Design Rules
COPPER.embedding

These design rules apply to:

Smart High-current-Multilayer-PCBs with embedded copper profiles

- The copper profile thicknesses are 300 µm, 500 µm or 800 µm.
- A maximum of 2x 800 µm is possible in one stackup.
- Without UL marking. All materials are UL listed.

HIGH CURRENTS REQUIRE HIGH COPPER CROSS-SECTIONS

However, high copper cross-sections are only possible to a limited extent due to the widening of the copper conductors. For this reason, the copper cross-section is preferably increased by increasing the thickness of the copper. But if this is realized over a large area via the base material with thick copper, this leads to high costs and high weight and limits the packing density for components and the routing of logic.

LOGIC REQUIRES A HIGH WIRING DENSITY

High wiring densities can only be achieved with thin copper layers. Partial vias in the form of microvias for the electrical connection of individual copper layers are also an efficient option for high wiring densities. Microvias are also an optimal and efficient solution for thermal contacting for optimal heat dissipation in the z-axis. The sequential design option enables stackups for optimized EMC and signal properties.

HIGH CURRENTS AND LOGIC REQUIRE SMART HIGH-CURRENT MULTILAYER PCBS

The solution is to combine multilayer circuits with locally embedded copper profiles. This enables the best possible "1 PCB solution" in terms of system costs and system size, signal integrity, wiring density, local current carrying capacity and thermal efficiency. Error-prone and expensive connections between modules of different technologies can be eliminated.

IMPLEMENTATION OF COPPER.embedding

Etched copper profiles of almost any shape are inserted into windows in the prepregs or inner layer cores and embedded completely and bubble-free in the multilayer pressing process. This creates localized high-current paths that enable the combination of power and logic on a single board, or even on a single layer. High copper cross-sections and microvias also enable optimized heat dissipation.

Basic instructions

- Please comply with general standards, such as IPC or IEC.
- Design Rules for line width, spacing, via and pad size and solder mask please refer to our WE Basic Design Rules (https://www.we-online.com/designrulesbasic).
- Special core-/prepreg combinations are required for embedding the thick copper profiles. Please use our standard stackups. We will be happy to adapt these to your special requirements.
- We will be happy to create the optimal delivery panel for you (best price!).
- Contact us: POWER@we-online.com .

Material specifications

Material	Standard	Spez. Blatt	Beschreibung	Anwendung
Base materials, cores, prepregs	IPC-4101	128	FR-4.1 Tg150 °C	low-halogen, filled, low CTE(z), reliable for temperature cycles
Copper foil	IPC-4562	-	ED-Kupfer	Standard
Copper profile	DIN EN-1172		CW004A	Standard
Solder mask	IPC-SM840 JIS C 5012		green, photosensitive	Standard

Standardausführung

1. Base material according to table above, prepreg constructions 1080 and 2116
2. Copper foil thickness 18 µm + plated copper (see BASIC Design Rules, chapter 5)
3. Copper profiles 300 µm, 500 µm or 800 µm thick
4. Photosensitive solder mask green
5. Standard PTH (Plated Through Holes), plating thickness according to IPC-6012
6. Outline milled or V-grooved, smallest milling diameter 1.6 mm
7. Solder surface ENIG
8. Packaged in ESD shrink wrap

Standard Stackups – basic modules

Copper profile thickness 300 µm, embedding of 2 x 300 µm

Materials	Thickness in µm (cold » laminated)	Stackup		Profile thickness in µm
Copper foil	35	1		
FR4 Prepreg 1080 TG150	57	2		
FR4 Prepreg 1080 TG150	75 » 69	4	3	300
Filling core w/o CU TG150	100	5		
FR4 Prepreg 1080 TG150	75 » 69	6		
FR4 Prepreg 1080 TG150	75 » 69	7		
FR4 Prepreg 1080 TG150	57	8		
FR4 Prepreg 1080 TG150	57	9		
FR4 core with blind layer top/bot TG150	18/100/18	10		
FR4 Prepreg 1080 TG150	57	11		
FR4 Prepreg 1080 TG150	57	12		
FR4 Prepreg 1080 TG150	75 » 69	14	13	300
FR4 Prepreg 1080 TG150	75 » 69	15		
Filling core w/o CU TG150	100	16		
FR4 Prepreg 1080 TG150	75 » 69	17		
FR4 Prepreg 1080 TG150	57	18		
Copper foil	35	19		

Copper profile thickness 500 µm, embedding of 2 x 500 µm

Materials	Thickness in µm (cold » laminated)	Stackup		Profile thickness in µm
Copper foil	35	1		
FR4 Prepreg 1080 TG150	57	2		
FR4 Prepreg 1080 TG150	75 » 69	4	3	500
FR4 Prepreg 1080 TG150	75 » 69	5		
FR4 Prepreg 1080 TG150	75 » 69	6		
Filling core w/o CU TG150	100	7		
FR4 Prepreg 1080 TG150	75 » 69	8		
FR4 Prepreg 1080 TG150	75 » 69	9		
FR4 Prepreg 1080 TG150	75 » 69	10		
FR4 Prepreg 1080 TG150	57	11		
FR4 Prepreg 1080 TG150	57	12		
FR4 core with blind layer top/bot TG150	18/100/18	13		
FR4 Prepreg 1080 TG150	57	14		
FR4 Prepreg 1080 TG150	57	15		
FR4 Prepreg 1080 TG150	75 » 69	17	16	500
FR4 Prepreg 1080 TG150	75 » 69	18		
FR4 Prepreg 1080 TG150	75 » 69	19		
Filling core w/o CU TG150	100	20		
FR4 Prepreg 1080 TG150	75 » 69	21		
FR4 Prepreg 1080 TG150	75 » 69	22		
FR4 Prepreg 1080 TG150	75 » 69	23		
FR4 Prepreg 1080 TG150	57	24		
Copper foil	35	25		

