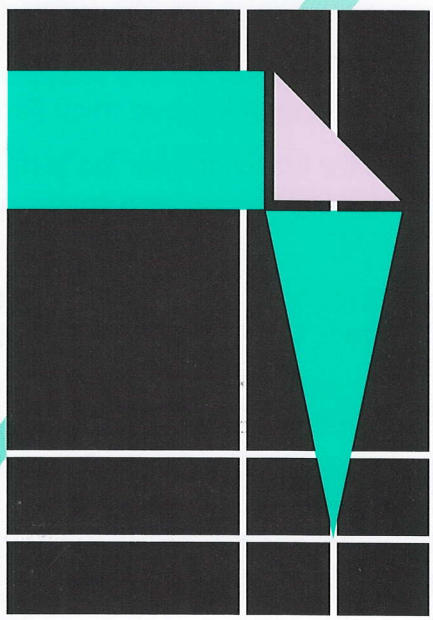
Laser tech services a·s



Technical Specifications
and Services.

Lasered Ceramic Substrates for HYBRID MICRO-Electronics.

Laser Tech has from the establishment in 1985 solely been concentrating on precision lasering of ceramic to the microelectronic industry, leading to it's today position, as Europe's biggest independent supplier of laserdrilled, -scribed and -profiled substrates.

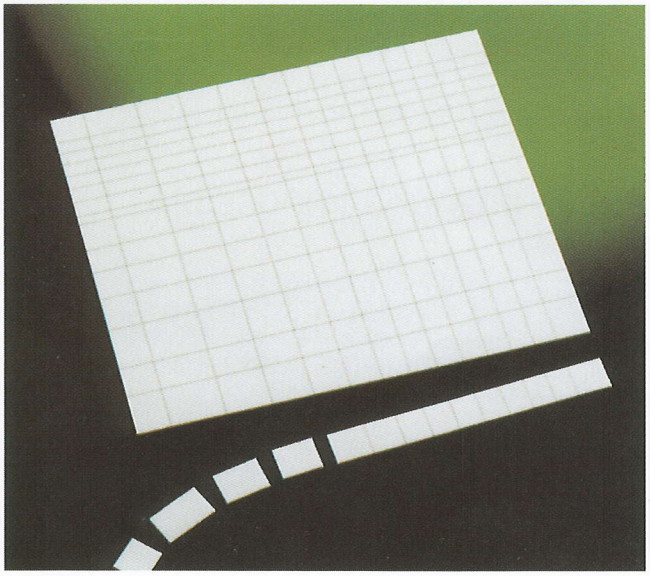
Following services are provided:

With almost 20 years of experience in laserprofiling, -drilling and -scribing of thick- and thinfilm substrates, we are your professional partner in optimizing your lasered substrate design and requirements in the most cost effective way.

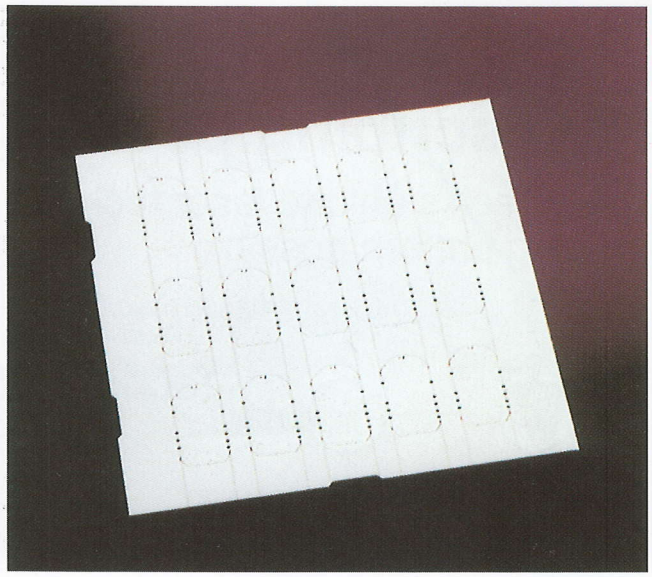
- Accurate scribing of "snapstrates" to customer's specifications, ranging in sizes from a few mm up to 152,4 mm × 228,6 mm (6" × 9").
- Precision laserscribed, -profiled and -drilled snapstrates with hole sizes down to ∅ 0,1 mm for "state of the art" thickfilm printed through hole technology.
- Laserguard – a Laser Tech formulated coating applied to the substrate surface prior to lasering to avoid laserprocess cause ceramic residue on the substrate surface.
- PrimEdge™ and Super PrimEdge™, the Laser Tech developed substrate edge treatment for optimized automatic printing and handling of lasered thick film substrates.
- CAD-datatransfer makes it possible for the customer via e-mail laser@lasertech.dk to transfer the necessary design data for a safe and fast order turnaround.
- Quick service
  Laser Tech's constantly updated laser technology and laser capacity of 24 laser beams, dedicated to ceramic works, allow us to offer prototypes and pilot runs at cost effective rates within 24-48 hours.

