MAXIMUM solutions

Multi-faceted and Vented Precision-Machined Pins

These multi-faceted and vented precision-machined pins are application specific pins primarily for terminating DC/DC (power) converters. They have many other uses where discrete pins and receptacles need to be installed in plated-through-holes of multilayer circuit boards.

Please see the attached article "Precision-Machined Pins for Power Converters." This article is extremely informative and should answer many of your questions.

For more information, please visit mill-max.com/PR545.

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MILL-MAX®
Maximum Interconnect Solutions

Precision-Machined Pins for Power Converters

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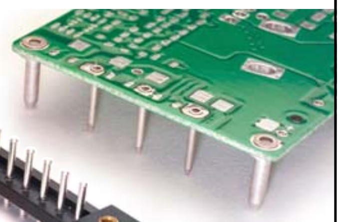
Complex computer systems are demanding more power; high efficiency DC/DC converters can provide that power. The connection between the power converter and the circuit board can limit the distribution of high current; precision-machined pins provide a secure and "powerful" interface.

DC/DC converters are the accepted way of distributing power in network computers. Typically, a primary 48-volt power supply is stepped down to an intermediate bus voltage of 12 volts for each circuit board. Then on the circuit board, additional point-of-load (POL) converters step down to lower logic voltages.

Precision-machined pins have traditionally been used to terminate power converters, Figs. 1 through 3 show a historical sequence of their application. The physical size of power converters is measured in fractions of a "brick" (full,$^{1}/_{2}$,$^{1}/_{4}$,$^{1}/_{8}$). Twenty years ago, "full brick" sized power converters were fully encapsulated and mounted on a heat sink. As their conversion efficiency has been increased (now approaching 97%), their "brick" size has been reduced and the heat sink eliminated. The latest frameless designs (Fig. 3) permit adequate cooling from the parent system's forced airflow.

Three methods of using precision-machined pins to terminate power converters

Fig. 1: Discrete pins, thru hole, riveted and wave or reflow soldered



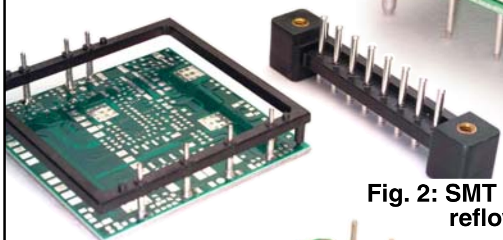


Fig. 2: SMT pins in a frame, reflow soldered.

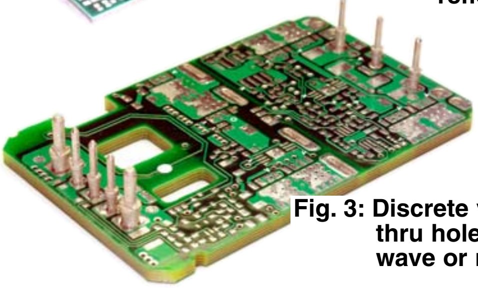
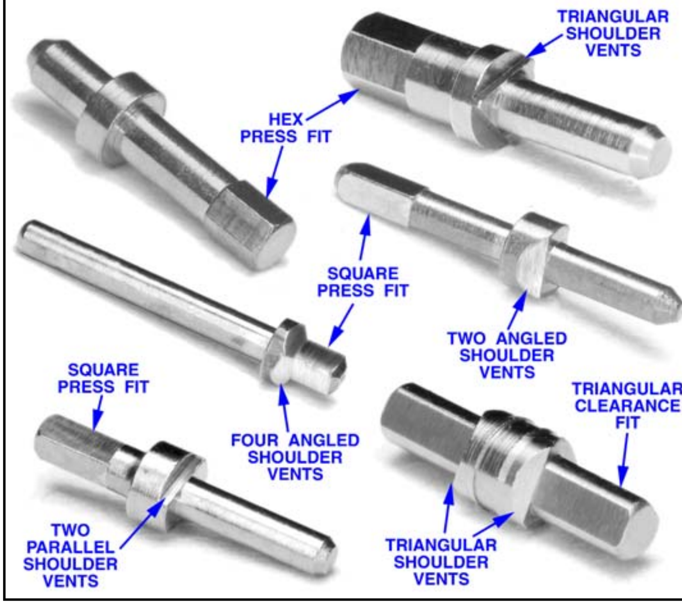


Fig. 3: Discrete vented pins, thru hole press-fit and wave or reflow soldered.

For the manufacturers of power converters, precision-machined pins have four benefits:

• The geometric press-fit features (Fig. 4) permit discrete signal and power pins to be installed directly into the plated-through-holes of the converter board. Fig. 5 shows how to calculate the geometry to fit a specific hole size without damaging the inner layers of the PCB.

