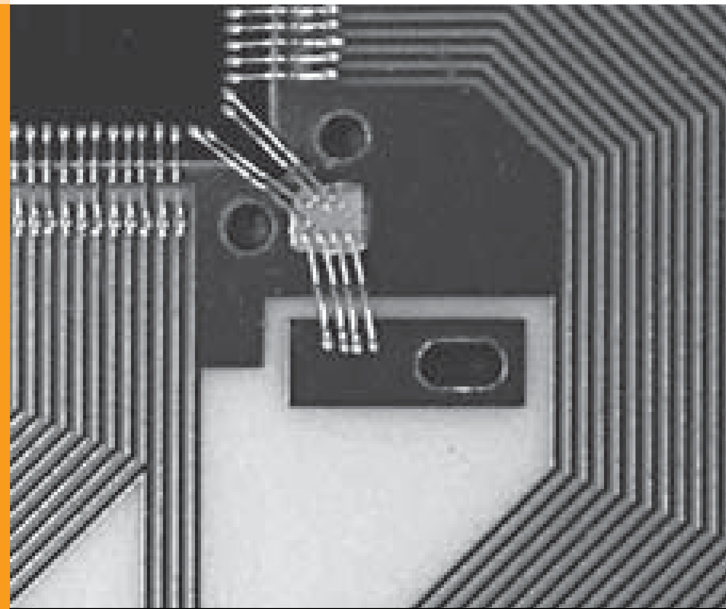
Thick Film
Thin Film
RF-PCB
Assembly/Packagng
Screening/Test

Design Manual



The following rules are effective for the draft of circuit boards and hybrid assemblies. The instructions are only valid for the layout design at RHe Microsystems GmbH. The rules are not intended to be exhaustive. All layouts should be designed in a close collaboration with RHe Microsystems GmbH.

Data file formats: GDS II, DXF, DWG, Extended GERBER (274-X) others on request

Compliance with mentioned values is depending on the properties of the used base material. A consultation is recommended.

Standard

These standard values can be used as a base for your layout and design process without request at RHe.

Special

These values are achievable by using special materials and/or special manufacturing equipment and methods. In any case a request for feasibility at RHe is recommended during early development/layout stage.

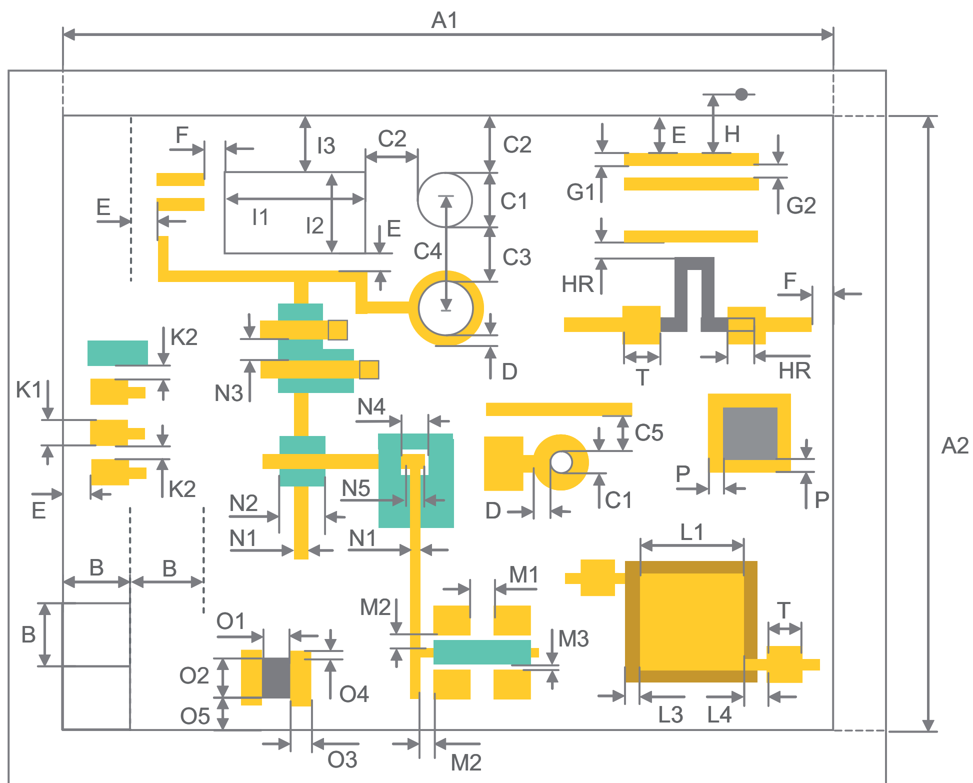
Special values should only be requested if a solution can't be found by using standard values.