Material and sizes on stock:

Substrates from the major raw material suppliers CoorsTek, CeramTec and Kyocera are available from stock in production quantities.



Multiple snapstrate



Laser profiled snapstrate drilled for advanced thick film printed through hole technology.

91% Al_2O_3 (black)

Generally used for optical thickfilm applications.
Standard available rawmaterial sizes and thicknesses:

- 4,5" × 4,5" (114,3 × 114,3 mm) for max. lasered size 108 × 108 mm

Stock available thicknesses: 0,635 mm and 1,0 mm. Standard camber tolerance 0,3%

Other sizes and thicknesses, please contact our sales department.

96% Al_2O_3

Generally used for thickfilm applications and isolation purposes.
Standard available rawmaterial sizes and thicknesses:

- 4,5" × 4,5" (114,3 × 114,3 mm) for max. lasered size 108 × 108 mm

Thicknesses: 0,25 - 0,38 - 0,5 - 0,635 - 0,762 - 1,0 - 1,27 - 1,5 - 2,0 mm

- 5,25" × 4,5" (133,3 × 114,3 mm) for max. lasered size 127 × 108 mm

Thicknesses: 0,25 - 0,38 - 0,5 - 0,635 - 0,762 - 1,0 mm

- 6,5" × 4,5" (165,1 × 114,3 mm) for max. lasered size 158 × 108 mm

Thicknesses: 0,25 - 0,38 - 0,5 - 0,635 - 0,762 - 1,0 - 1,27 mm

- 7,5" × 5,5" (190,5 × 139,7 mm) for max. lasered size 184 × 133 mm

Thicknesses: 0,25 - 0,38 - 0,5 - 0,635 - 0,762 - 1,0 mm

- 9,5" × 6,5" (241,3 × 165,1 mm) for max. lasered size 234 × 158 mm

Thicknesses: 0,635 - 1,0 mm

Other sizes and thicknesses, please contact our sales department.

99,5% Al_2O_3

Generally used for thick/thin film applications.
Standard available rawmaterial sizes and thicknesses:

- 4,5" × 4,5" (114,3 × 114,3 mm) for max. lasered size 108 × 108 mm

Thicknesses: 0,25 - 0,38 - 0,635 - 1 mm

Other sizes and thicknesses, please contact our sales department.

99,6% Al_2O_3

Generally used for thinfilm applications.
Standard available rawmaterial sizes and thicknesses:

- 4,5" × 4,5" (114,3 × 114,3 mm) for max. lasered size 108 × 108 mm

Thicknesses: 0,25 - 0,38 - 0,635 - 1,0 mm

Other sizes and thicknesses, please contact our sales department.

