ASPECT RATIO

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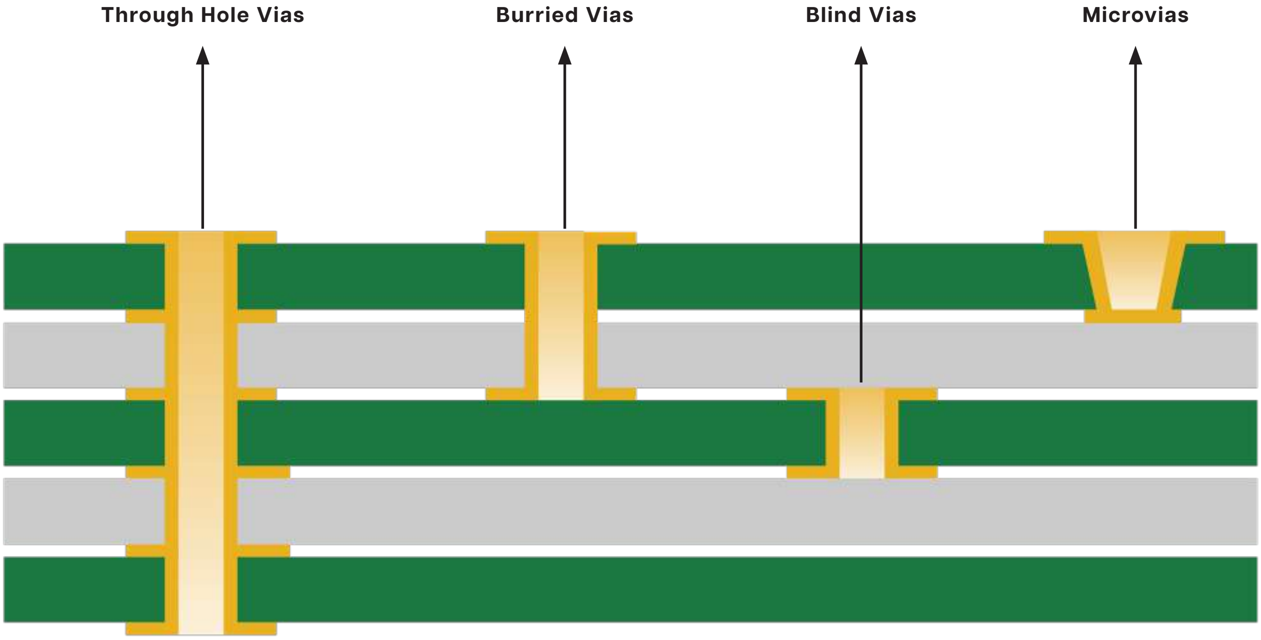
The aspect ratio relates to a ratio based on a hole length relative to the same hole diameter on a pcb. This includes through-hole plated holes, blind vias, buried vias, and micro vias. The aspect ratio applies to both mechanically and laser-drilled holes.



It is an essential parameter in PCB design and manufacturing, as it helps determine the board's manufacturability and reliability.

The aspect ratio is a numerical value typically expressed as "X:1," where "X" represents the ratio. For example, if a PCB has an aspect ratio of 8:1, it means that the board's thickness is eight times the diameter of its smallest drilled hole.

Why is aspect ratio important?

1. Drilling and Plating Process:

When holes are drilled into a PCB, they are usually plated with copper to create electrical connections between different layers of the board. The aspect ratio is crucial because it affects the drilling and plating process. As the aspect ratio increases, the plating process becomes more challenging and requires precise control.

If the hole size is too small relative to the pcb thickness, then the plating will take place on the inside of the hole at the top and bottom of the barrel but will not plate reliably in the middle of the barrel. The cause of the problem is that during the chemical plating process, the plating solution does not go through the hole properly and therefore the barrel of the hole does not plate properly.

2. Mechanical Strength

The aspect ratio also influences the mechanical strength of the PCB. A higher aspect ratio may lead to a thinner trace and decrease the overall strength and rigidity of the board. On the other hand, a lower aspect ratio results in thicker traces, making the board more robust.

Factors that play a major role in the mechanical strength would be the Tg (Glass Transition Temperature) and the CTE (Coefficient of Thermal Expansion) values of the laminate.

3. Heat Dissipation:

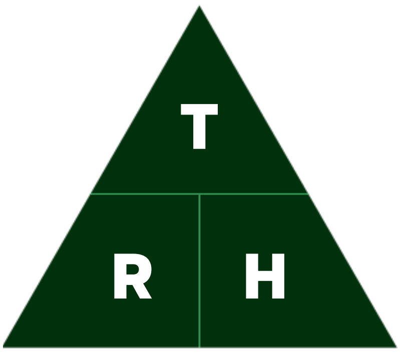
PCBs with higher aspect ratios tend to have better heat dissipation capabilities due to the larger internal surface area. This can be advantageous for high-power applications that generate significant heat.