Development

In this column named values are mostly custom made designs. As a developer/project leader please consider feasibility studies or separate sample manufacturing and use these parameters only in a tight collaboration with RHe in your products and constructions.

We look forward to be your partner for your special project. The manufacturing technologies will be especially designed to your requirements and series quantities.

Thick Film Drawing



Please note:

The drawing is a summary of all elements from thick film and thin film.

Because of this the selected design rule table below does not include all elements of the drawing.

Thick Film Design rules

		Standard	Special	Development
A1/A2	Tile dimension: 4“ x 4“, usable area:	≤ 95.6 x 95.6 mm²	x	x
A1/A2	Tile dimension: 6.5“ x 4.5“, usable area:	≤ 146.4 x 108.3 mm²	x	x
B	Dimension of single circuit boards on a tile:			
	Separation by laser scribing and breaking	≥ 3.0 x 3.0 mm²	≥ 2.0 x 1.5 mm²	
	Separation by sawing / dicing	≥ 2.0 x 2.0 mm²	≥ 1.5 x 0.6 mm²	
	Width of dicing channel (no metallisation in the channel allowed)	0.140 mm		
	Tolerances of single circuit board dimensions			
	Separation by sawing (after patterning)	± 0.050 mm	± 0.025 mm	± 0.015 mm
	Seperation by scribing and breaking (after patterning)			
	Substrate thickness: ≤ 0.381 mm	+ 0.100 / - 0.025 mm		
	Substrate thickness: ≤ 0.635 mm	+ 0.150 / - 0.050 mm		
	Substrate thickness: ≤ 1.270 mm	+ 0.200 / - 0.050 mm		
	Tolerance scribing line to scribing line	≤ ± 0.035 mm	≤ ± 0.020 mm	
C1	Drilled hole non-metallised: Ø */***	≥ 0.150 mm	≥ 0.100 mm	x
	Drilled hole for PTH: Ø (valid for 10-25 mil substrate thickness)*	0.150 mm	x	
	Tolerance drilled hole dimension	± 0.035 mm	± 0.025 mm	
C2	Distance hole circumference to substrate edge or cut-out	≥ Substrate thickness		
C3	Distance hole circumference to another hole circumference	≥ Substrate thickness	≥ 0.8 x Substrate thickness	
C4	Tolerance hole true center to another hole true center	≤ ± 0.050 mm	≤ ± 0.035 mm	
C5	Distance hole circumference to conductor 2nd layer on dielectric	≥ 0.200 mm	≥ 0.150 mm	x
D	Metallisation ring (rim) PTH around a drilled hole on top and bottom	≥ 0.250 mm	≥ 0.200 mm	
E	Distance conductor to substrate edge:			
	Separation by scribing and breaking	≥ 0.250 mm	≥ 0.200 mm	< 0.150 mm
	Separation by sawing/dicing	≥ 0.100 mm	≥ 0.050 mm	≥ 0.010 mm
	Distance conductor parallel to substrate or cut-out edge	≥ 0.200 mm		≥ 0.150 mm
F	Distance conductor orthogonal to substrate or cut-out edge	≥ 0.150 mm	≥ 0.100 mm	
	Conductor Line & Space:			
G1	Conductor width screen printed	≥ 0.200 mm	≥ 0.100 mm	≥ 0.080 mm
G2	Space between two conductors on ceramic	≥ 0.200 mm	≥ 0.150 mm	x
	Space between two conductors on dielectric	≥ 0.300 mm	≥ 0.150 mm	
G1	Conductor width, monolayer Au screen printed (etched)	≥ 0.150 mm	≥ 0.080 mm (≥ 0.040 mm)	
G2	Space between two conductors in Au screen printed (etched)	≥ 0.200 mm	≥ 0.080 mm (≥ 0.040 mm)	
I1/I2	Cut-outs (parallel to substrate edge)			
	Dimensions (measured at laser exit)*	≥ 1.000 mm x 1.000 mm	≥ 0.500 mm x 0.500 mm	x