Other ceramic materials

ALN (Aluminum Nitride), Forsterite, Bariumtitanate and others are available on request. Please contact our sales department. Laser Tech is not only experienced in lasering of ceramic material, but also in lasercutting none ceramic materials as flexible PCB materials, polyamide and acetate foils. Our experience is available on request.

Camber

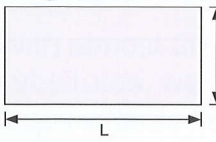
Measured between parallel plates in 45° and defined as ex. ≤ 0,2% ~ 0,051 mm per 25,4 mm in relation to the longest side of the substrate. Laser Tech only stock the premium ≤ 0,2% cambered substrates for the most commonly used thicknesses and sizes: 0,635 - 0,76 - 1,0 mm (4,5" × 4,5" - 6,5" × 4,5"). Camber tolerance quaranteed on the following thicknesses is: 0,25 mm ≤ 0,6%, 0,38 mm ≤ 0,3%, 0,5 mm ≤ 0,3%, 1,27 mm ≤ 0,3%. For tighter camber tolerances please contact our sales department.

Laser Scribed Substrates
Laser Tech. will provide scribed substrates to the customers desired application

Design guidelines • scribed substrates

General tolerances for economic manufacture are:

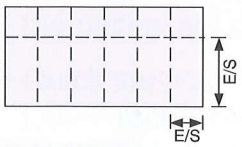
Length/Width



Tolerance between the scribed edges is substrate thickness dependent.

Thickness	Standard tolerance L/W
0,38 mm	+0,15 - 0,025
0,50 mm	+0,15 - 0,025
0,635 mm	+0,20 - 0,05
1,00 mm	+0,30 - 0,05
1,27 mm	+0,30 - 0,05

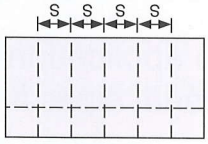
Edge/Scribeline



Tolerance between the scribed edge to the first scribeline is substrate thickness dependent.

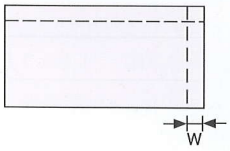
Thickness	Standard tolerance E/S
0,25 mm	+0,10 - 0,025
0,38 mm	+0,10 - 0,025
0,50 mm	+0,10 - 0,025
0,635 mm	+0,20 - 0,05
1,00 mm	+0,30 - 0,05
1,27 mm	+0,30 - 0,05

Scribeline/Scribeline



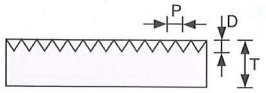
Tolerance S/S
± 0,05 mm, typical ± 0,035 mm

Width of waste to Edge



Edge waste to be snapped off should min. be 5 times substrate thickness (min. 3 mm)

Pitch/Depth

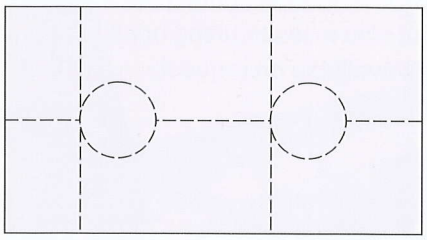


The scribing Pitch (pulse to pulse center distance) and Depth is determined by the application and the substrate thickness.
The general design rule is:

Substr. thickness	Depth	Pitch
0,25 mm	0,12 ± 0,05	0,14 ± 0,02
0,38 mm	0,15 ± 0,05	0,14 ± 0,02
0,50 mm	0,25 ± 0,05	0,16 ± 0,02
0,635 mm	0,25 ± 0,05	0,16 ± 0,02
1,00 mm	0,40 ± 0,05	0,17 ± 0,02
1,27 mm	0,65 ± 0,05	0,17 ± 0,02

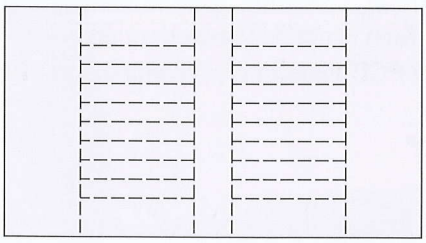
New scribing possibilities

Laser Tech's unique laser technology makes previous impossible scribing pattern possible.



