 times longer
to write and will increase
mask prices.**



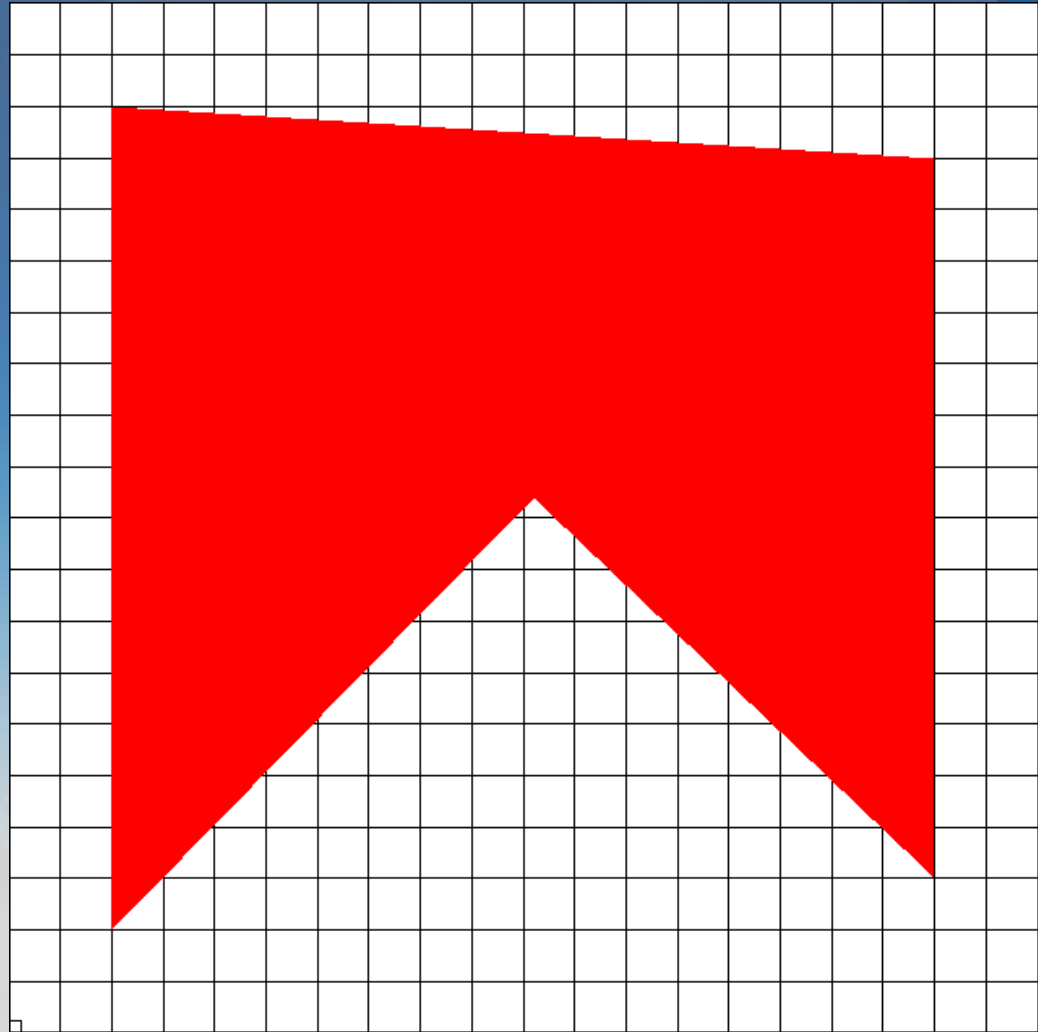
Address unit or grid



Data off grid

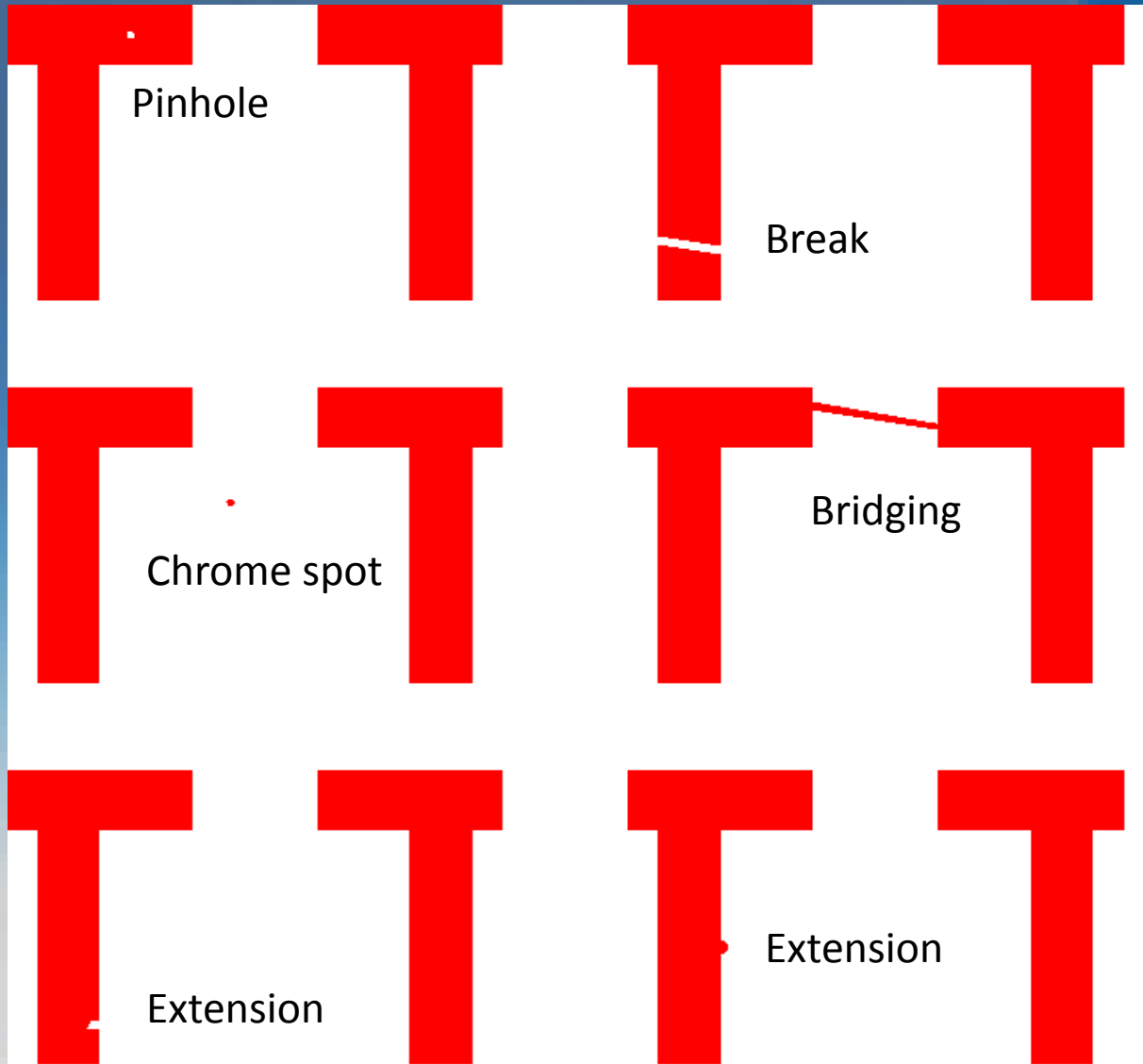
Address unit or grid

Design data
on grid to prevent
this type of problem



Data snapped to nearest address unit

Defect Types



Defect Inspection

- Manual inspection by operator. (\$)
Smallest feature they can detect is 3ums.
- KLA – Die to Die inspection. (\$\$)
Inspects one die to the GDS and then compares that die to the other dies.
- KLARIS – Die to Data inspection. (\$\$+)
Inspects the entire mask to the entire GDS file.
- Repair: Removes chrome or deposits chrome in voids. (\$\$\$)

Defect Spec

Low end defect specs

0>5ums = Standard manual inspection spec

0>3ums = Standard manual inspection spec

Additional defects specs with Automated Inspection

0>3ums = Used for reticles or 1X masks (\$)

0>1.5ums = Used for reticles or 1X masks (\$+)

0>1.0um = Used for reticles or 1x masks (\$\$)

0>.75ums = Used for reticles (\$\$\$)

Critical Dimension and tolerances

5ums and up +/- .5ums (\$)

2.5ums +/- .25ums (\$+)

2.0um +/- .2ums (\$\$)

1.0um +/- .1um on Quartz (\$\$\$)

0.6um +/- .05um on Quartz (\$\$\$\$)

Smaller or tighter spec on quote bases only

Overlay or Registration

- .5um layer to layer registration over 4" (\$)
- .25um layer to layer registration over 4" (\$+)
- .15um layer to layer registration over 4" (\$\$)
- .1um layer to layer registration over 4" (\$\$\$)

Sodalime vs. Quartz?

Sodalime

- Cost less.
- More defects.
- Looser CD tolerances and overlay.
- Thermal expansion issues.
(1um per degree C over 4")
- Great for lower end masks with features above 3ums.

