

Liquid Crystal Display (LCD) Construction Methods

Introduction

In a LCD module the driver electronics, which control the voltage applied to each pixel need to be connected to the LCD cell.

This application note gives details on the different IC connection techniques.

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1 IC Connection Technologies

1.1 Chip On Glass (COG)

Chip On Glass (COG) is where the controller or driver is bonded directly onto the LCD glass using Anisotropic Conductive Film (ACF), a material used for interconnecting the LCD to the driver IC. *Figure 1* shows the LCD/driver IC interconnection as well a mobile phone application where this construction is commonly utilised.

This bonding method is ideal for applications that require a high volume and low cost. Interface between the glass and the Printed Circuit Board (PCB) is made through a FFC (Flat Film Cable) or FPC (Flexible Printed Circuit). It offers a very low profile as only the glass thickness applies (reflective models i.e. without backlight or front-light).

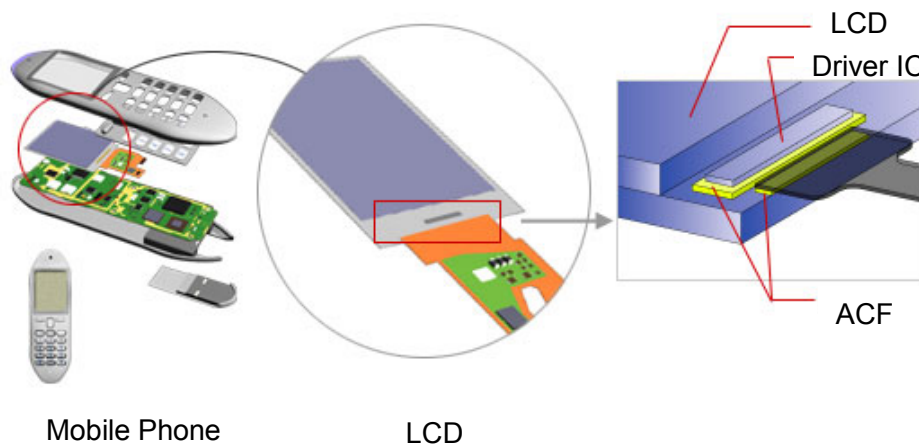


Figure 1: Chip On Glass (COG)

There are some disadvantages associated with COG, there is an extension of the glass fringe (approximately 6 mm) to accommodate the IC which increases the overall module length. As the pixel counts and screen sizes become larger so does the size of the fringe, which has important implications when dealing with a mobile application. COG can only be used at a certain resolution level where the ITO lines are not too fine, at very fine pitches COG becomes difficult to test, additionally it is not possible to construct peripheral, surface mountable devices such as resistors and capacitors onto the glass.

1.2 Tape Carrier Package (TCP)

Tape Carrier Package (TCP) process is where the IC driver chips are mounted directly onto a perforation in a polyamide tape by means of heat and pressure and then sealed with epoxy, an extremely tough and durable synthetic resin. Bond patterns and wires are printed on the tape. TCP is extremely flat and provides mechanical flexibility as well as excellent thermal characteristics. A glass fringe, as with COG, is required to mount the TCP IC onto the LCD. However, the fringe is only required to be approximately 2 mm. The TCP IC can then be fixed to the glass using ACF bonding method.

Figure 2 shows the interconnection between the LCD and TCP.

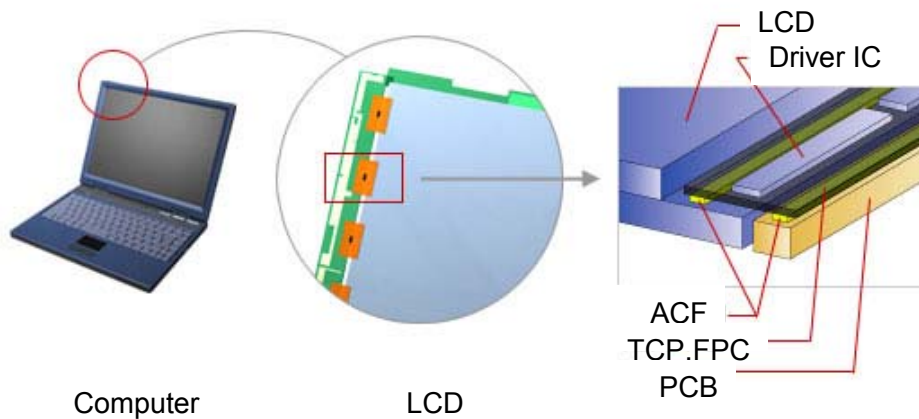


Figure 2: Example of TCP

There are three another main configurations of TCP:

