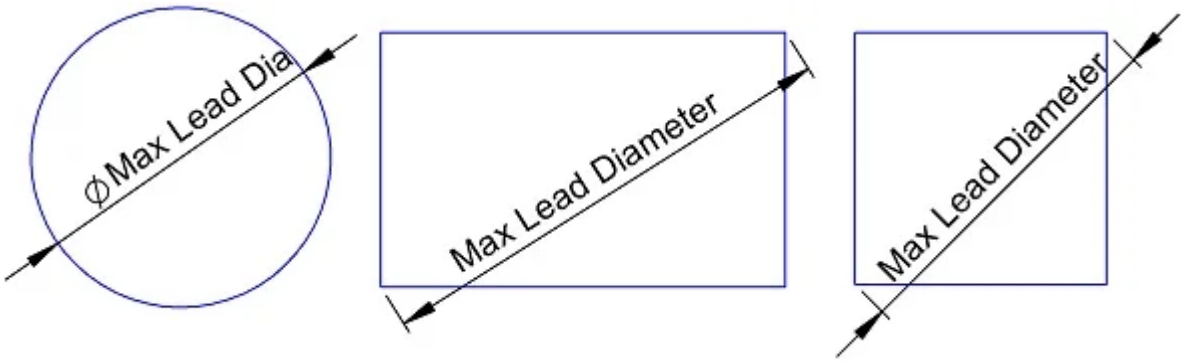
How to calculate PTH hole and pad diameter sizes according to IPC-7251, IPC-2222 and IPC-2221 standards?

This article shows how to calculate PTH (Plated Through-Hole) Hole and Pad Diameter sizes according to IPC-7251, IPC-2222 and IPC-2221 standards in the following steps:

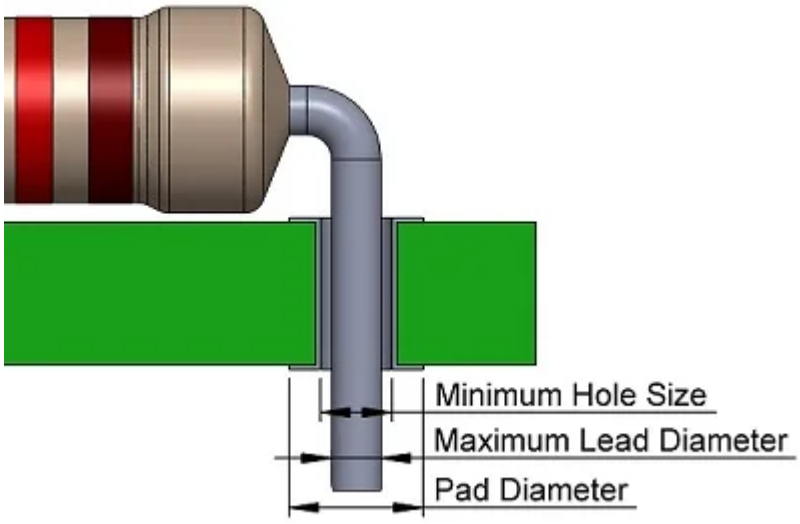
1. Find out the Maximum Lead Diameter

Firstly you should find out the maximum lead diameter. It is present in the datasheet or package drawing of the component. The maximum lead diameters for all shape types of holes are shown in the picture 1. Round hole shape is used for Round PTH Lead. Rectangle hole shape is used for Rectangle PTH Lead. Square hole shape is used for Square PTH Lead.



Picture 1. The Maximum Lead Diameters for Round, Rectangle and Square types of Holes

2. Calculate the Minimum Hole Size



Picture 2. Component Leads and Pad dimensions.

Minimum Hole Size is calculated according to equations below:

Minimum Hole Size = Maximum Lead Diameter + 0.25mm (for Level A of IPC-2222)
Minimum Hole Size = Maximum Lead Diameter + 0.20mm (for Level B of IPC-2222)
Minimum Hole Size = Maximum Lead Diameter + 0.15mm (for Level C of IPC-2222)

3. Calculate the Pad Diameter

After you calculate the Minimum Hole Size, you should know that the Minimum Annular Ring is
0.05mm (50um). According to IPC-2221 the Minimum Fabrication Allowance is 0.6mm for Level A, 0.5mm for Level B and 0.4mm for Level C.

Pad Diameter = Minimum Hole Size + Minimum Annular Ring X 2 + Minimum Fabrication Allowance

Pad Diameter = Minimum Hole Size + 0.1mm + 0.60mm (for Level A of IPC-2221)
Pad Diameter = Minimum Hole Size + 0.1mm + 0.50mm (for Level B of IPC-2221)
Pad Diameter = Minimum Hole Size + 0.1mm + 0.40mm (for Level C of IPC-2221)

Example: Maximum Lead Diameter = 0.55mm
According to Level A Minimum Hole Size = 0.80mm; Pad Diameter = 1.50mm
According to Level B Minimum Hole Size = 0.75mm; Pad Diameter = 1.35mm
According to Level C Minimum Hole Size = 0.70mm; Pad Diameter = 1.20mm

IPC-7251 Naming Convention for the Circular and Square Through Hole Pads

C + Pad Diameter + H + Hole Diameter (for the Circular Pad)
S + Pad Diameter + H + Hole Diameter (for the Square Pad)

Example: C150H90
C = Circular Pad
150 = 1.5mm Pad Diameter
H90 = 0.9mm Hole Diameter

Differences between density levels A, B and C

Levels A, B and C describe the measure of the relative ease of manufacturing.

Density Level A is used for General Design Productibility. It is a Preferred Level. Level A is used for the Low component density. In this case, footprint geometry is 'Maximum'. This method is applied to the most robust productibility.

Density Level B is used for Moderate Design Productibility. It is a Standard Level. Level B conditions are suitable for reflow, wave, drag or dip soldering. In this case, footprint geometry is 'Median'. This method provides a robust solder attachment conditions.

Density Level C is used for High Design Productibility. It is a Reduced Level. Level C is used for the High component density. In this case footprint geometry is 'Minimum'. This method is applied to a hand-held and portable appliances.

Tutorials in the category: IPC Standards

- How to calculate PTH hole and pad diameter sizes according to IPC-7251, IPC-2222 and IPC-2221 standards?
- IPC-7251 Naming Convention for Through-Hole 3D Models and Footprints
- IPC-7351B Naming Convention for Surface Mount Device 3D Models and Footprints
- IPC-7X51 Naming Convention for Connectors and Mechanical Components
- Naming Convention for Non Standard Surface Mount Device 3D Models and Footprints