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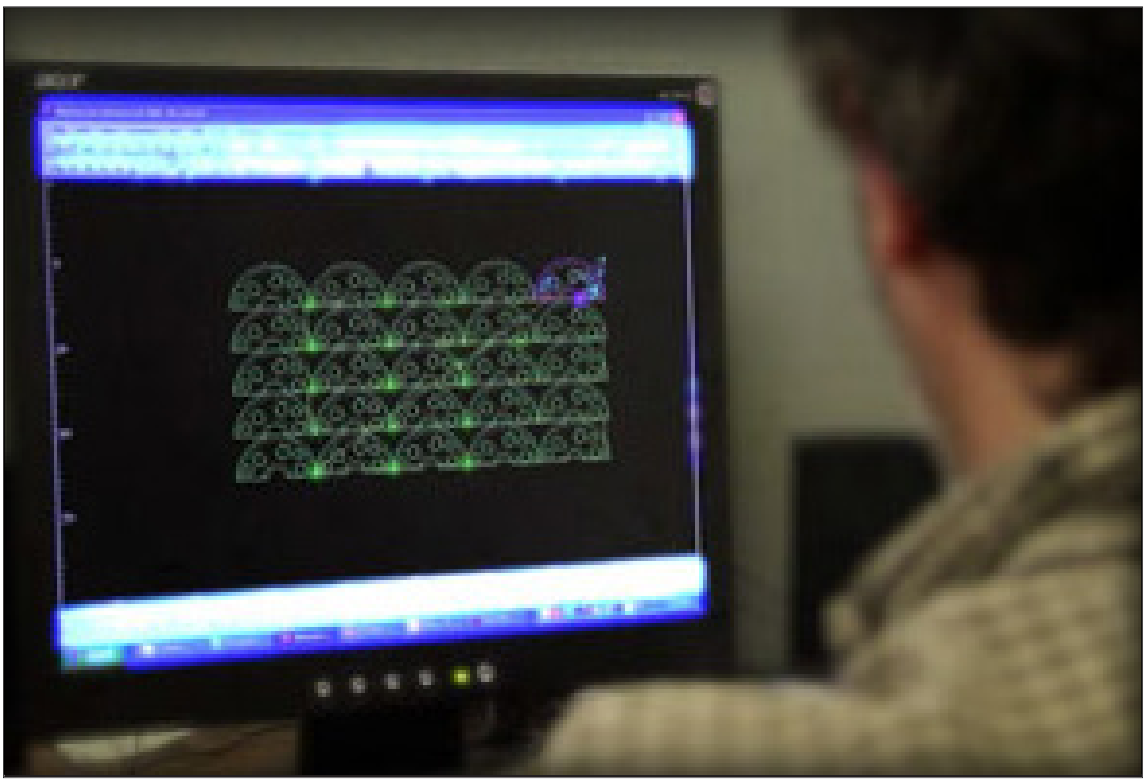
DESIGN GUIDELINE

OPTIMAL TOLERANCES AND LAYOUTS FOR LASER PROCESSING CERAMIC SUBSTRATES

How to Properly Orient Ceramic Substrate Cutting and Drilling Layouts in CAD



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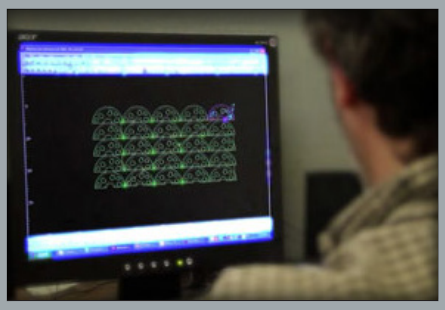

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Efficient layouts produce optimal yields

Use the tolerances and specifications listed below as general engineering guidelines. But please note: we have the capability to yield significantly tighter tolerances based upon your requirements and/or the demands of specific applications. Our coordinate measuring system has resolution capability to within 1 micron repeatability and to within 6 microns X-Y linear accuracy. Unless otherwise noted on your specifications, our standard tolerances (shown below) will be applied.

Minimum distance between laser machined features or singulated edges: Greater than or equal to ceramic thickness when measured from the most narrow distance between features.