Scribing of disc substrate possible by use of LFL.

Scribing of disc substrates down to ∅ 10 mm is an extremely cost efficient and reliable process, which only is possible by use of LFL offered by Laser Tech.



Snapstrate with interrupt scribing pattern.

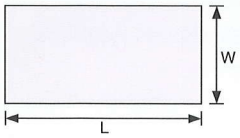
For more information on dimensional tolerances, please contact Laser Tech's technical sales department.

Laserdrilled • Profiled • Scribed substrates
Laser Tech will provide the combined laserdrilled, -profiled and -scribed substrates to the customers desired specification.

Design guidelines • Laser drilling and profiling

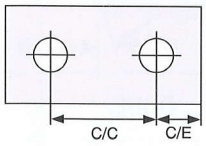
General tolerances for optimized economic manufacture are:

Length/Width



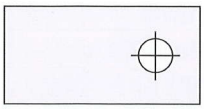
Tolerance between the profiled edges
≥ 0,050 mm (± 0,002")
typical ± 0,035 mm.

Hole Center/Hole Center



Tolerance profiled Edge to hole Center ± 0,050 mm (0,002")
Hole center to hole center
± 0,05 (0,002")

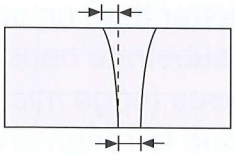
Holes



Min. drilled hole size
∅ 0,1 tolerance $^{+0,030}_{-0,010}$

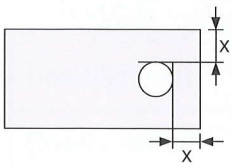
Min. hole size (one shot) ∅ 0,075 mm (0,003")
Max. drilled hole size limited by substrate size, tolerance ± 0,05 mm (± 0,002")
Hole size is measured on the laser beam exit side.

Hole Taper

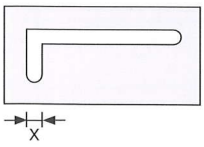


Taper angle ≈ 3°
min. ∅ laser beam exit

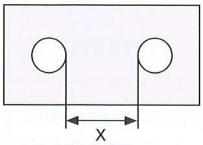
General design rules for optimized economic manufacture are:



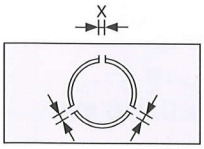
X ≥ Substrate thickness
Distance between hole edge and substrate edge should min. be ≥ the substrate thickness.



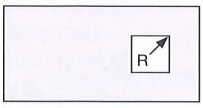
X ≥ 0,04 mm
Any profiled shape can be cut according to the customers requirement.
Min. cut width ~ to 0,04 mm



X ≥ Substrate thickness
Hole edge to hole edge distance should min. ≥ the substrate thickness.



X ≥ 0,1 mm
Profiled disc with holding tags, of minimum 0,1 mm width. (substrate thickness dependent)



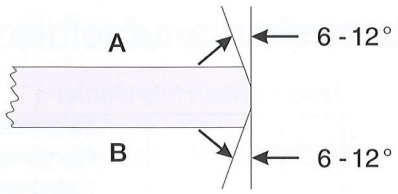
R ≥ 0,1 mm
Avoid designs with internal sharp corners, try to design with a corner radius of min. 0,5 × the substrate thickness to minimize the risk of micro cracking.

With request of improved tolerances and designs in conflict with the general design rules please contact Laser Tech.'s technical sales department for possible available improvements.

PrimEdge™ and Super PrimEdge™

The rational answer to improved thickfilm yield and the most economical solution to quality edge finish.