Fig. 4: ***Geometric pin features for press-fit into plated-through-holes with venting of holes***



• After installation, the pins are reflow soldered as part of the SMT assembly process.

• The pins have integral shoulders to define the seated height of the converter and allow airflow on both sides of the converter.

• Pins can be machined from different copper alloys: brass is normally used for durability and tellurium copper is now available for high current (>50 amp) power pins. Fig. 6 shows the electrical and thermal properties of some machineable copper alloys.

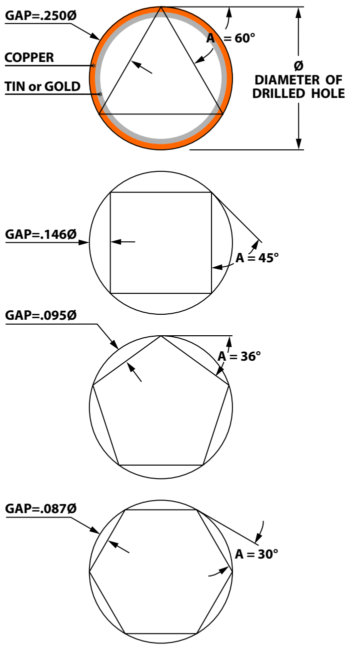
Fig. 5: *The design of multi-faceted press-fit pins for plated-through-holes*

Retention of the press-fit pin prior to wave or reflow soldering is provided by the thickness of the copper plating in the holes. The across points dimension of the geometric feature is made the same as the drilled hole diameter. The drilled hole diameter itself is usually .0005" less than the nominal drill size due to drill tolerance and tool wear. Repointed drills are not recommended for "press-fit" PTHs. Often the sharp points of the geometric feature are given a .002" flat so as not to cut the copper of the PTH when inserted.

When the pin is pressed into the plated-thru-hole, it is important for a gap to remain and permit solder to fill the hole and "wick" through the board without voids or flux entrapment.

When specifying plated-thru-holes that will receive multi-faceted press-fit pins, the PCB fabricator should be given the actual drill size (prior to plating thru) to use as well as a commercial finished hole tolerance (±.002", ±.003" etc.).

$$GAP=\left(\frac{1-\cos A}{2}\right)Ø$$



If the hole is plated .001" minimum to .0025" maximum copper, these are the recommended minimum drilled hole diameters for each geometry:

TRIANGULAR (rarely used)**:**
Ø.023" (use 0,6mm DRILL) minimum.

SQUARE:
Ø.039" (use 1,0mm DRILL) minimum.

PENTAGONAL (rarely used)**:**
Ø.0605" (use 1,55mm DRILL) minimum.

HEXAGONAL:
Ø.0645" (use 1,65mm DRILL) minimum.

Fig. 6: *Electrical & Thermal Conductivity of some machineable Copper Alloys*

There are also four additional benefits for users of power converters with precision-machined pins:

• Through-hole soldering of a relatively large and heavy power converter (compared with SMT components) is mechanically secure without the need for screws. Low power, POL and chip converters are quite amenable to surface mount (ball grid array) attachment.

• For the system board designer, plated-through-holes for power connections can simplify the power
distribution to the inner layers (fewer via holes from the surface of the board).

• For the system builder, **Intrusive Reflow** is a convenient SMT process that achieves the same reliable results as wave soldering does for through-hole components.

• When wave or reflow soldering power converters, vented shoulders on the pins allow the solder to completely fill the plated-through-hole and eliminate voids and flux entrapment that would reduce the current path. See Fig. 7.

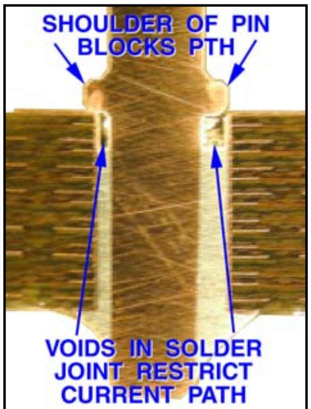


Fig. 7: ***The need for vented shoulders***

Intrusive reflow *(also called "pin-in-paste") is a technique of using conventional through-hole components in a reflow soldering process. The power converters are placed into plated-through-holes in the circuit board (solder paste has previously been screen printed on pads adjacent to the holes) and the board is reflowed in the same pass as other SMT components. Solder will fill the plated-through-holes and achieve solder joints as reliable as wave soldering. "Overprinting" paste on the solder mask can be used to adjust the volume of paste required to fill each hole.*

The increasing complexity and speed of computers are demanding very high power distribution within the circuit board. Precision-machined pins provide the lowest resistance current path from the power converter to the circuit board.