Basics

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A Quick Look At Some Fundamentals of Connector Design

Generally speaking, PCB connectors fall into one of two families: **SCREW MACHINE** or **STAMPED AND FORMED**. Screw machine sockets and headers are more expensive, since the terminals and contacts have to be "turned" on a machine (lathe). These types of terminals and contacts are frequently seen in PGAs (Pin Grid Arrays), IC Sockets and Adapters. Crane specializes in **stamped and formed** products on 0.100" (2,54mm), 0.079" (2,00mm) and 0.050" (1,27mm) centers. Products are available in THRU-HOLE and SURFACE MOUNT termination methods. Here's a look at some data usually associated with our type of products.

CONNECTOR CHECKLIST

A connector is a mechanical coupling device that provides rapid connection or disconnection between two or more sections of an electronic circuit. It may consist of two mating parts – a PLUG (male header) in which one or more pins are axially mounted and a RECEPTACLE (female socket) with corresponding hollow pins (i.e., tuning fork contact).

Before a component engineer designs in a connector, they will often consider the following criteria:

- √ centerline spacing (pin-to-pin)
- √ connector height
- √ PC mounting requirements
- √ contact tail length
- √ plating requirements
- √ number of contacts
- √ PC board thickness (0.062", 0.093", 0.125")
- √ insertion / withdrawal forces needed
- √ contact tail diameter
- √ polarization requirements
- √ available board space
- √ unit cost, total installed cost

TERMINATION STYLE

Termination Style refers to the type of tails the connector has. A **surface mount** termination style (see Figure 1) sits flush on the top of the PCB. A **thru-hole** termination style (Figure 2), on the other hand, features a connector with straight tails which go through plated-thru holes in the PCB.

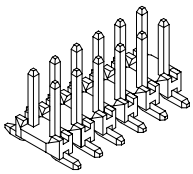


Figure 1
SURFACE MOUNT
Termination Style

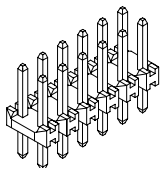


Figure 2
THRU-HOLE
Termination Style

TERMINATION METHODS

Termination method refers to the manner in which the connector is attached to the PCB. The most common methods are wave soldering (thru-hole parts), reflow soldering (SMT parts), and intrusive soldering (SMT and Thru-Hole). Here's a brief look at "terminations."

Wave Soldering:

One of the most widely used termination methods, it involves mass soldering interconnections by automatically conveying a printed circuit board over a wave of continuously flowing solder.

Wire Wrapping:

A high pressure method of terminating interconnects by means of wrapping wire tightly around a square tail to form a gas-tight, metal to metal contact. Used primarily for proto-typing.

Reflow Soldering:

This solder method, used primarily to attach SMT components, involves screening solder paste onto the surface of the PCB. The components are placed on the paste, then subjected to high heat (vapor cloud or convection oven) until the solder "reflows.".

Intrusive Relow:

This solder method allows thru-hole parts and SMT parts to be soldered in the same process. Solder paste is "pressed" into the PTH's (plated thru holes) in the PCB. Leaded components are then placed on the board along with SMT components. The entire board is then heated (convection, vapor cloud, or IR) causing the solder to reflow.

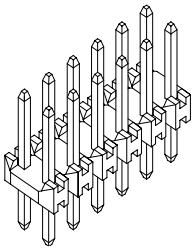
Infra-red Soldering:

A reflow soldering technique that utilizes infrared radiation as the heat transfer medium to attach parts to a PCB. This technique is more "directional" in its application, eliminating the need to expose all components on the board to high heat.

CONNECTOR COMPONENTS

INSULATOR: A key factor in the design of any connector is the insulator material or plastic housing. A good design will fail if the wrong materials are chosen.

The prime function of the insulator is to hold contacts in position for other operations, protect the contacts from damage, establish specific electrical attributes, and establish visual appeal.



The Plastic Insulator Holds Pin In Place

Insulator materials range from regular glass filled (GF) polyester for standard applications, to thermoplastic materials for high temp (reflow) requirements.

NOTE: Some companies use a high percentage of re-grind (old plastic) in their insulators to keep cost down. This can seriously degrade the performance of the finished product.

TERMINALS / CONTACTS: Equally important to the design of a good connector is the terminal post or contact. Factors impacting the selection of each include base material, deflection range, normal force, contact resistance, temperature, size and cost.

PLATING: Surface finishing (plating) is the process of overlaying a thin coating of metal on metallic components to enhance other desired properties. Benefits include:

- √ improved appearance
- √ corrosion resistance
- √ abrasion resistance
- √ improved lubricity
- √ improved solderability

Most gold plating on terminal pins and contacts are applied SELECTIVELY. In other words, the gold in placed only where needed. The rest of the pin is plated tin for economy. Most applications require gold to only be placed on the contact area, that part of the pin or contact that comes into contact with the mating connector.

CRANE PLATING OPTIONS

PLATING SPECS		CONTACT AREA	PC TAIL
G	Selective	15 microinch gold	100u" Tin/Lead
T	Tin/Lead	100 microinch Tin	100u" Tin/Lead
M	Selective	50 microinch gold	100u" Tin/Lead
H	Selective	30 microinch gold	100u" Tin/Lead
L	Selective	10 microinch gold	100u" Tin/Lead
M	Selective	03 microinch gold	100u" Tin/Lead

Crane platings are placed over a 50u" UNDERPLATE of nickel

A BRIEF CONNECTOR GLOSSARY

Body: The insulating part of a connector which holds the contacts in place. Also known as an "insulator."

Burn-In: Testing at a high temperature in order to accelerate failure in components with defects, allowing the designer so as to correct the problem eliminate them prior to placing in service.

Capillary Action: The effect of surface tension that draws a liquid into a small opening.

Coefficient of Thermal Expansion: The degree to which a particular material will expand or contract upon heating and cooling.

Contact: The conducting member of a connecting device designed to provide a point of electrical separability.

Contact Area: The surface of the contact where electrical connection will be made with an IC lead or terminal pin.

Contact Resistance: The resistance at the point of connection determined by the contact geometry, area of plating, and normal force.

Dielectric: A material that is a very poor conductor of electricity. An insulator.

Dielectric Strength: The maximum voltage an insulator may be subjected to without breaking down.

Fretting Corrosion: A form of tin corrosion caused by excessive vibration.

Flux: A compound used to aid wetting of solder to the metals being joined.

Gas Tight: A connection with sufficient contact pressure to keep contaminating gases from entering the contact area and degrading the electrical connection over time.

Header: One or more rows of round or square pins contained by an insulating body.

Insertion Force: The force needed to insert a male lead into a female socket. Force rises with number of pins.

LIF: Refers to sockets featuring Low Insertion Force contacts.

Normal Force: The force exerted on by the sides of a female contact on the mating pin.

Plated Thru Hole (PTH): A hole in a PCB which has metallic walls connected to conductors on the surface or inside the board, and to which the lead of a connector or other component is soldered.

Polarization: An arrangement of contacts and leads which prevents improper mating of mating connectors.

Resistance: A measure of the difficulty of moving electrical current through a medium.