Copper profile thickness 800 µm, embedding of 2 x 800 µm

Materials	Thickness in µm (cold » laminated)	Stackup		Profile thickness in µm
Copper foil	35	1		
FR4 Prepreg 1080 TG150	57	2		
FR4 Prepreg 1080 TG150	75 » 69	4		
FR4 Prepreg 1080 TG150	75 » 69	5		
FR4 Prepreg 1080 TG150	75 » 69	6		
FR4 Prepreg 1080 TG150	75 » 69	7		
Filling core w/o CU TG150	200	8	3	800
FR4 Prepreg 1080 TG150	75 » 69	9		
FR4 Prepreg 1080 TG150	75 » 69	10		
FR4 Prepreg 1080 TG150	75 » 69	11		
FR4 Prepreg 1080 TG150	75 » 69	12		
FR4 Prepreg 1080 TG150	57	13		
FR4 Prepreg 1080 TG150	57	14		
FR4 core with blind layer top/bot TG150	18/100/18	15		
FR4 Prepreg 1080 TG150	57	16		
FR4 Prepreg 1080 TG150	57	17		
FR4 Prepreg 1080 TG150	75 » 69	19		
FR4 Prepreg 1080 TG150	75 » 69	20		
FR4 Prepreg 1080 TG150	75 » 69	21		
FR4 Prepreg 1080 TG150	75 » 69	22		
Filling core w/o CU TG150	200	23	18	800
FR4 Prepreg 1080 TG150	75 » 69	24		
FR4 Prepreg 1080 TG150	75 » 69	25		
FR4 Prepreg 1080 TG150	75 » 69	26		
FR4 Prepreg 1080 TG150	75 » 69	27		
FR4 Prepreg 1080 TG150	57	28		
Copper foil	35	29		

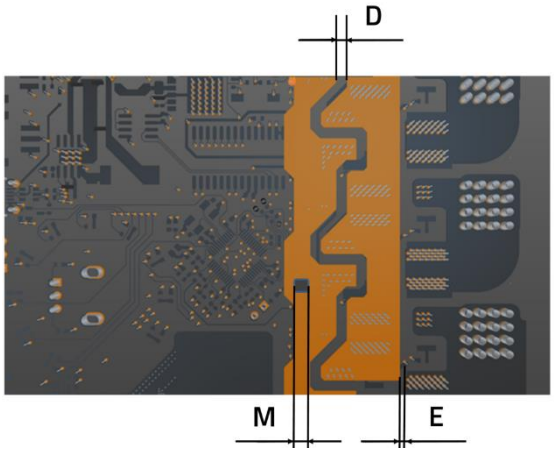
Naming the thick copper layers = copper profiles in the fabrication data

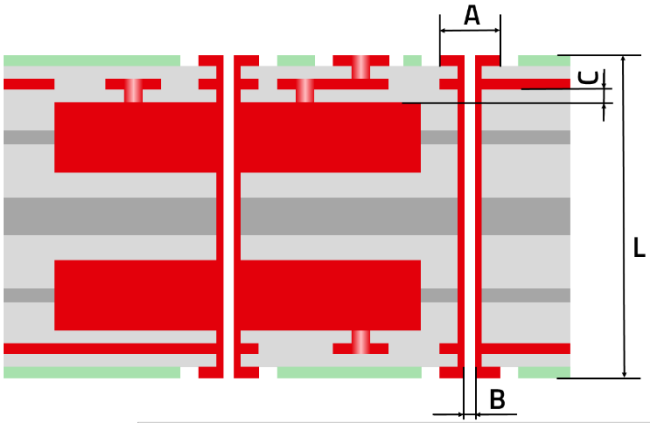
The designation of the thick copper layers = copper profiles in the fabrication data is made up of “copper profile + layer x”, where x is the copper layer number with the smallest distance to the copper profile, typically separated by a prepreg 1080 type.

Example:

Design Rules

COPPER.embedding





Symbol		Standard	Advanced
-	Line widths and spacings	See WE Basic Design Rules	
A	Minimum via pad diameter	See WE Basic Design Rules	
B	Final diameter of PTH	See WE Basic Design Rules Vias through thick copper: ≥ 0.55 mm	
C	Dielectric distance copper profile – copper foil	≥ 70 µm (1 x Prepreg1080)	
-	Buried Vias	On request	
-	Filling of Buried Vias	Not possible	
-	Micro vias	Yes - position and layer count on request	
D	Minimum distance between copper profiles	2.0 mm	1.5 mm
-	Embedded copper profile thickness	300 µm, 500 µm, 800 µm	On request
E	Minimum distance PTH – outline of profile	1/2 pad-Ø + 200 µm	1/2 pad-Ø + 100 µm
(F)	Distance copper - outline	≥ 300 µm	
(H)	Distance outline PCB – outline copper profile	≥ 500 µm	≥ 400 µm
(K)	Size copper profile	≥ 10 mm x 10 mm	≥ 5 mm x 10 mm
-	Shape of copper profile	Freely selectable - rounded corners with R ≥ 1.1 mm	
L	Total thickness of PCB	1.10 mm to 3.20 mm	
M	Recesses in the copper profile	≥ 400 µm, but: maximum 12 mm	On request

Further specifications available on request, please contact us: POWER@we-online.com