PrimEdge™

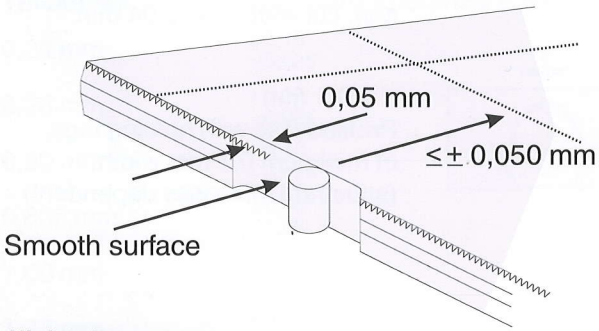


Advantages and benefits:

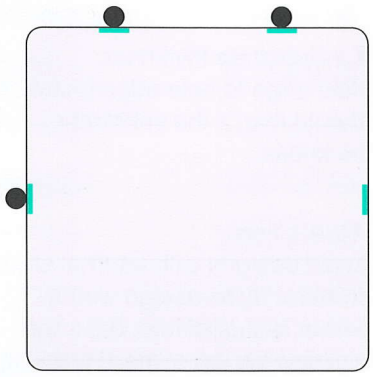
- Surface and bottom edge equally treated, for identical use of A and B side.
- Dimensional tolerances better than on standard scribed substrates.
- No edge chipping by aut. substrate handling.
- Reduced laser edge stresses (edge microcraks).
- No torn printing screens due to rough and sharp edges.
- Reduced location pin wear (better printing repeatability).

All benefits are leading to a higher production yield, to a cost only slightly higher than for a standard scribed substrate.

Super PrimEdge™



High tolerances:
≤ ± 0,050 mm from alignment slots to any hole or scribeline on the substrate.



Alignment slots standard 4x5 mm (or more) to be placed according to customer requirements.

The ultimate answer to quality edge finish and superior printing repeatability for "state of the art" fineline printing and printed through hole technology

Advantages and benefits:

- Surface and bottom edge treated, for identical use of A and B side.
- Rounded corners (radius 1 mm) for troublefree aut. cassette handling and to avoid the well known sharp corner chipping.
- Laser profiled alignment slots for optimal print repeatability, with tolerances superior to any other edge treatment solution.

All benefits are resulting in significantly higher production yield of advanced thickfilm substrates.

CeramTec material properties

Properties	Units	Rubalit® 708S 96% Al_2O_3	Rubalit® 710 99,6% Al_2O_3	Alunit® Ain	Test per
Colour	–	white	white	translucent medium gray	–
Medium grain size d_{50}	µm	3-5	2	4-5	–
Surface roughness R_a	µm	0.6 max	0.1	0.6 max	–
Bulk density	kg/m³	3780	3900	3330	ASTM C 20
Water absorption capacity	%	0	0	0	ASTM C 373
Bending strength – 4-point method (40×4×3 mm³) – dual-ring method (0.63 mm substrate thickness)	Mpa MPa	400 500	 400	360	ASTM F 417 DIN 52292
Modulus of elasticity	GPa	340	350	320	ASTM F 417
Thermal conductivity 20-100° C	W/m° K	24	28	180	ASTM C 408
Specific heat	J/kg° K	800	–	738	
Coefficient of linear expansion 20-300° C 20-600° C 20-1000° C	10^{-6}/° K	 6.8 7.3 8.0	 6.8 7.5 8.5	 4.7 5.2 5.6	ASTM C 373
Dielectric constant – 1 MHz – 1 GHz		 9.8 ± 10% 10.0 ± 10%	 10.1 ± 10% 10.1 ± 10%	 9.0 ± 10%	ASTM C 150
Dielectric loss factor (1 MHz)	10^{-3}	0.3	0.2	0.4	ASTM D 150
Breakdown Strength – 1 mm substrate thickness – 0.63 mm substrate thickness – 0.25 mm substrate thickness	KV/mm	 15 20 28	 > 10	 16	ASTM D 149
Volume resistivity – 20° C – 200° C – 400° C – 600° C	Ohm x cm	 10^{13} 10^{12} 10^{11} 10^{8}	 10^{13} 10^{13} 10^{12} 10^{9}	 10^{13}	ASTM D 257