		Standard	Special	Development
I3	Distance cut-out to substrate edge or another cut-out edge	≥ Substrate thicknss		
	Aligment tolerance cut-out to substrate edge cut or sawn	± 0.050 mm	± 0.020 mm	
	Aligment tolerance cut-out to substrate edge scribed/broken***	+ 0.250 / - 0.100 mm		
	Cavity (parallel to substrate edge)			
I1/I2	Dimensions (related to cavity base)	≥ 1.000 mm x 1.000 mm	≥ 0.500 mm x 0.500 mm	x
	Remaining substrate thickness in cavity/cavity base	≥ 0.130 mm	x (≥ 0.100 mm)	
I3	Distance cavity edge to substrate edge	≥ Substrate thickness		
	Tolerance cavity to substrate edge	≤ ± 0.250 ... ≥ ± 0.050 mm	± 0.030 mm	
K1	Wire bonding pad dimension: Standard	≥ 0.500 mm x 0.500 mm	≥ 0.300 mm x 0.300 mm	< 0.300 mm x 0.300 mm
K2	Wire bonding pad: Distance to other pads/solder stop/other...	≥ 0.200 mm	≥ 0.150 mm	x
M1 *****	Distance between solder pads	≥ 0.500 mm	≥ 0.250 mm	≤ 0.250 mm
M2 *****	Distance solder pads to conductor without covering	≥ 0.500 mm	≥ 0.300 mm	
M3 *****	Distance solder pad to overglaze/solder stop	≥ 0.150 mm	x	
	Conductor cross-over area			
N1	Conductor width underneath/on insulation of cross-over area	≥ 0.300 mm	≥ 0.200 mm	
N2	Insulation width and length	≥ 0.900 mm	≥ 0.700 mm	
N3	Distance conductor to conductor on insulation	≥ 0.300 mm	≥ 0.200 mm	
	Distance conductor to conductor at insulation edge	≥ 0.500 mm	≥ 0.400 mm	
N4	Via opening in insulation (sq or Ø)	≥ 0.6 x 0.6 mm²	≥ 0.4 x 0.4 mm²	
N5	Via pad dimension conductor/filling (sq or Ø)	≥ 0.4 x 0.4 mm²	≥ 0.35 x 0.35 mm²	
	Dimensioning of resistors (resistors parallel to substrate edge):			
O1	Resistor length	≥ 0.500 mm		
O2	Resistor width	≥ 0.700 mm		
O3	Overlapping zone resistor - conductor	≥ 0.350 mm	≥ 0.300 mm	≥ 0.250 mm
O4	Conductor margin at resistors	≥ 0.200 mm	≥ 0.150 mm	≥ 0.100 mm
O5	Distance resistor to substrate edge or scribe lines	≥ 0.500 mm	≥ 0.400 mm	
P	Pad for die attach			
	Metallisation ring circulating the die	0.150 mm		
T	Pad dimension for electrical measurements and laser trimming of resistors	≥ 0.500 mm x 0.500 mm	≥ 0.30 mm x 0.300 mm	< 0.300 mm x 0.300 mm
	x on request			
	* measured at laser exit, laser exit larger than entry, 7 ... 10 % of ceramic thickness larger on each edge			
	** depending on width and paste type			
	*** depending on substrate thickness			
	**** depending on substrate edge quality			
	***** Solder pads in high density packages need special dimensions – request in any case at RHe			