Manhattan Features vs. Circles and Curves

Orthogonal or Manhattan features do not cause problems.

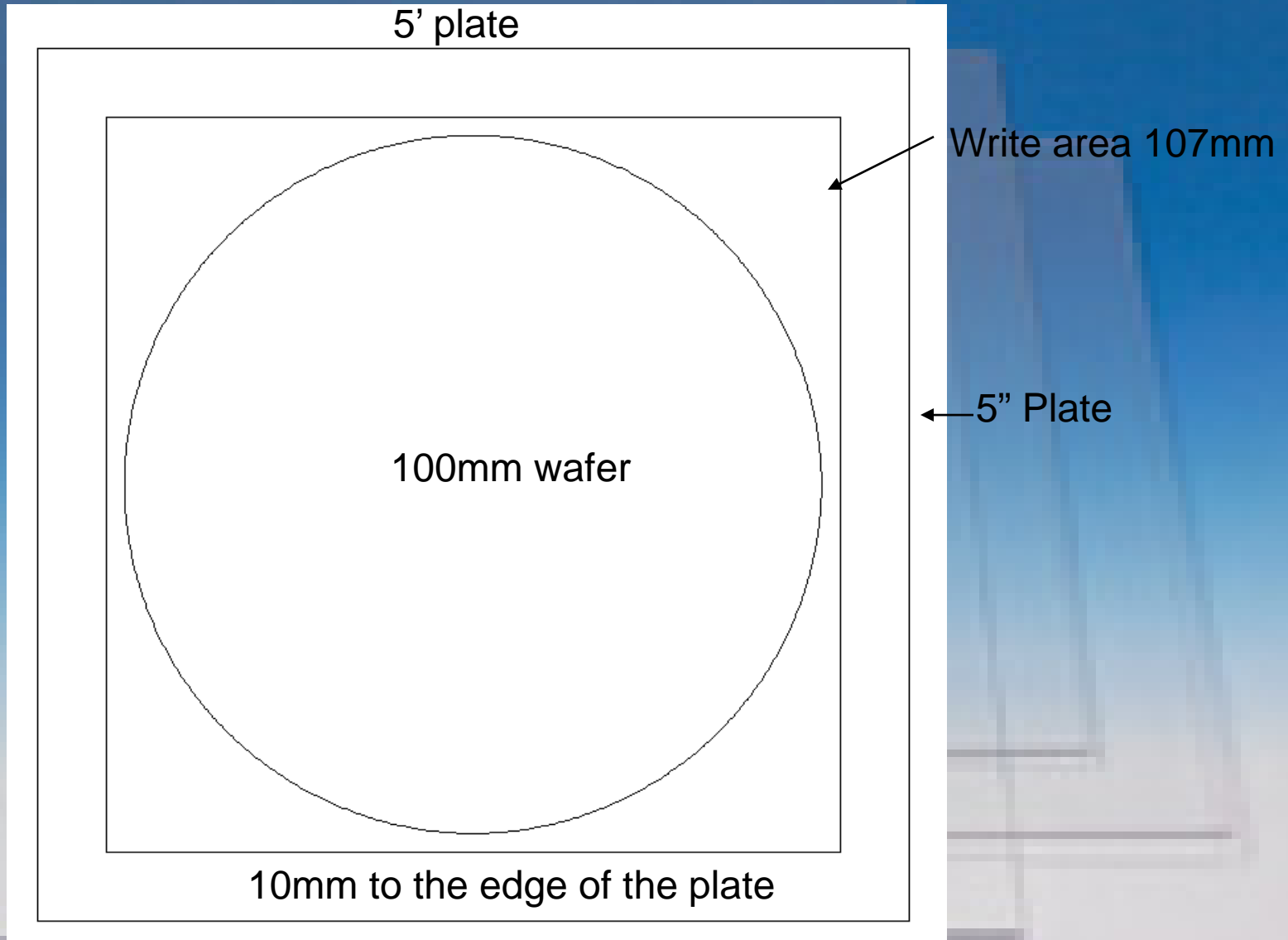
Circles and arcs can greatly increase write times and cost.

Use squares or Octagons in place of circles when possible.

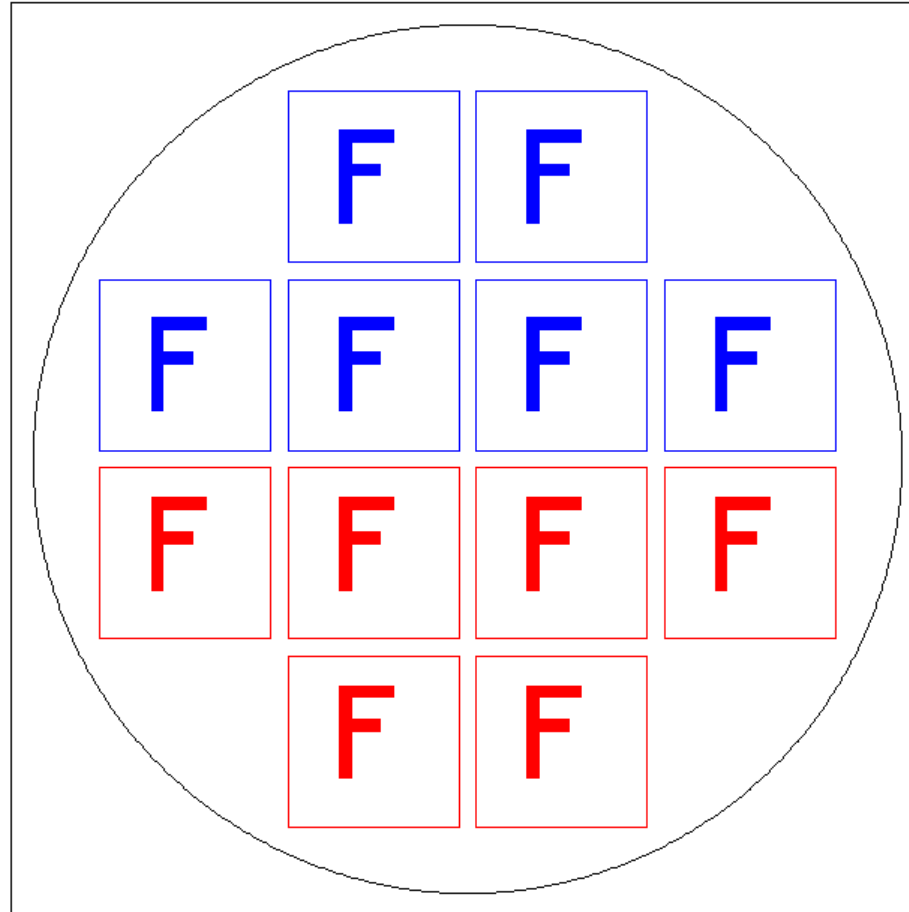
Problems start occurring after 5,000 circles with some Laserwriters

Squares smaller than 1 μ m will be rounded!

Contact Masks = 107mm x 107mm Write area



Multiple layers on one mask



Multiple layers on one mask

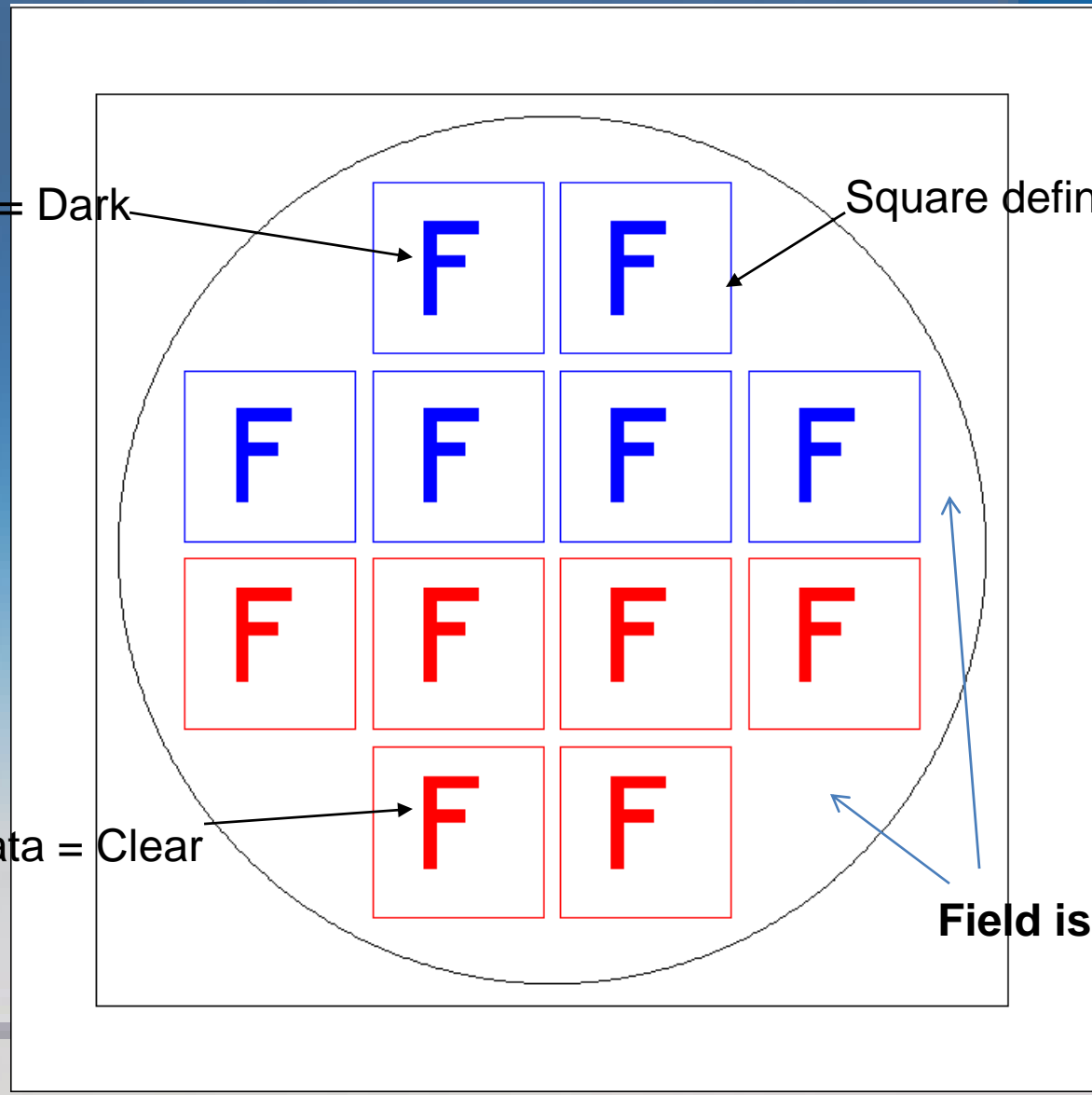
Array data prior to sending to mask shop if possible.