Characteristic	Unit	Test Method	ADOS-90R	ADS-96R
Alumina Content	Weight %	ASTM D 2442	91	96
Colour	–	–	Dark Brown	White
Density	g/cm^3	ASTM C 373	3.72 min.	3.75 min.
Hardness – Rockwell	–	ASTM E18, R45N	78	82
Surface Finish – CLA (as fired)	Microinches	Profilometer .0004" Radius Stylus .030" Cut-off ANSI/ASME B 46.1	≤ 45	≤ 35
Average Grain Size	Micrometers	Intercept Method	5-7	4-7
Water Absorption	%	ASTM C 373	NIL	NIL
Gas Permeability	–	*	NIL	NIL
Flexural Strength	Kpsi	ASTM F 394	53	58
Elastic Modules	10^6 psi	ASTM C 623	45	44
Poisson's Ratio	–	ASTM C 623	.24	.21
Coefficient of Linear Thermal Expansion	10^{-6}/° C	ASTM C 372		
25° -200° C			6.4	6.3
25° -500° C			7.3	7.1
25° -800° C			8.0	7.6
25° -1000° C			8.4	8.0
Thermal Conductivity	W/m° K	Various		
20° C			13	26
100° C			12	20
400° C			8	12
Dielectric Strength (60 cycles AC avg. RMS)	Volts/mil	ASTM D 149		
.025" thick			540	600
.050" thick			–	–
Dielectric Constant (Relative Permittivity)	–	ASTM D 150		
1 KHz			11.8	9.5
1 MHz			10.3	9.5
Dissipation Factor (Loss Tangent)	–	ASTM D 150		
1 KHz			.1	.0010
1 MHz			.005	.0004
Loss Index (Loss Factor)	–	ASTM D 150		
1 KHz			1.2	.009
1 MHz			.05	.004
Volume Resistivity	ohm-cm	ASTM D 1829		
25° C			$> 10^{14}$	$> 10^{14}$
300° C			4×10^8	5.0×10^{10}
500° C			–	1.0×10^9
700° C			7×10^6	4.0×10^7

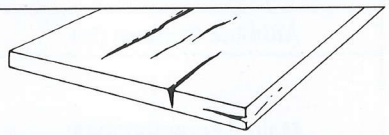
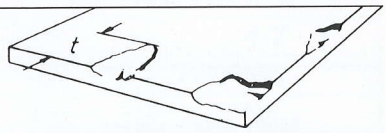
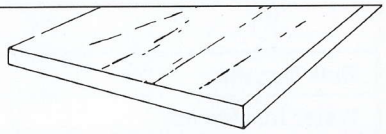
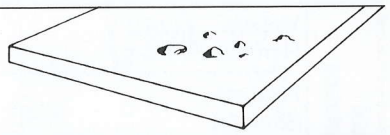
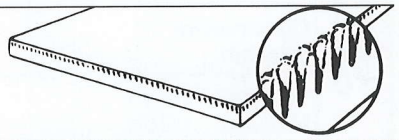
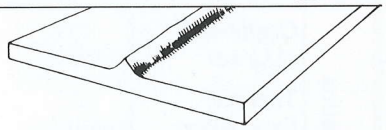
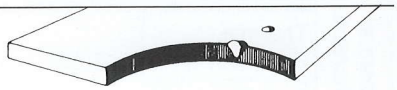
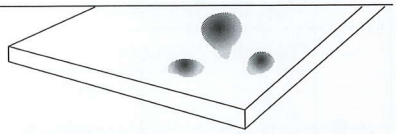
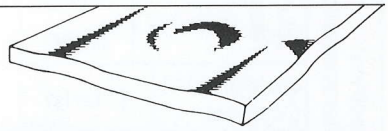
* Helium leak through a plate 1" diameter by 0.010" thick measured at 3×10^{-7} torr vacuum versus approximately one atmosphere of helium pressure for 15 seconds at room temperature.

