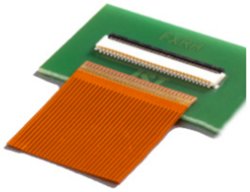
Interconnect Solutions for Flexible Printed Circuits and Etched Foil Heaters

One of the most common questions our Applications Team receives is, “what is the best way to mate with a flexible printed circuit (FPC) or etched foil heater?” This is a difficult question to answer as every application is unique, because of this some interconnect solutions lend themselves better to certain applications rather than others. One thing to keep in mind is that almost any component that can be assembled to a rigid-board or flat flexible cable (FFC) can be assembled to flexible printed circuit (FPC) or etched foil heater technology. This paper will go over some of the more common types of interconnects and provide some advantages and disadvantages for each.



Zero Insertion Force (ZIF) Connectors:

Arguably the most popular connector style in our industry is the Zero Insertion Force (ZIF). With this type of connector the FPC is designed with a tail that has a row of pads with a pitch and overall thickness that corresponds with the specific ZIF connector being used. Because this is such a popular connector type there are dozens of manufacturers that offer hundreds of different configurations, pin counts, retention styles, and metal finishes to fit customers' unique applications. One of the main advantages to using a ZIF connector would be interchangeability. If your application requires that a circuit or heater be replaced after a certain amount of uses and/or if a certain aspect of the application needs to be disposable (E.g. medical device, test equipment), it is quite easy to loosen the retention mechanism, remove the flex, and lock in a new one. Another advantage to ZIF connectors is the price; because there is so much competition in the market for ZIF connectors this technology is very affordable. Disadvantages to utilizing ZIF style connectors would be in applications where there is shock and vibration present. All connector types have a finite amount of retention strength associated with them. ZIF connectors rely on small beams locking the flex into the connector, this is not as robust of a connection when compared to a connector-to-connector solution such as a board-mount or through-hole connector. Also, ZIF connectors are limited in their current carrying ability, many times redundant traces will need to be used on nets with more than .5 Amp. Regardless, with their low profile and plethora of configuration options, ZIF connectors offer a great solution at an attractive price.

Board-Mount or SMT Connectors:

Another popular connector style would be board-mount connectors, which are assembled to FPC's and etched foil heaters via surface mount technology (SMT) assembly. This assembly method involves equipment designed to "pick and place" the connectors from a feeder reel, tray, or tube, onto an FPC which has had solder paste applied to the pads. After placement the circuit is fed into re-flow oven that melts the paste and solders the connector into place. It is also a good design practice to apply a rigidizer such as FR406 (we would recommend at least .021" thick) behind the surface mount component so that the solder joints are not compromised when mating and de-mating. There are many advantages to utilizing SMT style connectors, the most significant being package size. Designers can utilize high pin count connectors in small areas using SMT connectors, which allows for more connectivity with the circuit. SMT connectors are quite inexpensive and the time and cost to assemble them is far less compared to through-hole connectors, because holes do not need to be drilled in the circuit, SMT connectors can reduce the price of the circuit itself. Some disadvantages for SMT connectors would be applications or environments that could potentially compromise the solder joints such as high heat. Also, some SMT connectors have very small leads that do not require much mechanical force to damage the leads, pads, or solder joints, connectors like this should utilize an additional retention solution (E.g. epoxy surrounding the connector body) if used in such applications.

Through-Hole Connectors:

Through-hole connector technology is considered the most robust and reliable way to connect to an FPC or heater. It is also one that can confuse and cause a problem for novice designers when it comes to assembling them to an FPC. The most common way to assemble a through-hole connector to an FPC is to apply a rigidizer, such as FR406, between the circuit and the connector, after which the pins are soldered to the FPC from the back side. The rigidizer helps to provide mechanical support and to keep the flex planar. Many times, an adhesive or potting material is applied over the pins for electrical isolation, and at the same time provides additional mechanical support. There are a variety of through-hole connector styles available to fit individual designs. Some of the more common would be Circular and D-Sub connectors, which are available in numerous pin counts and sizes. Through-hole connectors are common in high reliability applications such as circuits in military, aerospace, and medical assemblies. They perform well in high shock and vibe applications, as well as in extreme climates. One of the disadvantages to through-hole connectors would be package size. Because holes are required, designers can be limited in how many positions they can have compared to SMT connectors. Also, assembly time and the overall cost of the connectors is typically more compared to other connector styles. However, the benefits in reliability through-hole connectors provide justify the price.

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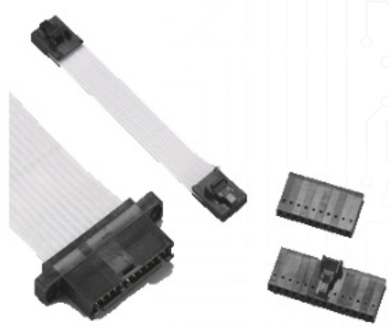

FFC/FPC Crimp-Style Connectors:

In some applications soldering a connector to a circuit is not an option due to the material being used or the environment the circuit will be in. crimp-style connectors, such as those from T.E. Connectivity (AMP), are solderless and terminate to flexible circuits using equipment that installs pins into the circuit, after which a connector housing is applied over the pins. This connector style is quite popular in the automotive industry and has found its way into the design arsenal of many OEM's. One of the advantages to using crimp-style connectors would be that many different materials can be used with the technology, that includes polyester, polyimide, Teflon, etc. The price of the pins and housing are typically quite inexpensive as well. The main disadvantage for crimp-style connectors would be that they require specialized equipment to install the pins. This means that a company would need to invest in the equipment to install the pins, or, find a supplier that can install the pins for them.

This is a list of the most common types of interconnect and termination methods used when mating to an FPC or etched foil heater, this is not an exhaustive list of all the possibilities available. Each design has different requirements and as you can see each connector option has its own set of advantages and disadvantage, both of these must be taken into consideration when deciding on what connector will be the optimal choice.