1. Data that is clear needs to be on it's own layer.
2. Data that is dark need to be on it's own layer.
3. Put a square around the area that protects the Chrome field.
4. If scribe between dies are to be Chrome then digitize them.

Or

Mask shop will do for you for a service fee (\$150)
if you have more than three layers.

Multiple layers on one mask. Example 1=Mainly Clear Field



Digitized data = Dark

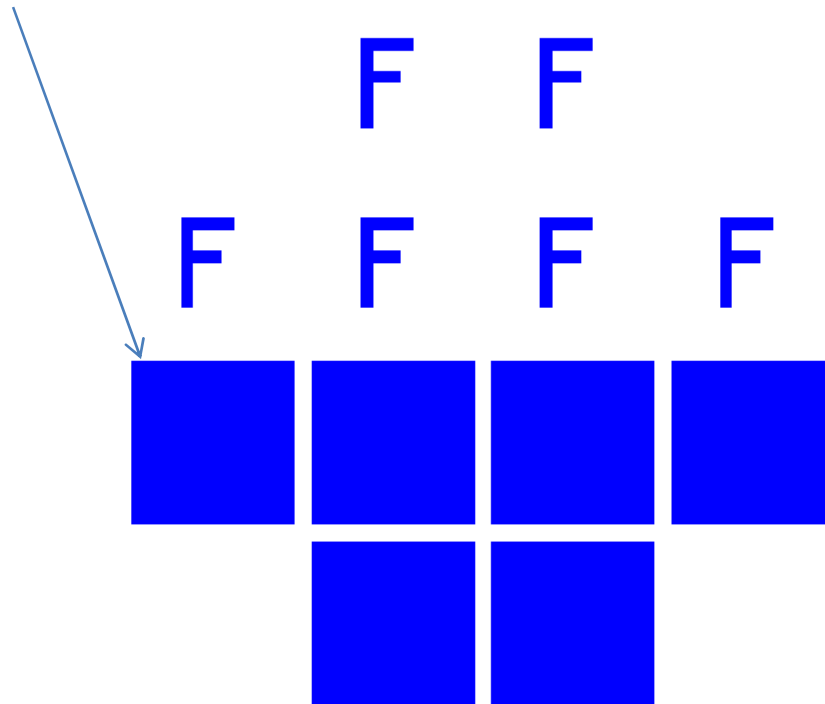
Square defines the Layer

Digitized data = Clear

Field is Clear

Multiple layers on one mask. Example 1=Mainly Clear Field

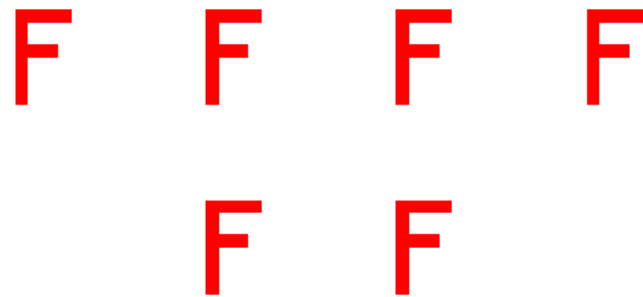
If you want the field to be clear outside of the die then add a square on the Data=Dark layer to define the area you want to protect to be chrome



