A+B Manufacturing guide

Design for Manufacturing (DFM) - Tips for the optimal design of PCBs for efficient SMD and THT assembly

DFM RULES FOR THE PCB

Maximum PCB size

The selection of test methods and assembly processes has an influence on the maximum PCB size that can be processed. The dimensions apply depending on the respective process step.

Rules:

- **SMD** placement **without** AOI test: **505 x 390 mm**
- **SMD** placement with AOI test: **505 x 330 mm**
- **THT** placement: **420 x 320 mm**

Pad design

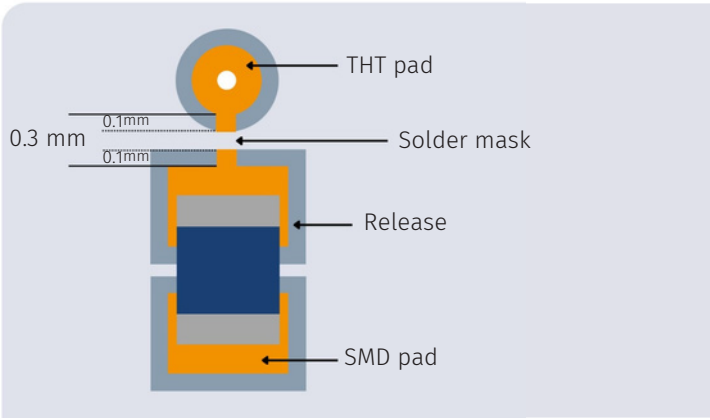
Dimension pads according to the component manufacturer's specifications to ensure reliable soldered connections:

- **Large** pads can cause bridging.
- **Small** pads can lead to cold solder joints.

Solder mask cover

To avoid short circuits and unwanted solder connections, the solder resist must completely separate the pads from each other.

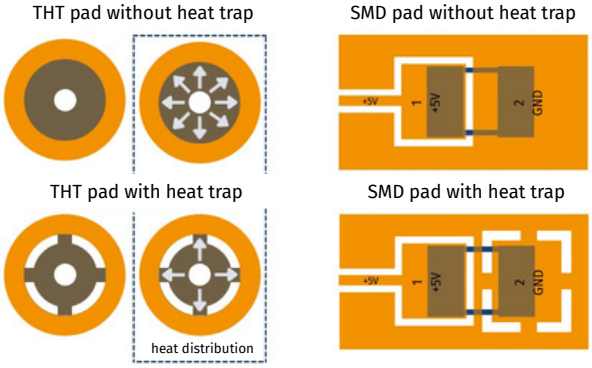
Rule: Maintain a minimum distance of **≥ 0.1 mm** between the solder resist edges and the pad edges. This ensures a clean separation and prevents errors during the soldering process.



Thermal relief (heat traps) for ground planes

To ensure effective and uniform heating of the connection pads during soldering, so-called "thermal reliefs" should be designed into large copper pours. This thermal decoupling facilitates the soldering process and prevents incomplete solder joints.

Note: Applies to both SMD pads and THT drill holes.

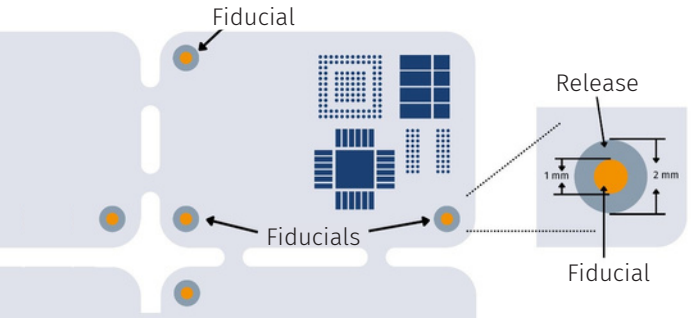


Polarity and markings

The polarity of components such as diodes, ICs, LEDs and electrolytic capacitors must be clearly marked. This should be done in the assembly plan and, if space is available, also added to the assembly print.