Kyocera material properties

Item \ Material				ALUMINA (Al_2O_3)				
Kyocera No.				A-445	A-459	A-473	A-476	A-493
Appearance				Dense	Dense	Dense	Dense	Dense
Colour				Dark Brown	Russet	White	White	White
Alumina Content (%)				91	90	92	96	99.6
Main Characteristics				Opacity High Heat Dissipation	High temperature and themal shock resistance	Metallizing Mechanically Strong	Standard Substrate Material	Good surface Smoothness
Main Applications				IC Packages Lids	Metallization	Lids, Substrates For Refractory	Thick Film Substrates	Thick Film Substrates
Bulk Density			–	3.9	3.6	3.6	3.8	3.9
Water Absorption			%	0	0	0	0	0
Mechanical Characteristics	Vickers Hardness (Load 500 g)		kg/mm²	1.100	1.300	1.350	1.500	1.650
	Flexural Strength		psi kg/cm²	30,000 2,100	41,000 2,900	46,000 3,200	40,000 2,800	70,000 5,000
	Compressive Strength		psi kg/cm²	–	–	–	–	–
	Young's Modulus	(x10⁶) (x10⁶)	psi kg/cm²	–	37 2.6	39 2.7	–	–
Thermal Characteristics	Coefficient of Linear	40°~ 400°C	1/°C (x10⁻⁶)	7.2	7.0	6.9	7.1	7.2
	Thermal Expansion	40°~ 800°C		8.1	7.8	7.7	7.8	8.2
	Thermal Conductivity	20°C	$\frac{cal \cdot cm}{cm^2 \cdot sec \cdot °C}$	0.04	0.04	0.04	0.05	0.08
	Specific Heat		cal/g°C	0.19	0.20	0.19	0.19	0.19
	Max. Use Temperature		°C	1,200	1,500	1,500	1,600	1,750
Electrical Characteristics	Dielectric Strength		kv/mm	10	10	10	10	10
	Volume Resistivity	20°C	Ω · cm	$> 10^{12}$	10^{14}	$> 10^{14}$	$> 10^{14}$	$> 10^{14}$
		300°C		10^8	10^{12}	10^{13}	10^{14}	10^{14}
		500°C		10^7	10^9	10^{10}	10^{11}	10^{12}
	Dielectric Constant	(1 MHz)	–	7.9	8.5	9.5	10.2	9.9
	Dielectric Loss Angle	(1 MHz)	(10^{-4})	–	3	8	2	2
	Loss Factor		(x10⁻⁴)	–	25	76	19	19

Specifications for surface imperfections

Visual Inspection, based on a sample inspection according to ISO 2859 level II Cum. AQL 2.5 %

1. Crack	None	
2. Chips	≦ 0,5 mm width (t) Depth max. 50 % of substrate thickness	
3. Surface Scratches	None more than .0007" (0,018 mm) in depth	
4. Lumps	None more than ≤ 0,025 mm high	
5. Burr	None more than .0008" (0,02 mm) high	
6. Ridge	None more than .001" (0,025 mm) high	
7. Pin Holes	None more than .007" (0,18 mm) "diameter	
8. Porous Area	None opened to the surface	
9. Waveness	Acceptable if within specified camber	
10. Foreign Material	Acceptable unless exposed even if it shows discoloration	

The quality

Laser Tech's quality system, for securing the optimum quality of lasered substrates to the microelectronic industry, has been ISO 9002 certified since 1993, upgraded in 2002 to DS/EN ISO 9001:2000. Laser Tech extended in 2003 the ISO 9001:2000 certification also to be DS/ISO/TS-16949:2002 certified, enabling Laser Tech to be preferred as a supplier to the international automotive industry. The ISO/TS-16949 certification will not only be beneficial to Laser Tech's automotive customers, but to all our customers.