This is the Data=Dark Layer

Blue is Chrome on plate

Multiple layers on one mask. Example 1=Mainly Clear Field

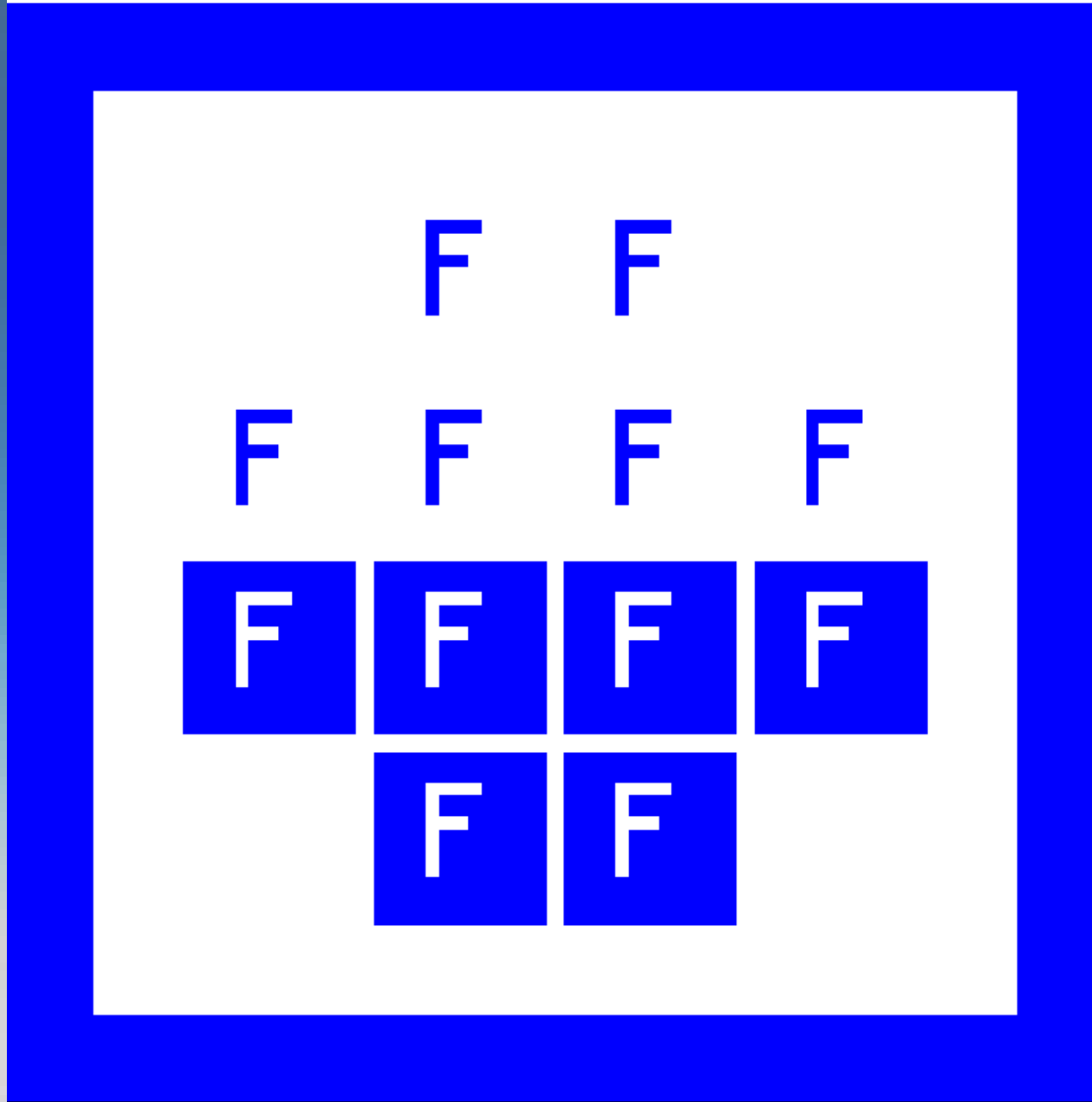


F F F F
F F

This is your DATA=CLEAR Layer

RED is Clear on plate

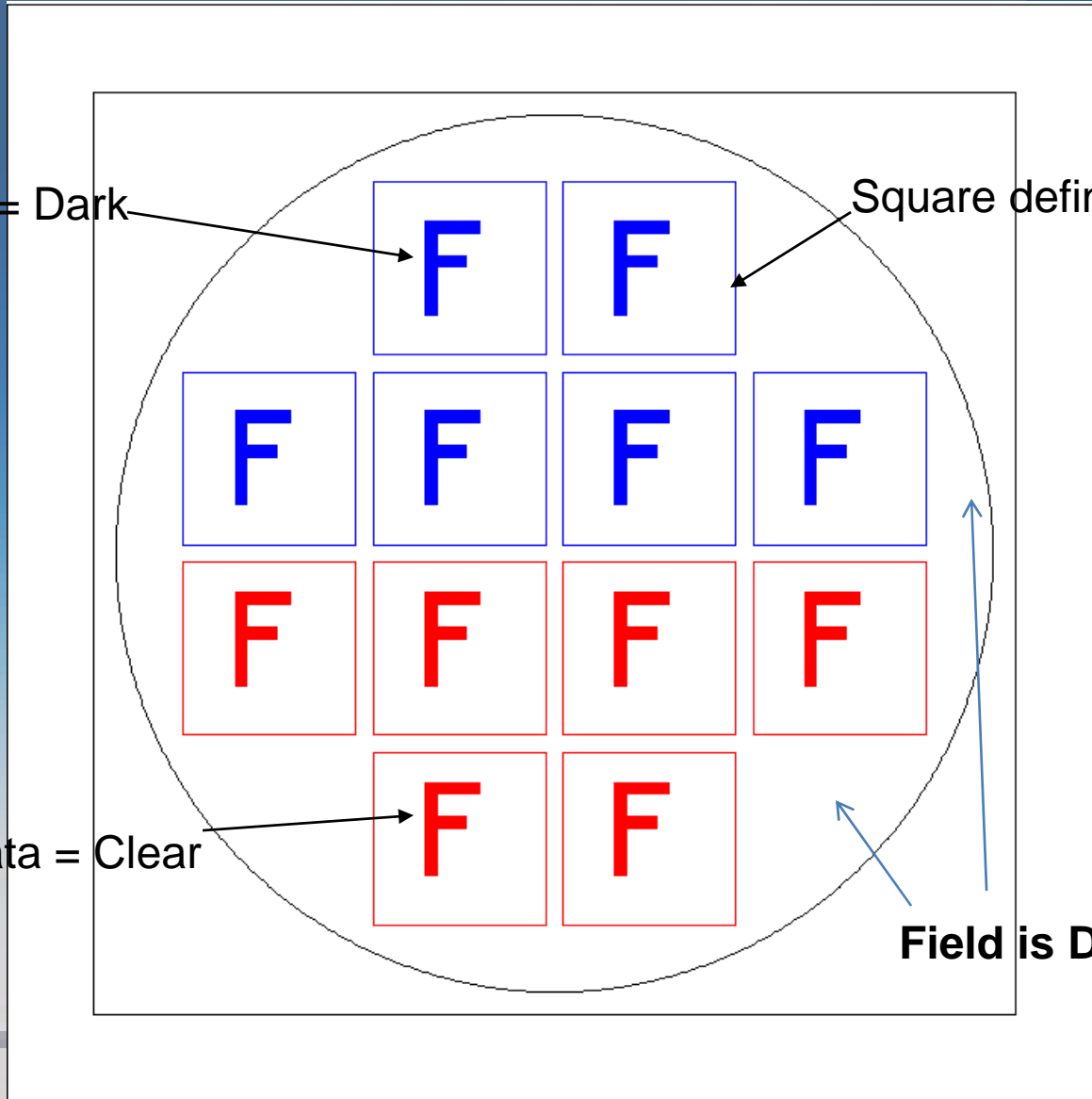
Multiple layers on one mask. Example 1=Mainly Clear Field



Final Plate will look like this

Blue is Chrome on plate.

Multiple layers on one mask. Example 2=Mainly Dark Field



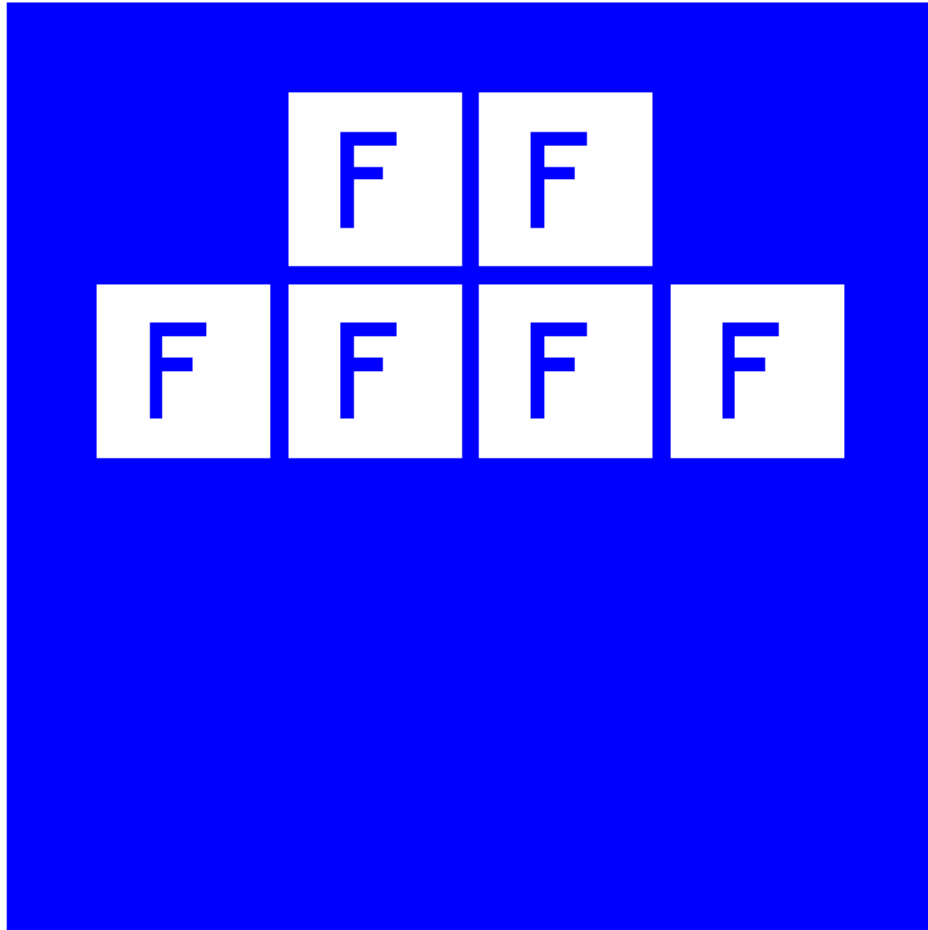
Digitized data = Dark

Square defines the Layer

Digitized data = Clear

Field is Dark

Multiple layers on one mask. Example 2=Mainly Dark Field



If you want the field to be Dark outside of the die then add polygons on the Data=Dark layer to define the area you want to protect to be chrome.

