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Application Note

Specifying plated-through-hole diameters for solderless press-fit connectors.

Introduction:

As the complexity of printed circuit boards increases, more layers of circuitry must be added. High-speed board designs also require the introduction of multiple ground planes. Multilayer circuit boards are therefore becoming thick and heavy like backplanes, and wave or reflow soldering of components becomes very difficult (it's like soldering to a sheet of copper). Wave soldering requires tremendous pre-heat, and reflow soldering needs many additional zones for pre-heat. Thus, solderless press-fit into plated through holes becomes a more practical method of attaching connectors.

Specifying the size of plated through-holes:

Connectors with truly compliant pins will work with industry standard hole tolerances of ±.003". Still, the drill size should be specified before plating in order to center the finished hole size within the ±.003" tolerance. For example, to achieve a finished hole diameter of .040±.003", if the copper in the hole is specified as .001" minimum to .0025" maximum, plating would nominally reduce the hole diameter by .0035", hence a 1,1mm (.0433") drill should be used.

There are many discrete pins and receptacles available for press-fit into plated through-holes. They can have square, pentagonal or hexagonal press-fit features. These are not truly compliant, because their tight envelope doesn't permit it. In this case the drill size before plating is critical. A square, pent. or hex. press-fit design uses the thickness of the copper in the plated through-hole for the press-fit interference. The drill size should be slightly larger than the diameter of the points of the press-fit feature. For example: if a discrete receptacle has a hexagonal across points diameter of .109". The hole prior to plating through should be Ø.1095", i.e.: use a #35 or 2,8mm drill. (Actual hole diameters are usually .0005" smaller than the nominal drill size in FR-4). The nominal finished hole size with copper would then be Ø.106". A note to board fabricators when plating large panels: it is important to mask the edges of the panel in the electro-copper tank to reduce the excessive build-up of copper in the edge holes relative to holes in the center of the panel.

The thickness of the tin-plating in the holes is not critical to the press-fit operation; it is soft enough to be displaced by the pins.

Many discrete pins and receptacles have barbs or knurls as their press-fit feature. These are designed for pressing into molded housings or drilled holes (not plated through) in circuit boards. Drilled holes can be specified with a ±.001" tolerance.

Make the pressing easier:

When pressing gold plated pins into gold plated boards or tin pins into tinned boards, there is "cold welding" of the similar metals in contact. This gives rise to extremely high insertion forces that could damage the board or the connector.

A lubricant in the holes will dramatically reduce "cold welding". A contact lubricant such as OS-138 is recommended. A soap solution can also be used followed by a board wash. Alcohol is not as effective a lubricant, but it can be used without leaving a sticky residue.

Even with lubricant, some "cold welding" still occurs, and this generates localized heat in the holes during pressing. The press rate should be slow to minimize heat damage to the board.