ACB GROUP NEWS
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ADVANCED CIRCUIT BOARDS
ATLANTEC CIRCUIT BOARDS
Eyes on the future, feet on the ground

ACB's HDI PCB Design Rules Classification.

*At ACB we are proud to launch a new version of our **Design Rule Classification Table**. Initiated 15 years ago, as an answer to a lack of similar design guidelines on the market, ACB's Design Rule Table is now recognized by designers and pcb manufacturers alike as a very easy to use and well set up tool. This table is part of ACB's in depth DFM analysis. Using it will help you to improve design quality, avoid manufacturing problems and reduce risk. It is valid also for High Density Interconnect (HDi) pcbs.*

UNITS = µm	Design Rules Version 11/11/2010 ACB group	STANDARD Classification 3	4	5	6	7	8	ADVANCED or ENGINEERING 9	10	11	12
Track & Gap	min Track to Track (TT) / Track to Pad (TP) / Pad to Pad (PP) Thermal Line Width (TW)	300	200	150	120	100	100	85	75	60	<
	min Track Width (MTW) / min Thermal Gap (GAP)	300	200	150	120	100	100	85	75	60	<
	Local fan out density (allowed on 10 % of the surface)	N A	N A	120	100	100	85	75	60	50	<
Ring for IPC Class 2	min Plated Layer Annular Ring (OAR) on Production Hole Diameter (PHD)	200	175	150	120	100	100	75	75	60	<
	min Inner Layer Annular Ring (IAR) / Thermal Annular Ring on PHD	225	200	175	145	125	125	100	100	85	<
Ring for IPC Class 3	min Plated Layer Annular Ring (OAR) on Production Hole Diameter (PHD)	250	225	200	170	150	150	125	125	110	<
	min Inner Layer Annular Ring (IAR) / Thermal Annular Ring on PHD	250	225	200	170	150	150	125	125	110	<
Aspect Ratio	max aspect ratio PTH: see table (Thickness / PHD)	see table	see table	see table	see table	see table	see table	see table	see table	see table	
Example for PCB with thickness 1.6mm											
Hole diameter	min PHD	500	450	400	350	300	250	250	200	150	<
IPC Class 2	min Plated Layer Pad Diameter	900	800	700	590	500	450	400	350	270	<
	min Inner Layer Pad Diameter	950	850	750	640	550	500	450	400	320	<
IPC Class 3	min Plated Layer Pad Diameter	1000	900	800	690	600	550	500	450	370	<
	min Inner Layer Pad Diameter	1000	900	800	690	600	550	500	450	370	<
µvia	min µvia top pad size				350	300	300	275	250	250	<
	min µvia landing pad size				350	300	300	275	220	220	<
	µvia diameter with dielectric 1 x 1080 prepreg				125	125	125	110	100	100	<
	µvia diameter with dielectric 2 x 106 prepreg (default)				150	150	150	130	N A	N A	<
	µvia diameter with dielectric 2 x 1080 prepreg				175	175	175	150	N A	N A	<
	max number of laserruns / side				1	2	3	4	4	4	>
Drill - Cu	distance PTH to Cu on inner layers (= TT/TP/PP + IAR class 2)	525	400	325	265	225	225	185	175	145	<
	distance PTH to PTH (= TT + 2 x IAR class 2 for standard)	750	600	500	410	350	350	285	275	230	<
	distance NPTH drill to Cu on inner layers (NPTH Routing always > 250 um)	IAR + 25	IAR + 25	IAR + 25	IAR + 25	IAR + 25	IAR + 25	IAR + 25	IAR + 25	IAR + 25	<
	distance NPTH to Cu on outer layers (NPTH Routing always > 200 um)	350	300	250	200	200	200	150	100	75	<
Cu Thickness	maximum total cu thickness that can be etched (no minimum)	105	70	60	50	35	35	20	15	15	<
	(Same trackwidth & bigger gap increases this value)	If Cu thickness is higher than the maximum for a class, class -> class +1									
Solder Mask	solder mask annular ring (MAR) & conductor overlap (MOC): typical	150	100	75	60	50	50	42,5	37,5	30	<
	solder mask annular ring (MAR) & conductor overlap (MOC): exceptional	100	70	50	43,5	37,5	30	25	25	25	<
	solder mask min segment (MSM) (If ACB creates SM, MSM >= 100)	200	150	125	100	100	100	87	87	75	<

▸ **PHD** = Production Hole Diameter = Final hole size + 100 for Component Holes if tolerance is symmetrical (+ 150 for HASL) ▸ **PHD** = Production Hole Diameter = Final hole size for Via Holes

The table is used as follows : every new part that we prepare for production in one of the ACB plants is submitted to a thorough DFM check. Part of the DFM analysis is the Design Rule Check (DRC) of the layout. As result of this DRC-check we define minimum values for different parameters. (track widths / spacings / annular ring / aspect ratio / …) The most critical parameters will define the risk-criteria.
ACB translates the DRC-parameters into our Classification table, which ranges from "easily manufacturable" (Class 3) to "extremely critical" (Class 12). Up to Class 8 (which is the green area of the table) you can consider the design as being industrial. From Class 9 onwards, the risk of getting a lower final yield increases and therefore some extra attention is needed during the manufacturing process. This is why we call them the "Advanced or Engineering" classes (orange area on the table).

For the annular ring parameter, you also have to consider the acceptance criteria. If IPC Class 3 is required, you need to use larger pads in the design. The same design, with a more severe acceptance requirement for the annular ring, will therefore "push" the design into a higher Classification.
Pay attention to the fact that the outer layer annular ring is measured in a different way to inner layers annular rings. The final outer layer annular ring also includes the plating in the hole, whilst the inner layer annular ring is measured without the plating-barrel in the hole.

Starting from classification 6, you may consider introducing microvias (µVia). The choice of dielectric at the microvia stage will define the microvia diameter which is needed for a good shaped microvia and the appropriate plating.
If you're designing a higher density board which needs some features from the Advanced classes, it would be a wrong approach to take all parameters from this higher class. Try to limit as much as possible the parameters you use from the "orange area" and check with ACB's Product Engineers that the combination of design rules you wish to apply, is feasible and cost-efficient.
The classification-table is in addition linked to the type of components planned in the design. From left to right (from Class 3 to Class 11 and more) you can see the incorporation of the smaller pitch components.

Some examples for BGA-design rules according to our table:

For pcbs with thickness 1,6 mm and IPC class 2 requirements						
Component pitch (mm)	1	1	1	0.8	0.5	0.4
Class	6	8	8	8	9	10
Inner pad size (µm)	640	500	300	500	275	220
Drill size (µm)	350	250	150 (µvia)	250	130 (µvia)	100 (µvia)
# Tracks / channel	1	2	3	1	1	1
Track / gap (µm)	120	100	100	100	75	60

Find the complete DRC table at **www.acb.be**

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