Blue is Chrome on plate

Multiple layers on one mask. Example 2=Mainly Dark Field

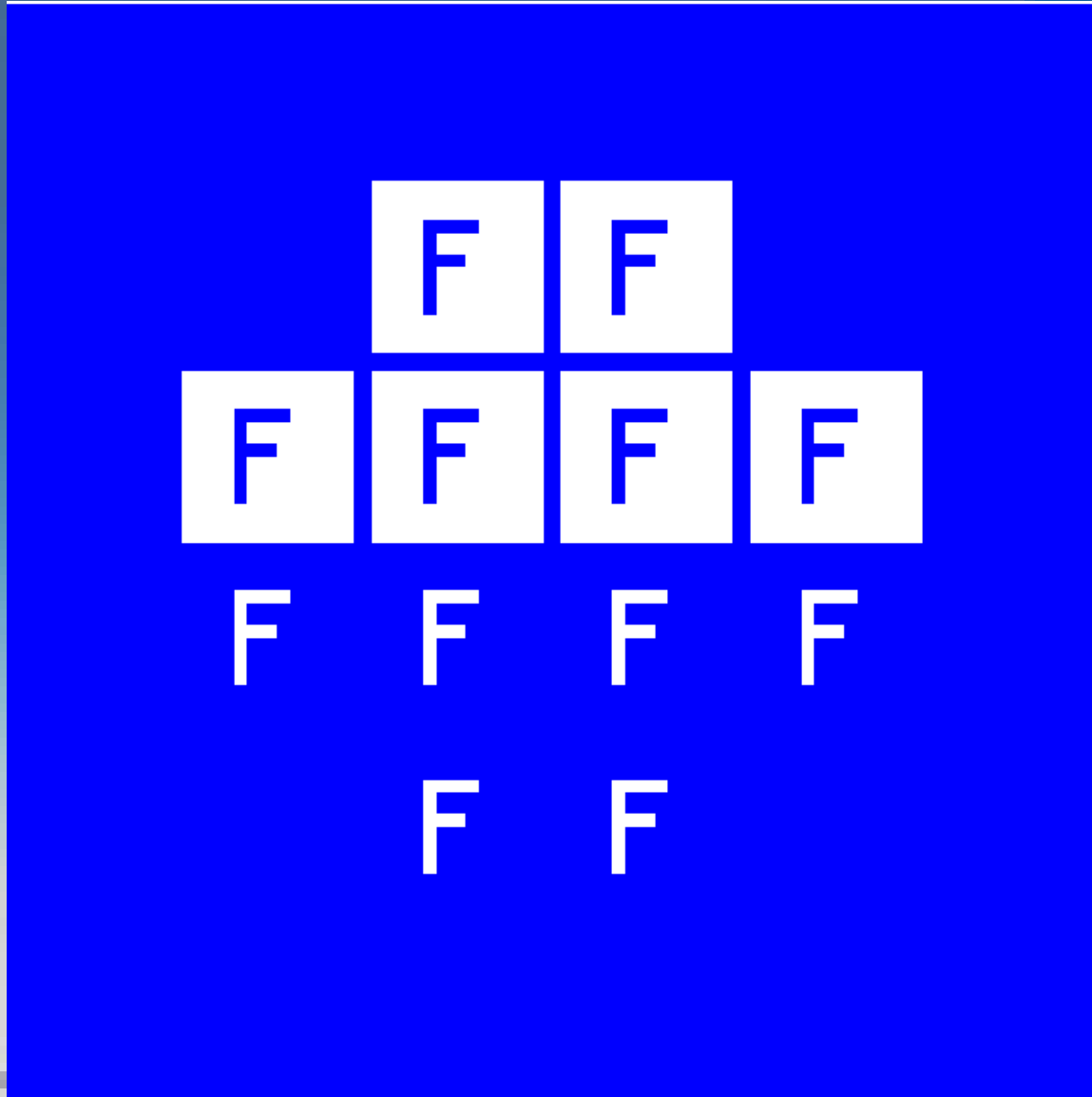


F F F F
F F

This is your DATA=CLEAR Layer

RED is Clear on plate

Multiple layers on one mask. Example 2=Mainly Dark Field



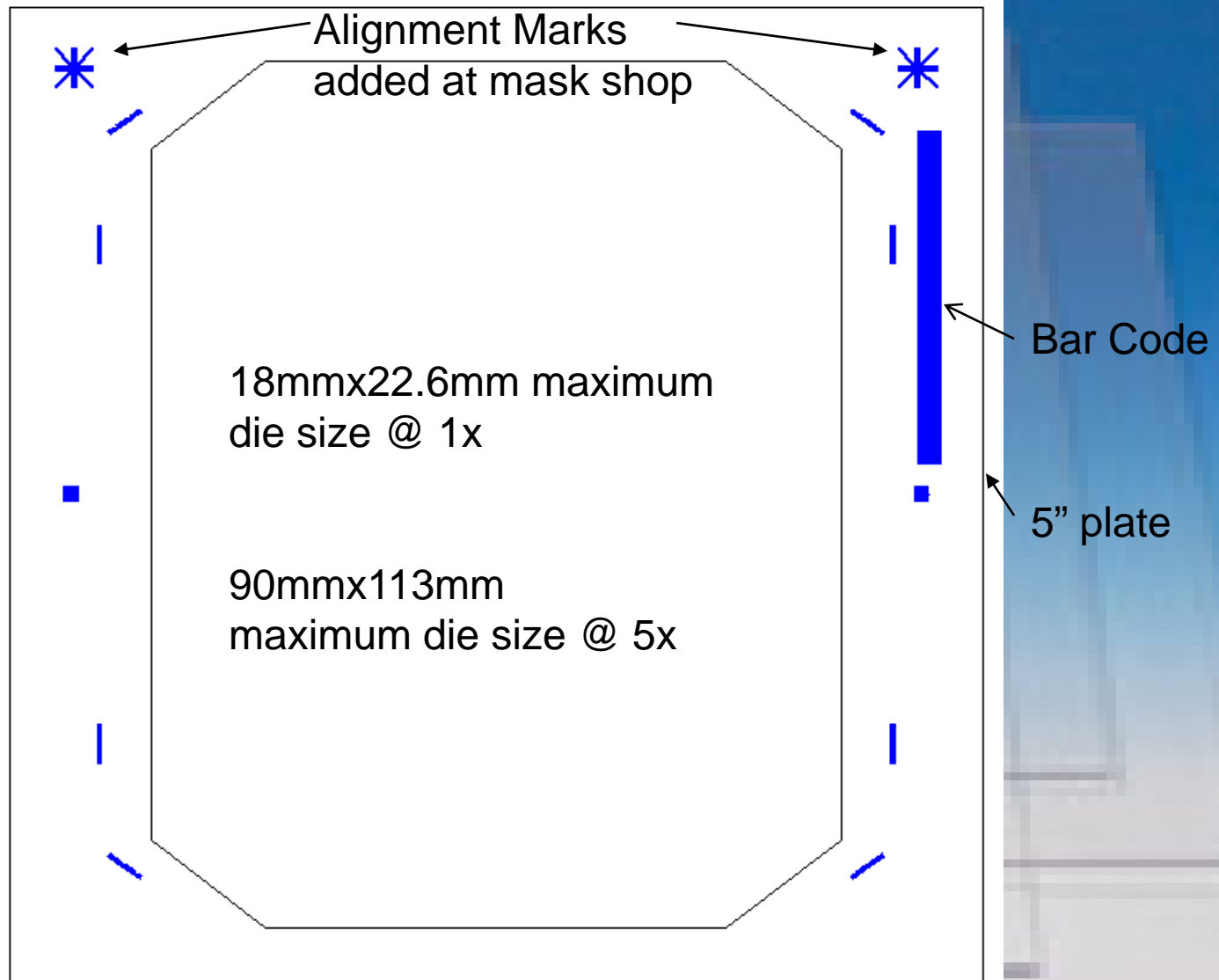
Blue is Chrome on plate.

Final Plate will look like this.

