Recommendations for Installing Flash LEDs on Flex Circuits

White Paper

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Abstract

For the mobile market some PCB assemblies have been converted to flex circuit assemblies, in part because flex circuit assembly can be twisted or bent per the application needs.

Flex circuits offer the same advantages as conventional printed circuit boards: quality, reliability, and high density.

However, the most important attribute that has encouraged designers to opt for flex circuit technology is the capability of the flex circuit to assume three-dimensional configurations. Flex circuits can flex during installation, maintenance and use. A flex-circuit can save up to 70 percent of the space or weight of conventional wiring.

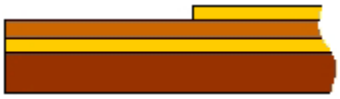
Assembly of components on flex involves a cleaning process, soldering process and handling process. Bending close to the edge of the component may cause solder joints to crack and subsequently cause open-circuit failures. This paper will provide recommendations on soldering and bending processes when components are mounted on a flex circuit.

What is a Flex Circuit?

A flex circuit is made from a flexible polymer film laminated to a thin sheet of copper that is etched to produce a circuit pattern. Flex circuit can be manufactured in several different configurations, including single-sided flex, double-sided flex, multilayer flex and rigid flex circuits. Table 1 shows the construction of different types of flex.

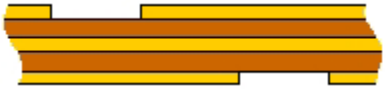
Various Flex Constructions

Single-sided Construction



One conductive layer. Copper laminated with polyimide cover film.

Double-sided Construction

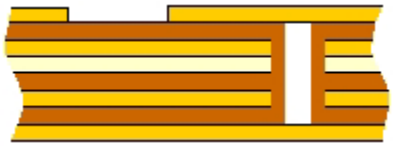


Two conductive layers with an intermediate insulating layer, laminated with a polyimide cover on both sides. Access holes or exposed pads may be on either or both sides.

Dual Access

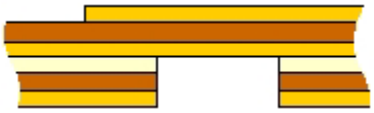
Similar to single-sided flex, however it provides access to both sides of the copper layer.

Multi-layer



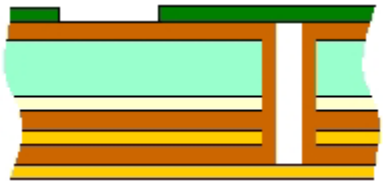
It can be three to 10 layers, consisting of multiple layers of single and/or double-sided material laminated with thermoset adhesive.

Wimpy



A combination of single-sided and double-sided flex. Certain areas will have double-sided construction, and the dynamic flexing area will have single-sided construction to achieve maximum flexibility.

Rigid Flex



By far the most difficult construction in the PCB or flex circuit industry. This construction uses a combination of flex circuit materials and rigid printed circuit materials. The flex is laminated with thermoset adhesive onto a single and/or double-sided FR-4 clad material.

Legend:

- Polyimide Cover Film
- Copper Adhesive
- Polyimide Stiffener
- Solder Mask
- FR-4

Flex Recommendations for Avago Technologies Flash LEDs

Conventional flex assembly is too soft to support heavy components, thus rigid flex is the recommended assembly when using LEDs such as Avago Technologies Flash modules which have substantial mass and need better support. The solder joint will be very fragile when there is a bend near the joint. An accidental bend of the flex close to the solder joint will cause cracks, and thus open-circuit failure. In order to provide the best support for Avago Technologies Flash LEDs, the best recommendation is to use a hybrid combination. The hybrid combination consists of rigid boards and has the design flexibility of flexible circuits. The rigid flex boards provide a higher component density and better quality control. Designs can be rigid where support for components is needed, and flex around corners and in areas requiring extra space. Figure 1 is an example of the recommended rigid flex assembly.