1.2.1 Straight TCP

As the name suggests the TCP, PCB and LCD are all in-line (*Figure 2*). This has the advantage of minimising the thickness of the module, however, the outline dimension of the module is increased.

1.2.2 Bent TCP

Bent TCP has the advantage that it can be placed on the LCD glass directly without using the heat seal (*Figure 3*). Bent TCP reduces the overall dimensions of the product but the thickness of the display is slightly increased.

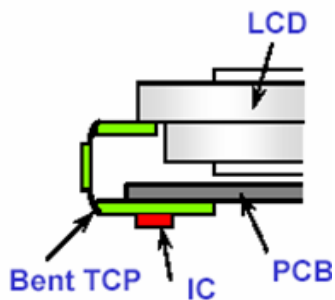


Figure 3: Bent TCP

Bent TCP requires a lot of tooling costs which makes Bent TCP a relatively expensive solution for producing in smaller quantities. When considering production in larger quantities, bent TCP becomes a much more economical and viable option.

1.2.3 TCP and Heatseal

In this construction method a flat, flexible and adhesive printed circuit is bonded to the contact edge of the LCD glass using heat, the straight TCP is then bonded underneath the LCD along with the PCB (*Figure 4*).

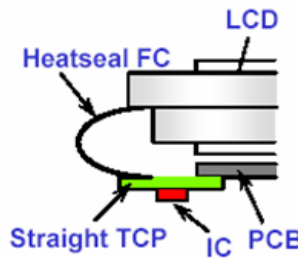


Figure 4: TCP and Heat-seal

1.3 Chip On Film/Foil (COF)

Chip On Film (COF) is where the driver IC is located on a film with conductive tracks. The flexible film is then bonded with ACF to the matching contacts on the LCD Glass (*Figure 5*). Initial tooling can be more expensive than COG, however, the overall cost per unit remains very competitive. Like TCP, COF typically only require a 2 mm fringe for mounting onto the glass and can be folded away under the LCD glass to reduce overall module footprint.

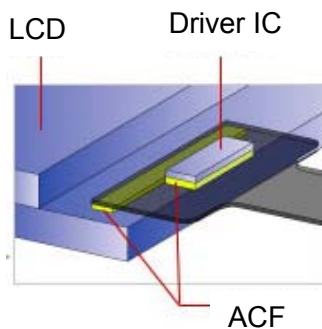


Figure 5: Chip On Film (COF)

The advantage of COF over the other construction methods is the composition of the flexible circuit, which enables the controller/driver to be bonded directly onto the flex as well as any other surface mount components eg resistors and capacitors.

1.4 Chip On Board (COB)

Chip On Board (COB) this type of construction method allows the controller or driver IC to be bonded directly onto the PCB. Electrical connections are made by micro diameter gold wires. The entire area is then covered with epoxy. This is effectively the most expensive type of display but allows the integration of external components outside that of the controller. Customisation is relatively simple and mounting is straightforward.

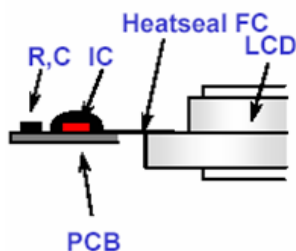


Figure 6: Chip on Board (COB)

2 Summary

There are many different techniques available to manufactures regarding the connection of an LCD cell to the drive electronics and associated microprocessors and other components. Each assembly technique has its' own advantages and disadvantages and it depends on the particular application as to which technique is best.

3 Cautions

Keep safety first in your circuit designs!

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