Quality control

We use quality control to monitor and correct the manufacturing of the products in order to meet our customers quality requirements. SPC (Statistical Process Control) is used wherever possible to help us to get closer to our ultimate goal, a zero-defect production.

Quality policy

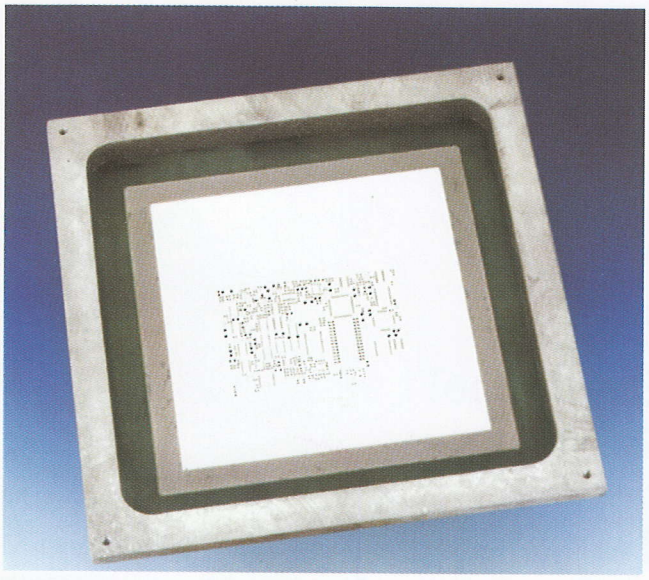
It is our policy, by working closely together with our customers, to be able to meet all customer requirements, simplified in the expression "supply the requested product in the right quality on the requested date". To achieve this requires a total commitment from both staff and management and it is therefore a natural part of the company spirit of an ongoing commitment to improved quality and service.

Other products and services by Laser Tech

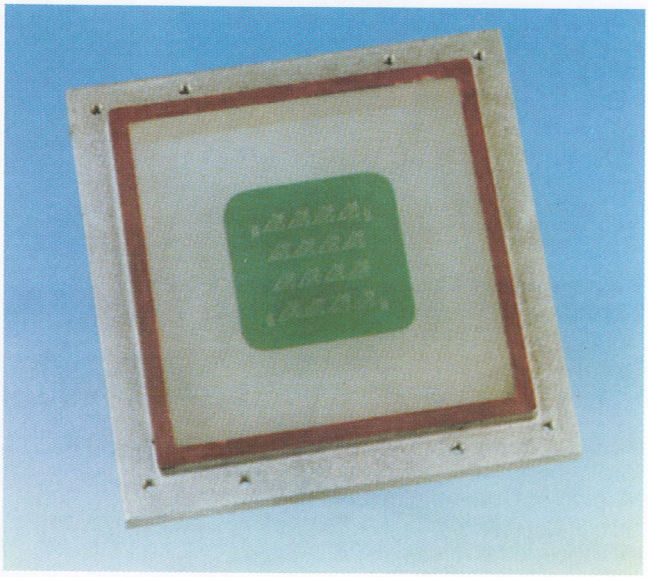
Screen Tech, a division of Laser Tech, with more than15 years experience in manufacturing of precision printing screens for thickfilm printing and SMT-solderpaste printing, offers "state of the art" LaserEtch™ laser cut stainless steel metal mask stencil screens for high yield fine pitch SMT- solderpaste printing, and very specialized stencils for flip chip wafer bumping.

The most modern production facility enables Screen Tech to offer cost effective stainless steel-/polyester mesh screens and metal mask stencil screens at a very short lead time.

For more detailed information about Screen Tech's products, please contact your Laser Tech representative or the technical sales department.



LaserEtch™ Laser cut stainless steel metalmask stencil screen for fine pitch SMT-solderpaste printing.



Stainless steel mesh screen for thickfilm fineline printing.