Average scribe depth and laser pulse spacing: per table below

Substrate Thickness	Ref. Pulse Depth, External Scribe	Avg. Pulse Depth, Internal Scribe	Avg. Pulse Spacing, Internal Scribe
0.010″	40-70%	35-65%	0.003-0.005″
0.015″	40-65%	35-65%	0.004-0.006″
0.020″	40-65%	35-65%	0.004-0.006″
0.025″	45-65%	35-65%	0.005-0.007″
0.030″	45-65%	40-65%	0.005-0.007″
0.040″	45-70%	45-70%	0.006-0.008″
> 0.040″	50-70%	50-70%	0.006-0.008″

Internal machined or scribed feature to internal feature: tolerance ± 0.001″, non-cumulative.

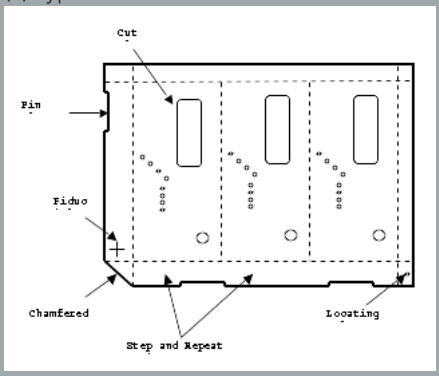
Overall length and width tolerance for cut edges: ± 0.002″

Length and width tolerance for singulated edges: per table below

Substrate Thickness	Tolerance
< 0.016″	+0.003/-0.002″
0.017-0.030	+0.004/-0.003″
0.031-0.040″	+0.005/-0.003″
0.041-0.060″	+0.006/-0.004″
< 0.016″	+0.007/-0.005″

Figure 1. Lasered ceramic substrate:

(a) Typical view



(b) Singulated edge and feature tolerance

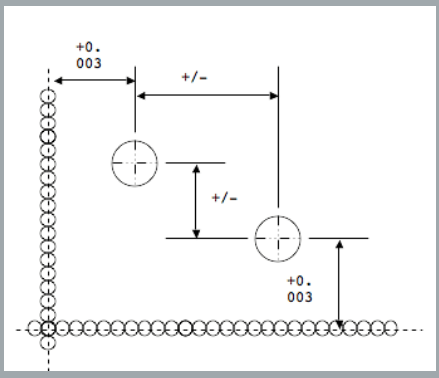
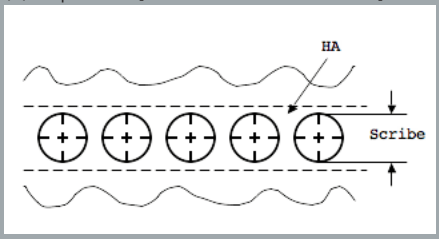
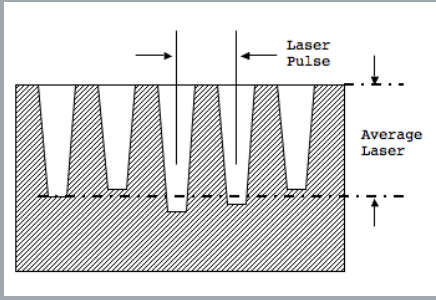


Figure 2. Typical laser scribed line:

(a) Top View ["A" Face of Substrate]



(b) Cross Section



Singulated edge to internal feature: tolerance +0.003/-0.002" (Figure 1)

Hole diameter: ±0.001" for Exit Diameter (Figure 3)

Hole taper: tolerance 10% of substrate thickness, 0.005" maximum (Figure 3)

As-fired edge to internal feature, mechanically aligned: tolerance ±0.010"

As-fired edge to internal feature, optically aligned: tolerance ±0.005"

Optically determined feature to internal feature, optically aligned: tolerance ±0.002"

Slag height: 0.001" maximum above ceramic surface when measured with a micrometer.

Thickness, non-lapped: ±10% of standard manufacturer's thicknesses.

Thickness, lapped: per lapping purchase order specifications.

Surface finish, non-polished: per table below

Substrate Type	Finish
96% Alumina	15-35 microinches
99.6% Alumina	3-5 microinches
Aluminum Nitride, Thick Film	15-35 microinches

Surface finish, polished: per polishing purchase order specifications.

Camber, as fired: per table below

Substrate Thickness	Camber
<= 0.010"	+0.004"/inch
0.011-0.030"	+0.003"/inch
0.031-0.040"	+0.002"/inch
> 0.041"	+0.003"/inch

Figure 3. Typical laser drilled features (cross section)