Thick Film materials

Substrate Material	Composition	Dielectric Constant [ε_r @ 25 °C]	Loss Tangent [$\tan\delta$ @ 1 MHz]	Thermal Conductivity [W/mK @ 25 °C]	Coefficient of linear Thermal Expansion CTE [ppm/K]	Dielectric Strength [kV/mm]	Density [g/cm^3]	Surface finish typical Ra [nm]	0.127 mm	0.178 mm	0.254 mm	0.381 mm	0.504 mm	0.635 mm	1.016 mm	1.270 mm	Laser drilling	Laser cutting	Cavity	Laser scribing	Sawing
									Thickness **								Processing				
Aluminium oxide ceramics 96 % (Al_2O_3)	as fired	9.5	0.001	26	6.4	> 19	3.75	< 900			x	x	x	x	x	x	x	x	x	x	x
Aluminum nitride ceramics (AlN)	as fired	9	0.001	180 – 190	4.7	> 20	3.30	≤ 600			x	x	x	x	x	x	x	x	x	x	x
Beryllium oxide ceramics (BeO 99.5 %)	as fired	6.8	0.0017	250	7.6	> 10	2.86	400													
Microwave-Ferrite																	x				x

** Thickness-Tolerance: Standard ± 10 %, other thickness in compliance with customer request
Other thicknesses available on request.

Thick Film paste materials

Conducturs:

Paste	Base Material	Fired Thickness in µm*	Rsq in mOhm/sq for mean fired thickness	Line & Space in µm	Processes/Applicable for			RoHS	Firing/Curing Temp. in °C
					Soldering	Die Attach	Wire Bonding		
AgPd	Al_2O_3	12 – 16	< 32	150	x			x	850
AgPd	AIN	13 – 15	< 25	150	x			x	850
AgPt	Al_2O_3	13 – 19	< 2.5	150	x			x	850
AgPt	AIN	9 – 11	< 65	150	x			x	850
Ag	Al_2O_3	14 – 18	1 – 2	150 - 200	x			x	850
Ag	AIN	9 – 11	< 3	125	x			x	850
Au	Al_2O_3	7 – 9	< 6.5	175		x	x	x	850
Au	AIN	8 – 12	< 6	100		x	(x) Au only	x	850
AuPt	Al_2O_3	13 – 17	60 – 100	150	x			x	850
Polymer Au	Al_2O_3	25 – 30	< 100	250				x	125

Resistors:

Paste	Base Material	Fired Thickness in µm*	Rsq in mOhm/sq	RoHS	HTCR in +/- ppm/K	Firing/Curing Temp. in °C
Resistors	Al_2O_3	10 – 20	0.1 Ohm – 3 Ohm	x	25 – 75	850
Resistors (decade system)	Al_2O_3	10 – 20	10 Ohm – 1 MOhm	x	50 – 125	850
Resistors (decade system)	AIN	10 – 20	5 Ohm – 1 kOhm	x	100 – 150	850

Insulation, Overglaze, Solder Stop:

Paste	Base Material	Fired Thickness in µm*	Via Resolution	Dielectric Constant	Loss Factor	RoHS	Firing/Curing Temp. in °C
Dielectric	Al_2O_3	> 30	250 – 300	8 – 10 @ 1 MHz	0.5 %	x	850
Dielectric	AIN	> 30	250 – 300	5 – 8 @ 1 MHz	0.2 %	x	850
Overglaze	Al_2O_3	10 – 12				x	500
Overglaze	AIN	14 – 16				x	650
Polymer blue	Al_2O_3/AIN					x	150/200
Polymer red	Al_2O_3/AIN					x	150
Polymer Flex green	Al_2O_3/AIN					x	> 80

* Fired thickness only reachable with multiple prints

RHe Microsystems GmbH · Heidestraße 70 · 01454 Radeberg · Germany
Tel. +49 3528 4199-0 · Fax +49 3528 4199-99 · info@rhe.de · www.rhe.de

Ausgabe 1 / 2009