4. Layer Stackup Design:

The aspect ratio plays a role in determining the board's layer stack-up design. Higher aspect ratios may necessitate careful consideration of the dielectric materials between layers to maintain signal integrity.

Calculating the Aspect Ratio

The formula is as follows:



Where:

T = PCB Thickness

R = Aspect Ratio

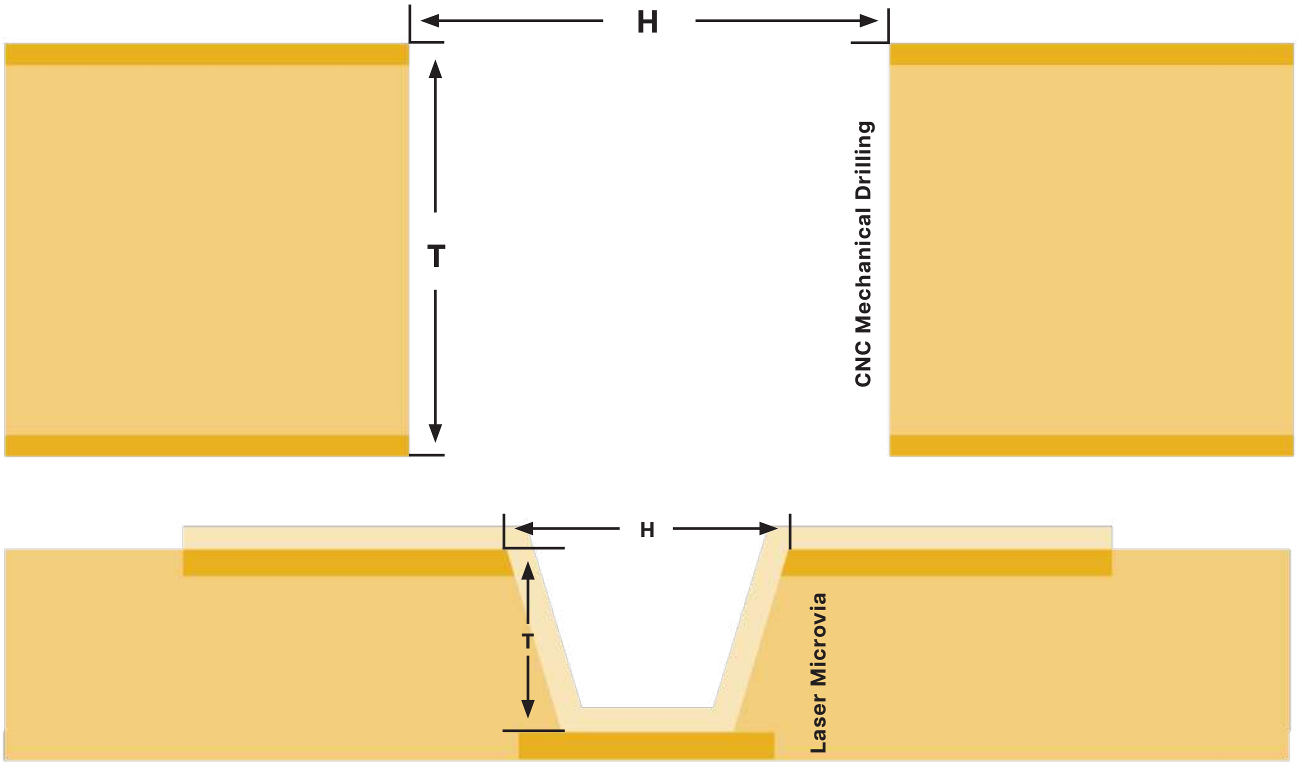
H = Hole Size

Therefore:

T = R x H (mm)

R = T / H

H = T / R (mm)



Example 1

To work out the minimum hole size that can be used for a 1.60mm thick board at an aspect ratio of 8:1.

H = T / R
= 1.6mm / 8
= 0.20mm

Example 2

To work out the aspect ratio for a 1,6mm thick pcb where the smallest hole size is 0.3mm.

R = T / H
= 1.6mm / 0.3mm
= 5.33

This equates to an aspect ratio of 5.33:1

Manufacturing considerations:

Manufacturers have specific limitations on aspect ratios based on their equipment and capabilities. As a rule of thumb, it is essential to communicate with the PCB manufacturer to understand their acceptable aspect ratio range. If the aspect ratio exceeds their capabilities, they may face drilling and plating challenges, leading to PCB defects.

Designers must consider the aspect ratio early in the design process to ensure that their design meets manufacturing and performance requirements.

In summary, the aspect ratio of a PCB is a critical design parameter that affects manufacturability, mechanical strength, heat dissipation, and layer stack-up. Proper consideration of the aspect ratio ensures a well-designed and reliable printed circuit board.

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