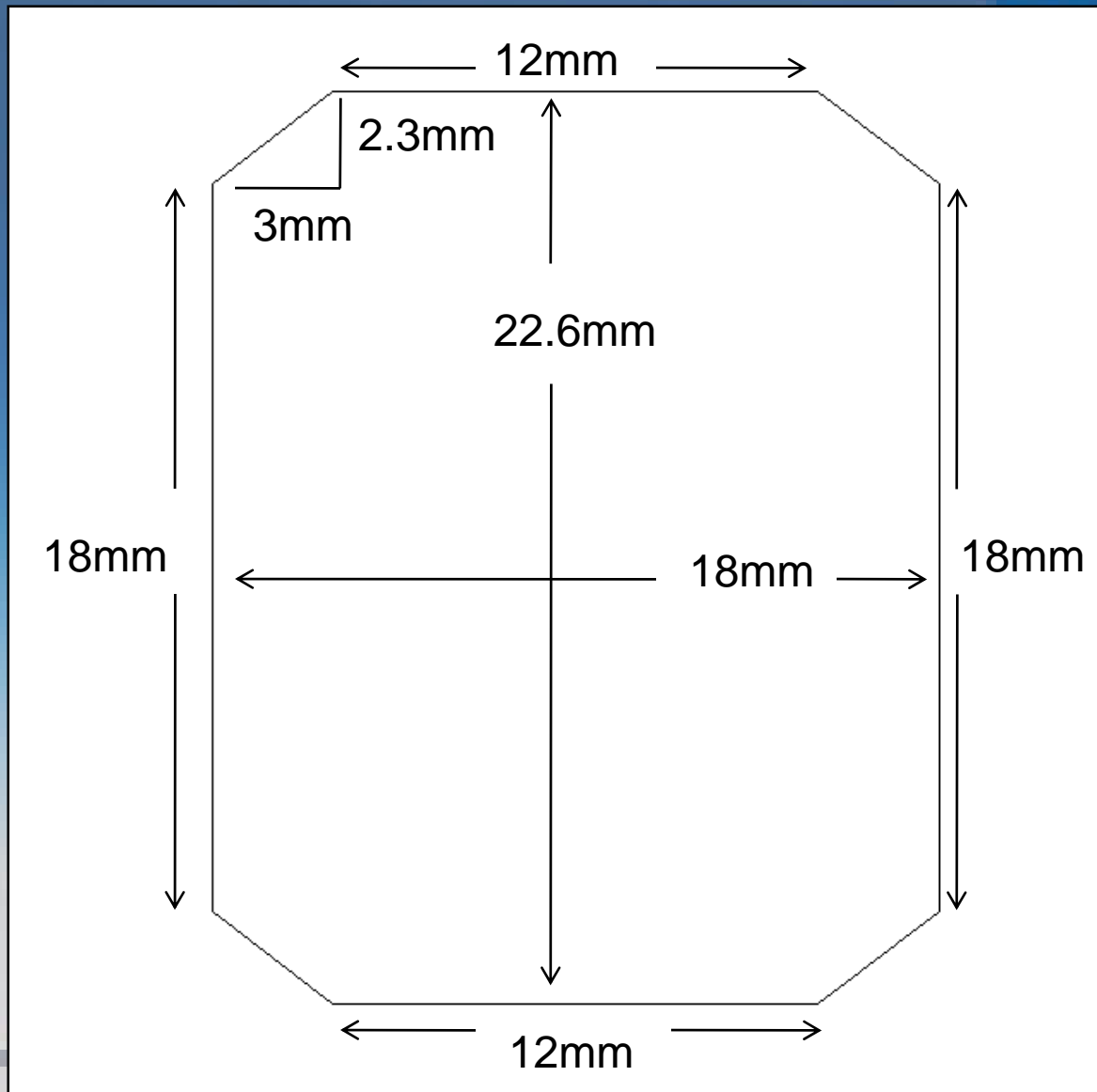
Stepper Reticles

- #1. Mask Shops do not need the outer alignment marks.
- #2. You should supply data at 1x.
- #3. Put DATA=CLEAR on separate layer than DATA=DARK layer.
- #4. Add polygons on DATA=DARK layer around the area that you want to protect to be chrome.
- #5. Digitize chrome scribe area on DATA=DARK layer.
- #6. Define window to be written. You will need to provide the lower left corner and the upper right corner of the area to be written.

ASML 5500 PAS Stepper

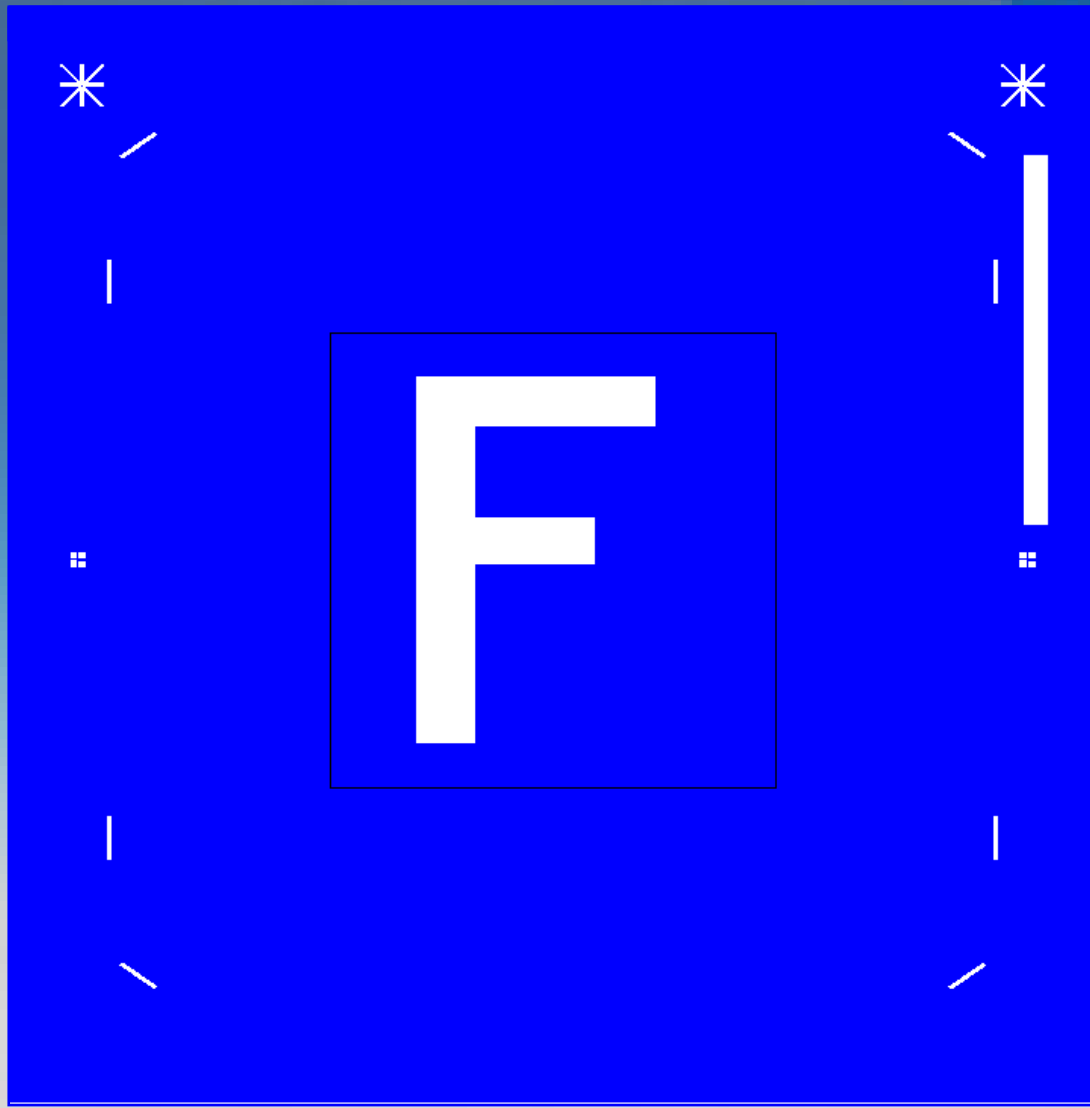


ASML 5500 PAS Stepper



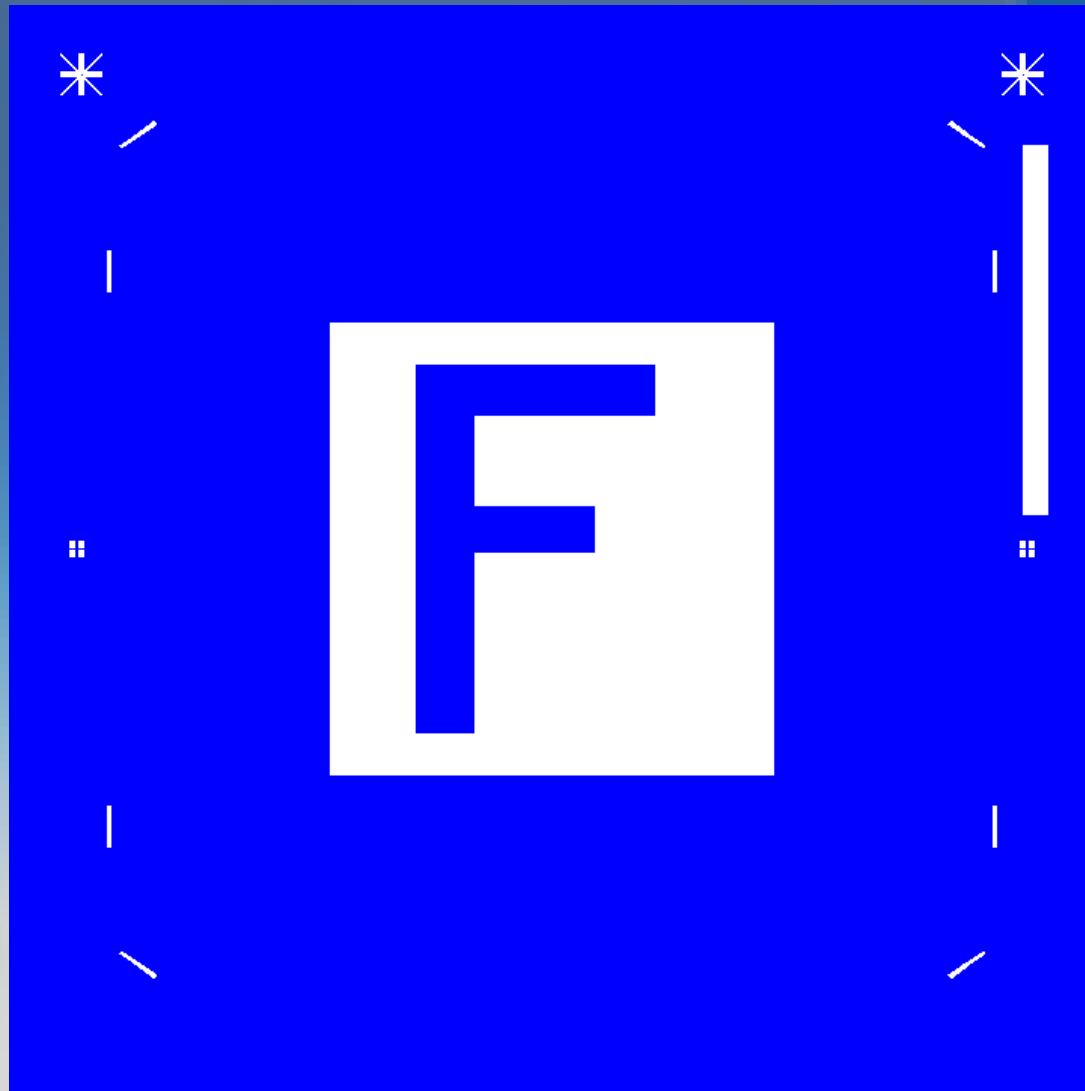
GDS file of this @ 1x = ASML_1X_Write_Area.GDS

