

Flexible circuit structures

There are a few basic constructions of flexible circuits but there is significant variation between the different types in terms of their construction. Following is a review of the most common types of flexible circuit constructions

Single-sided flex circuits

Single-sided flexible circuits have a single conductor layer made of either a metal or conductive (metal filled) polymer on a flexible dielectric film. Component termination features are accessible only from one side. Holes may be formed (drilled or laser) in the base film to allow component leads to pass through for interconnection, normally by soldering. Single sided flex circuits can be fabricated with or without such protective coatings as cover layers or cover coats, however the use of a protective coating over circuits is the most common practice.

The development of surface mounted devices on sputtered conductive films has enabled the production of transparent LED Films, which is used in LED Glass but also in flexible automotive lighting composites.

Double access or reverse bared flexible circuits

Double access flex, also known as back bared flex, are flexible circuits having a single conductor layer but which is processed so as to allow access to selected features of the conductor pattern from both sides. While this type of circuit has certain benefits, the specialized processing requirements for accessing the features limits its use.

Sculptured flexible circuits

Sculptured flex circuits are a novel subset of normal flexible circuit structures. The manufacturing process involves a special flex circuit multi-step etching method which yields a flexible circuit having finished copper conductors wherein the thickness of the conductor differs at various places along their length. (i.e., the conductors are thin in flexible areas and thick at interconnection points.)

Double-sided flexible circuits

Double-sided flex circuits are flex circuits having two conductor layers. These flex circuits can be fabricated with or without plated through holes, though the plated through hole variation is much more common. When constructed without plated through holes and connection features are accessed from one side only, the circuit is defined as a "Type V (5)" according to military specifications.

It is not a common practice but it is an option. Because of the plated through hole, terminations for electronic components are provided for on both sides of the circuit, thus allowing components to be placed on either side. Depending on design requirements, double-sided flex circuits can be fabricated with protective coverlayers on one, both or neither side of the completed circuit but are most commonly produced with the protective layer on both sides. One major advantage of this type of substrate is that it allows crossover connections to be made very easy.

Many single sided circuits are built on a double sided substrate just because they have one of two crossover connections. An example of this use is the circuit connecting a mousepad to the motherboard of a laptop. All connections on that circuit are located on only one side of the

substrate, except a very small crossover connection which uses the second side of the substrate.

Multilayer flexible circuits

Flex circuits having three or more layers of conductors are known as multilayer flex circuits. Commonly the layers are interconnected by means of plated through holes, though this is not a requirement of the definition for it is possible to provide openings to access lower circuit level features. The layers of the multilayer flex circuit may or may not be continuously laminated together throughout the construction with the obvious exception of the areas occupied by plated through-holes.

The practice of discontinuous lamination is common in cases where maximum flexibility is required. This is accomplished by leaving unbonded the areas where flexing or bending is to occur.

Rigid-flex circuits

Rigid-flex circuits are a hybrid construction flex circuit consisting of rigid and flexible substrates which are laminated together into a single structure. Rigid-flex circuits should not be confused with rigidized flex constructions are simply flex circuits to which a stiffener is attached to support the weight of the electronic components locally. A rigidized or stiffened flex circuit can have one or more conductor layers. Thus while the two terms may sound similar, they represent products that are quite different.

The layers of a rigid flex are also normally electrically interconnected by means of plated through holes. Over the years, rigid-flex circuits have enjoyed tremendous popularity among military product designer, however the technology has found increased use in commercial products. While often considered a specialty product for low volume applications because of the challenges, an impressive effort to use the technology was made by Compaq computer in the production of boards for a laptop computer in the 1990s.

While the computer's main rigid-flex PCBA did not flex during use, subsequent designs by Compaq utilized rigid-flex circuits for the hinged display cable, passing 10s of 1000s of flexures during testing. By 2013, the use of rigid-flex circuits in consumer laptop computers is now common.

Rigid-flex boards are normally multilayer structures; however, two metal layer constructions are sometimes used.