Fiducials (reference marks)

Fiducials are required to ensure precise alignment of the PCB during assembly.



Rules:

1. At least **three fiducials** per single PCB, ideally in an **"L" arrangement**
2. Fiducials must be included in both the **pick & place** data and the **solder paste data**

Minimum distances from conductor tracks and copper surfaces to the outer edge

To ensure safe separation of the assemblies from the production panel and to avoid mechanical damage to the PCB, the distance between the conductor tracks and copper surfaces and the outer edge should be **must** be at least **0.5 mm**.

NOTE

Our DFM rules for the PCB relate to the **smooth assembly and soldering** of the PCB. Please note, however, that specific rules must also be observed when **manufacturing the raw PCB**. These vary depending on the PCB supplier. If you would like to find out more, we will be happy to provide you with the requirements of some of our suppliers.

RULES FOR SMD ASSEMBLY

Component spacing

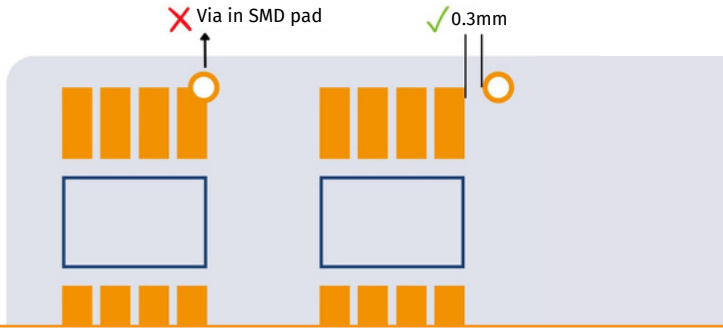
Make sure there is sufficient clearance between components to enable efficient placement with nozzles and grippers of the SMD placement machines and to avoid short circuits. Sufficient distances to the outer edge also prevent mechanical damage when handling the PCB.

Rules

1. Minimum distance between SMD components: **≥ 0.5 mm**
2. Distance to PCB edges for **SMD** components: **≥ 3 mm**
3. Distance to PCB edges for **THT** components: **≥ 5 mm**

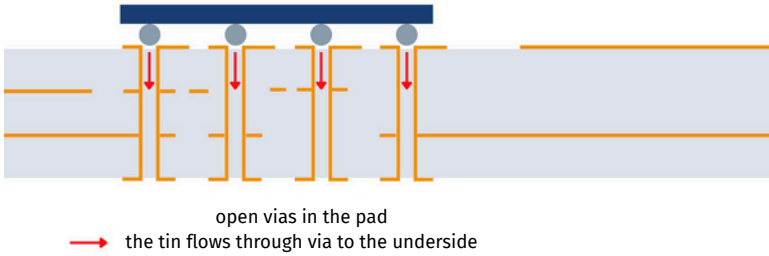
Via placement

Vias should not be placed in SMD pads as this can lead to soldering problems. The solder can flow down through the via, leaving insufficient solder between the pad and the component to make a correct solder connection. Instead, the excess solder collects on the second side and prevents the paste stencil from being placed flat.

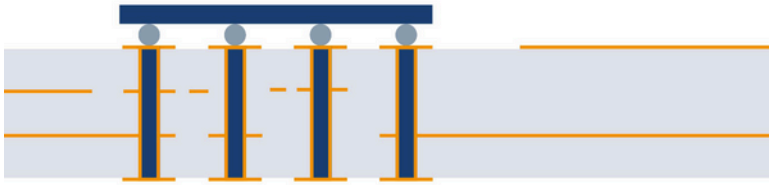


Rules:

1. Vias must be placed at **least 0.3 mm** away from pads.
2. If it is unavoidable that vias lie within a pad, these must be closed as **“Filled / Capped”** in accordance with **IPC 4791 Type VII.**



open vias in the pad
the tin flows through via to the underside



via-filling / capping
(closed vias)

EXCURSE

If a PCB is painted, all vias must be sealed in any case.