ASML 5500 PAS Stepper



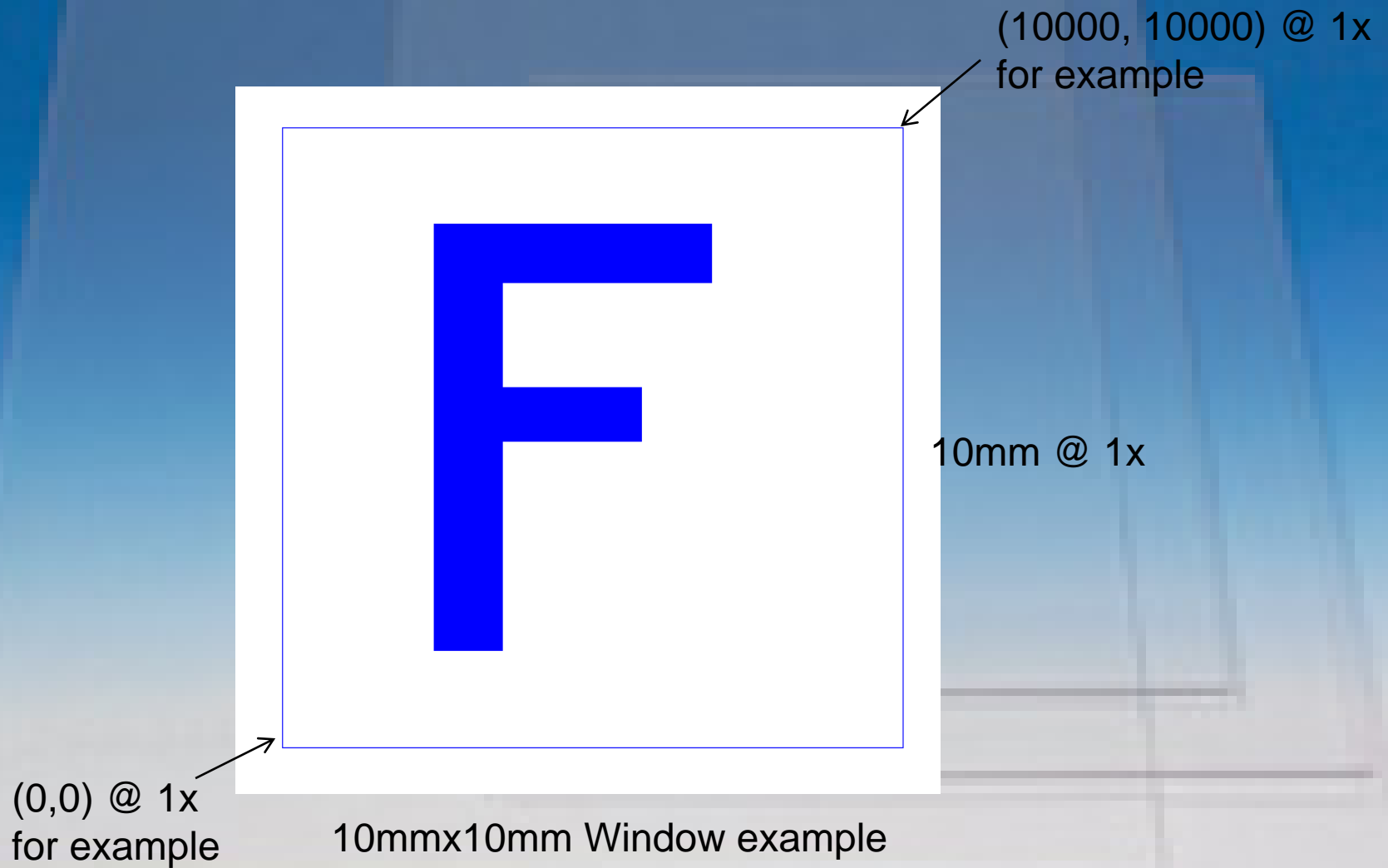
Digitized DATA = CLEAR
with a dark window of 10mm x10mm @ 1x