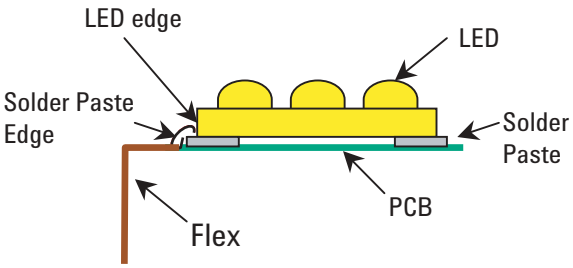


Figure 1. Rigid flex assembly.

Note: Whenever multiple flex layers are used on folding boards, allowance must be made for the inner flexible layer to kink when the board is folded.

Recommended Copper on Flex

Try to get a balance of copper on both side of the foil, otherwise it will tend to warp during the manufacturing process and the weaker side of the flex will experience more stress when bent .

Figure 2. Example of copper spreading on flex

Recommended Soldering Method for Avago Technologies 1X3 Flash LED

An appropriate soldering process is needed to form a good solder joint. For example, insufficient heat to the solder paste will cause a problem with dry joints. There are various soldering techniques, such as manual soldering, reflow soldering, hot bar soldering and many others. Hand soldering is not recommended, especially for surface mount LEDs, since hand soldering is highly dependent on operator skill level to achieve a good solder joint. There is the possibility of overheating the LED if there is poor process control and/or operator skills.

The reflow soldering process is strongly recommended. Figure 3 is the recommended reflow soldering profile for the Avago Technologies 1X3 Flash LED.

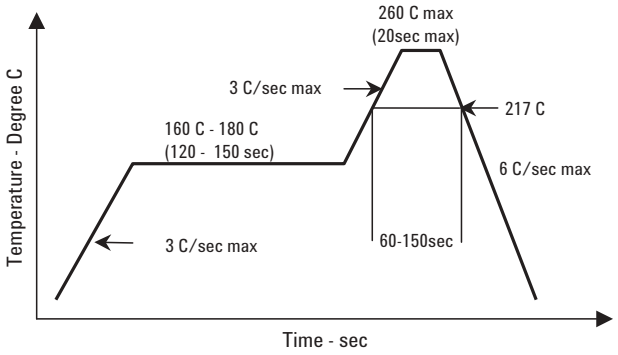


Figure 3. Recommended Reflow Soldering Profile

Recommended Bending Process for Flex

The bending process usually takes place after all the components are mounted on the flex circuit (see Fig. 4).

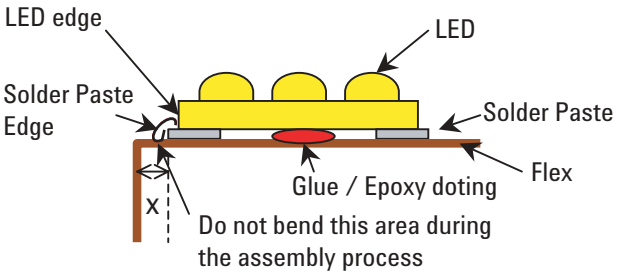


Figure 4. Bending Process on Flex

Notes:

1. LED edge / solder paste edge is the weakest point on copper flex.
2. Any bending at the edge may cause broken solder joints / traces.
3. During the assembly process, do not bend this weak point.
4. An epoxy coating under the Flash LED between the two solder terminals may help to increase adhesion to the flex.
5. Solder pads or mounting holes should be placed at least 2.54 mm away from the bend area.
6. Very thick copper should be avoided on flex layers to minimize stress during bending
7. Permanent bend flex tails or tails with a sharp bend near the rigid part should be secured with adhesive.
8. If the circuit is used for a continuous flex application, plating at the bend area is not recommended.
9. The maximum degree of bend in rotary-draw bending is 180 degrees (Fig. 5).