Component sizes and positioning

For SMD components assembled on two sides, large and heavy components should be placed on one side. Otherwise, there is a risk that these assembly components will fall off during the second heating process in the reflow oven.

RULES FOR THE THT PLACEMENT

Hole sizes and tolerances

To ensure easy assembly and optimum soldering quality, the vias for THT components should be precisely dimensioned. The component connections should be easy to insert, but must not be too loose.

Rule:
Bore diameter = connection diameter **+ 0.2 to 0.4 mm**
Example: A bore of 1.0-1.2 mm is suitable for a connection with a diameter of 0.8 mm.

The solder pads of the vias must also be sufficiently large to enable good heat transfer and optimum solder wetting.

Rule:
The pad size should be at least **0.5 mm larger** than the pin diameter.

Distance of the drill holes

The distance both between drill holes and to the edges of the PCB is crucial in order to avoid short circuits, space problems and loss of stability.

Rules:

1. The minimum distance between two drill holes should be **≥ 1.0 mm**. This corresponds to the smallest possible THT pin spacing (“pitch”) of 1 mm.
2. The distance between the drill holes and the edges of the PCB should be **≥ 1.5 mm** to prevent stability problems.

Component arrangement

The positioning of THT components should be carefully planned to ensure mechanical stability and facilitate assembly.

Rules:

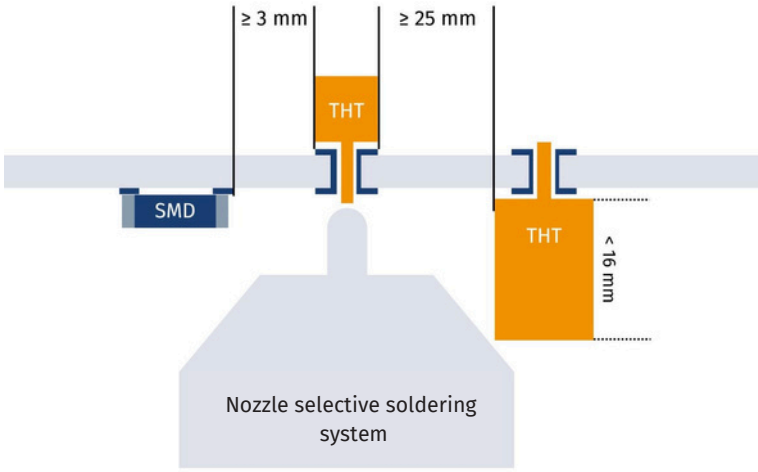
1. Large or heavy components (e.g. transformers, relays) should be positioned close to fixing points to ensure the mechanical stability of the assembly. Care must be taken to ensure that these components do not cover other components.
2. As with SMD assembly, all THT components should be assembled from one side of the PCB if possible. At least the heavy components should be concentrated on one side to simplify the soldering process.

Component spacing and keep-out zones for selective soldering

For selective soldering, it is important to maintain sufficient distances between components and pads to avoid short circuits and soldering errors.

Rules:

1. The distance between an SMD component (outer edge of the SMD pad) and a THT pad of the THT component to be soldered must be at **least 3 mm**.
2. The distance between the THT pad of a THT component to be soldered and another THT component (with a height not higher than 16 mm) must be at **least 25 mm**.



NOTE

All these rules apply as described above to ensure efficient, error-free and cost-effective production. Deviations from these rules are not an exclusion criterion for production, but are likely to cause additional work/extra costs during production and reworking of the assemblies. Please do not hesitate to contact us.

TIPS FOR SELECTING COMPONENTS

Manufacturer-independent components

Choose passive/discrete components such as resistors or capacitors without manufacturer ties to facilitate procurement.

Standardized designs

Combine identical components into one design to simplify production. Example: Instead of a capacitor in three designs, use only one design.

Smallest design

We equip standard designs from 0201 upwards. Smaller designs such as 01005 are also possible - simply contact us.