ASML 5500 PAS Stepper

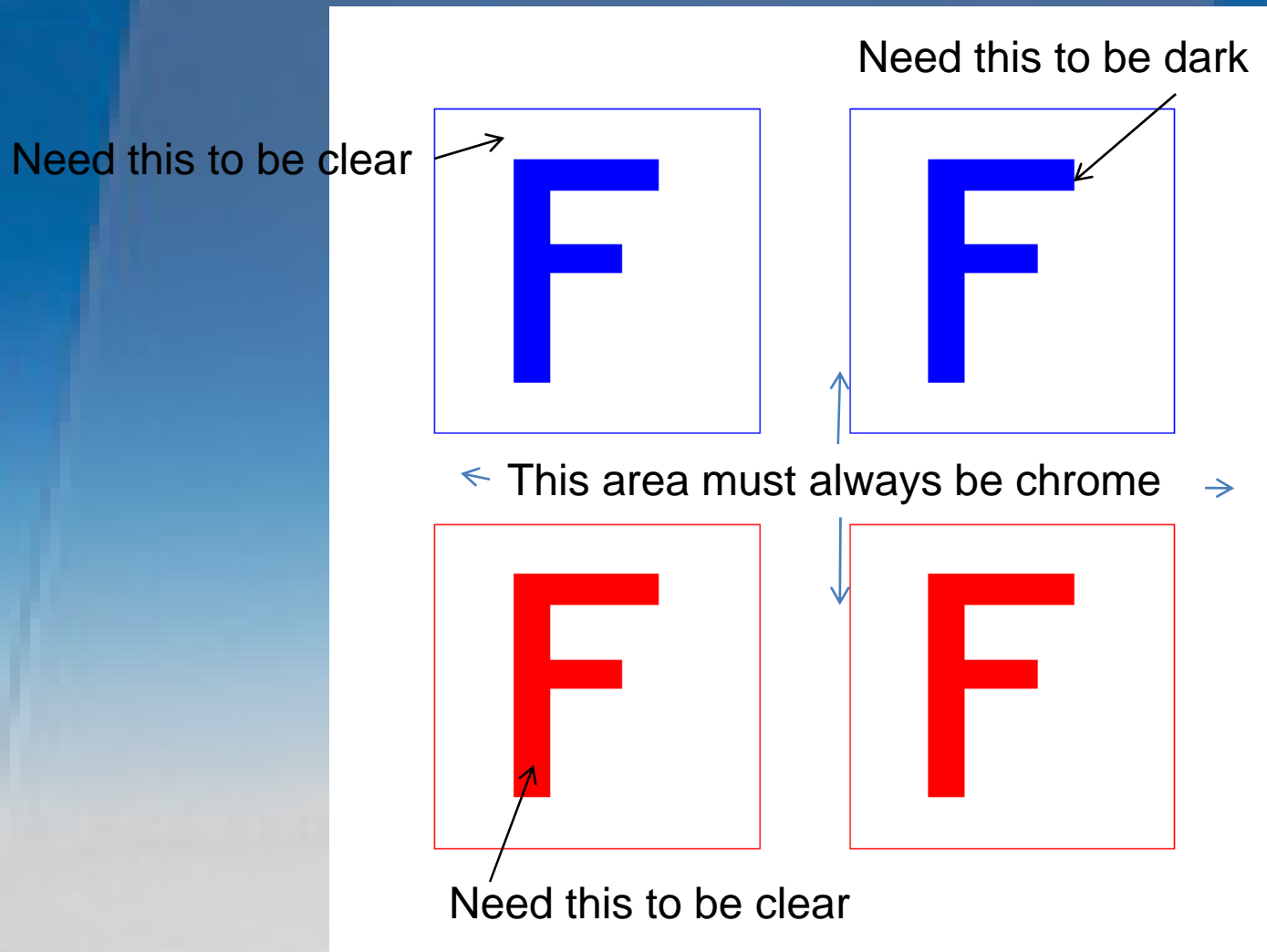


Digitized DATA=DARK
with a 10mm x10mm clear window @ 1x

ASML 5500 PAS Stepper

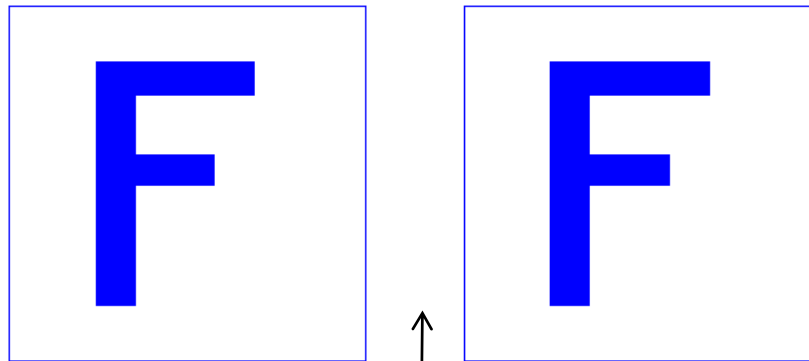


ASML 5500 PAS Stepper

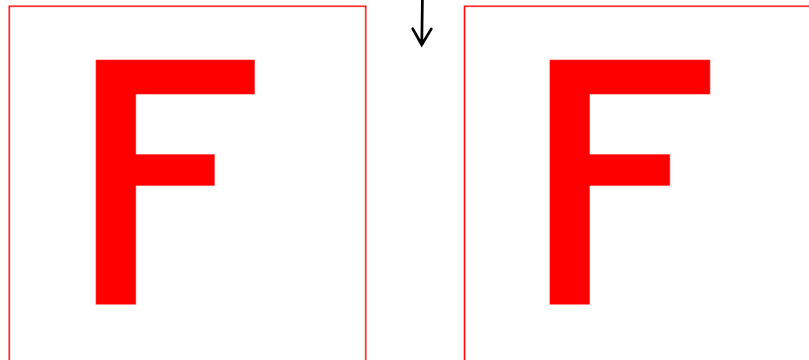


Both fields on the same mask

ASML 5500 PAS Stepper

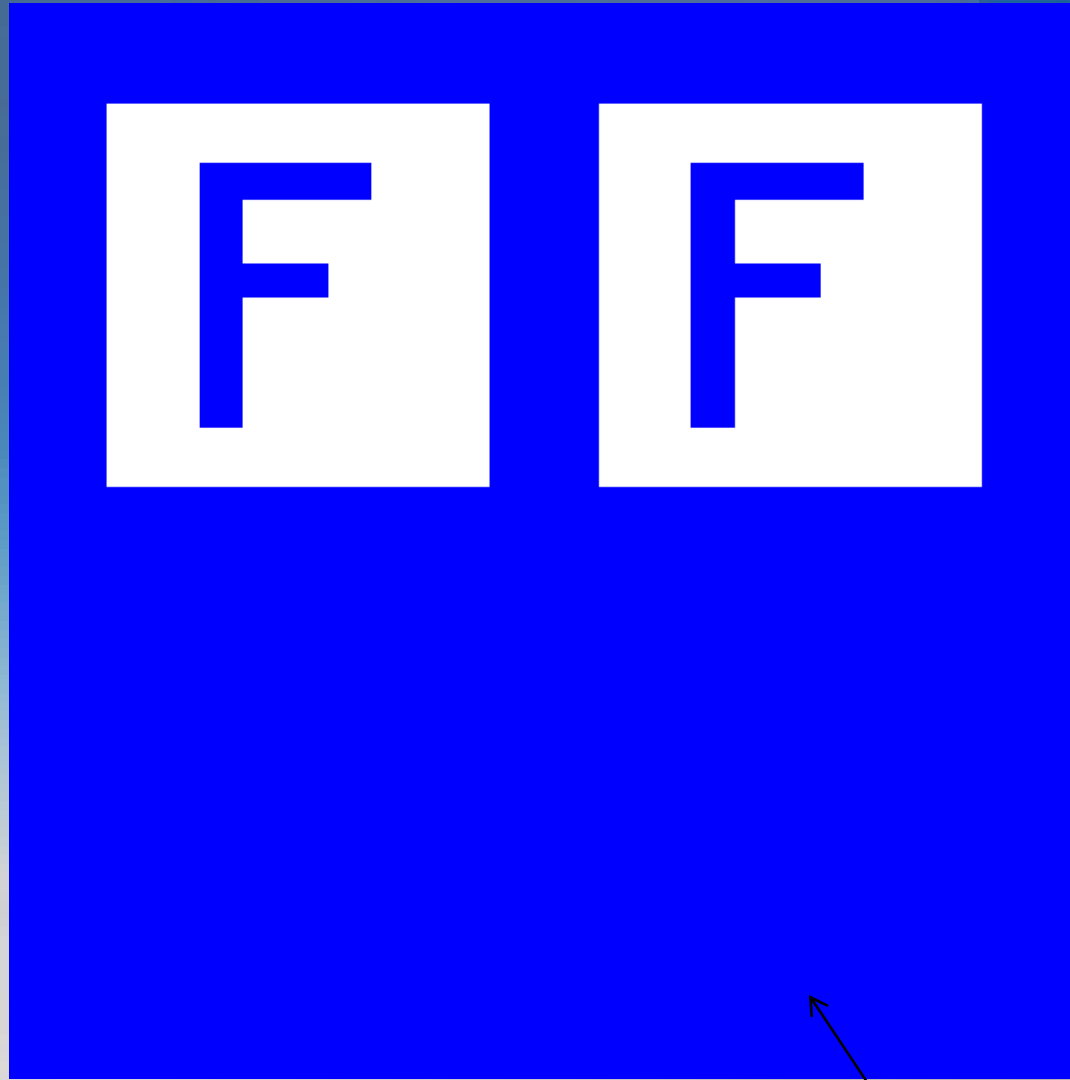


← Gap needs to be 1.4mm or larger →



Both fields on the same mask

ASML 5500 PAS Stepper



DATA=DARK Layer

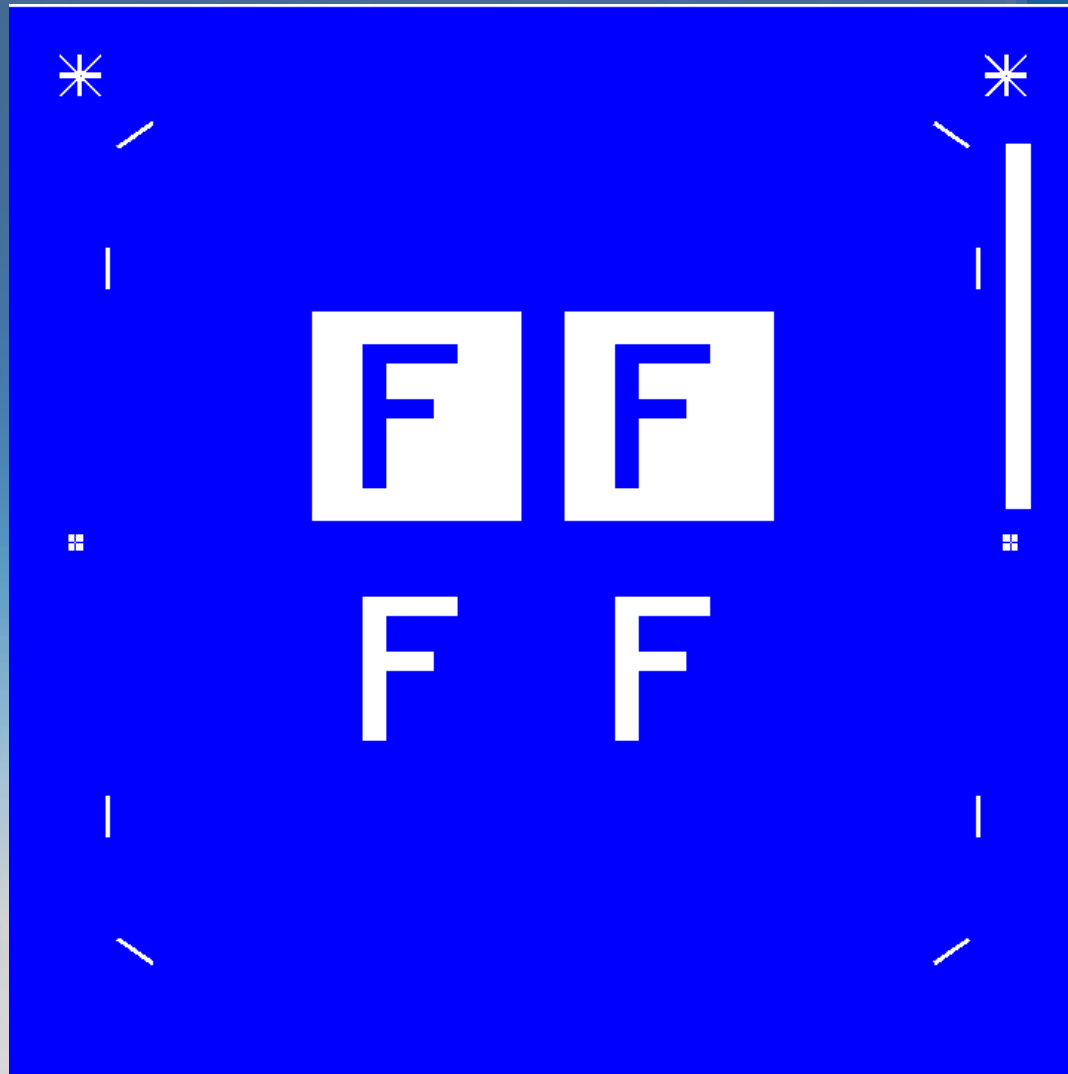
Add polygon to protect
Chrome area.

ASML 5500 PAS Stepper

F F

DATA=CLEAR layer

ASML 5500 PAS Stepper



Mask will look like this with white being clear and blue being chrome