Recommended Bend Radii

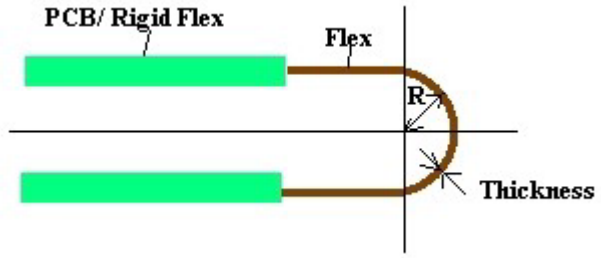


Figure 5. Bend radius definitions

The minimum bend radius is a function of the thickness in the flex area. Table 2 shows the recommended bend radii as recommended by MIL - P - 50884 C.

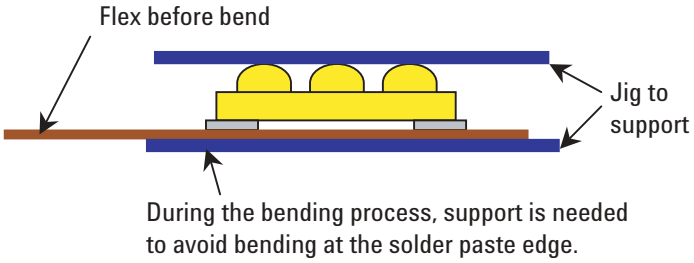
Table 2. Recommended Bend Radii

Flex Type	Bend Radius
1-2 flex layers	R = 6x thickness
> 2 layers	R = 12x thickness
Plated flex layers	R = 20x thickness

Before Bending

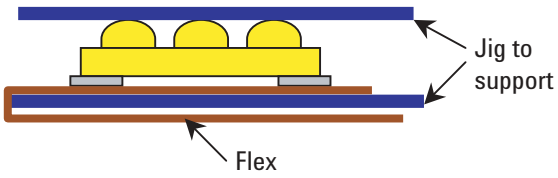
Before the bending process on flex, a jig is needed to support the component on the flex to avoid bending near the solder edge.

Note: During clamping, do not pull or adjust the flex. Only bending is allowed.



After Bending

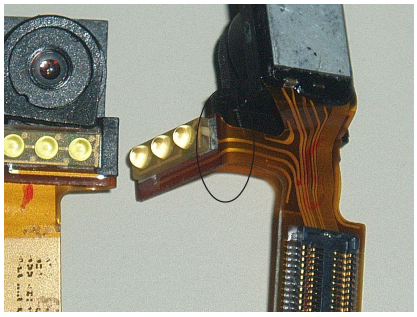
Note: Slowly pull out the jig when the bending is done.



Example of Incorrect Flex Assembly:

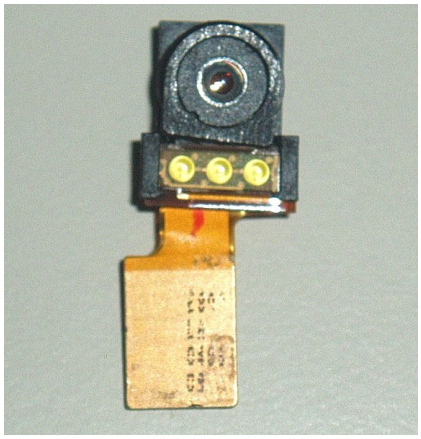
First Bending

The bending is too close to the solder joint edge and no support was given, thus the potential for a crack at the solder paste edge.



Second Bending

After the first bending, the unit needs to slot into the socket. The flex was twisted to slot into the black socket. As the socket is too tight there will be friction between the solder joint with the socket, thus potentially causing cracks at the solder paste edge.



Conclusion

In summary, this paper presented various types of flex assemblies and offered some recommendations on the flex handling process, flex soldering process and bending radius. Rigid flex is the recommended for Avago Technologies 1x3 flash modules because it provides better support to higher-mass components.

Reference

www.minco.com

http://www.bendtooling.com/

http://www.dyconex.co.uk/

MIL 50884

For product information and a complete list of distributors, please go to our web site: **www.avagotech.com**

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