

# LCD Driver IC Assembly Technologies & Status

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## **Abstract**

According to the difference of flex substrate, (reel tape), there are three kinds of assembly types of LCD driver IC: COG, TCP and COF, respectively. The TCP is the most mature in these types for stability of raw material supply and other specifications. And TCP is the major assembly type of LCD driver IC and has a huge demand from Taiwan's large TFT LCD panel house since this spring. But due to its package structure and the raw material applied in this package, there is some limitation in fine pitch application of this package type, (TCP). So, COF will be very potential in compact and portable applications compared with TCP in the future. There are three kinds of assembly methods in COF, one is ACF by using the anisotropic conductive film to connect the copper lead of tape and gold bump of IC, another is eutectic bonding by using the thermo-pressure to joint the copper lead of tape and gold bump of IC, and last is NCP by using non-conductive paste to adhere the copper lead of tape and gold bump of IC.

To have a global realization, this paper will briefly review the status of Taiwan's large TFT panel house, the internal driver IC design house, and the back-end assembly house in the beginning. The different material properties of raw material, PI tape are also compared in the paper. The more details of three kinds of COF assembly methods will be described and compared in this paper.

## **Keyword**

TCP: Tape Carrier Package, COF: Chip on Film, COG: Chip on Glass, TCM: Tape Carriers Module, COF Module, ACF: Anisotropic Conductive Film, Eutectic bonding.

## **Biography**

*Dr. G.S. Shen* joined in ChipMOS after receiving his Ph.D. degree from Mechanical Engineering Department of National Cheng-Kung University in 1998. He majored in mechanics and charged the new technology development in ChipMOS. There are more than 15 papers published after he joined in ChipMOS.

# **LCD Driver IC**

## **Assembly Technologies & Status**

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- What is LCD Panel & LCM?
- LCD Application - Product/Trend
- Large TFT LCD Panel -Capacity & Investment  
-Shipment & Market Share
- TFT LCD Panel Generation Definition
- LCD Driver IC Industry Status
- What is TCP?
- Comparison of Tape/Outline & Dimension
- TCP/COF/COG & Process Comparison
- Assembly Principle & Method
- Process: Eutectic/NCP/ACF
- Module Process
- Reliability Program
- Conclusion



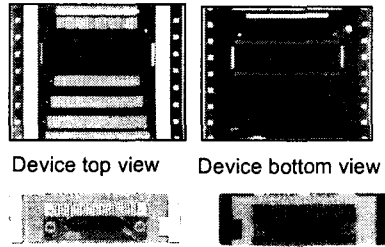
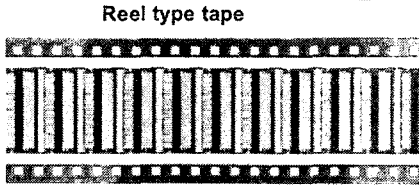
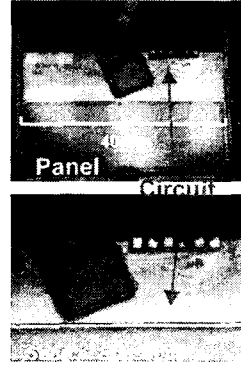
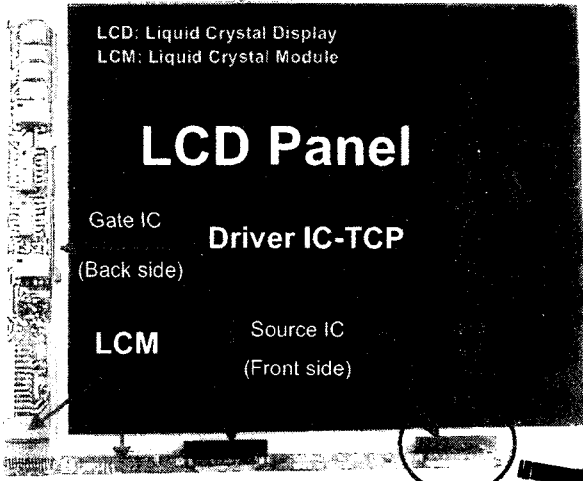
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*LCD Panel & LCM*

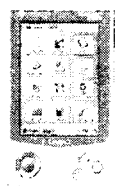
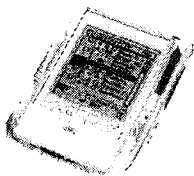
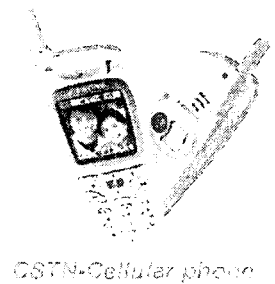


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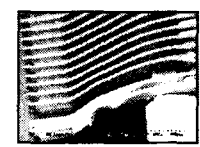
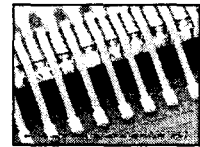
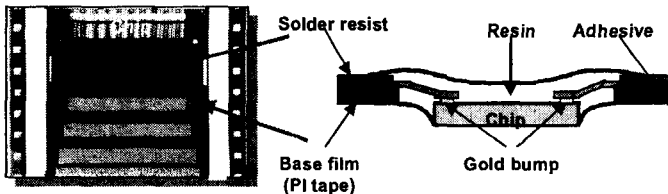
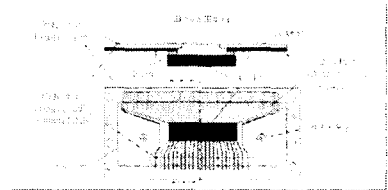
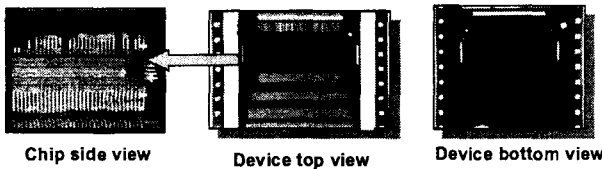
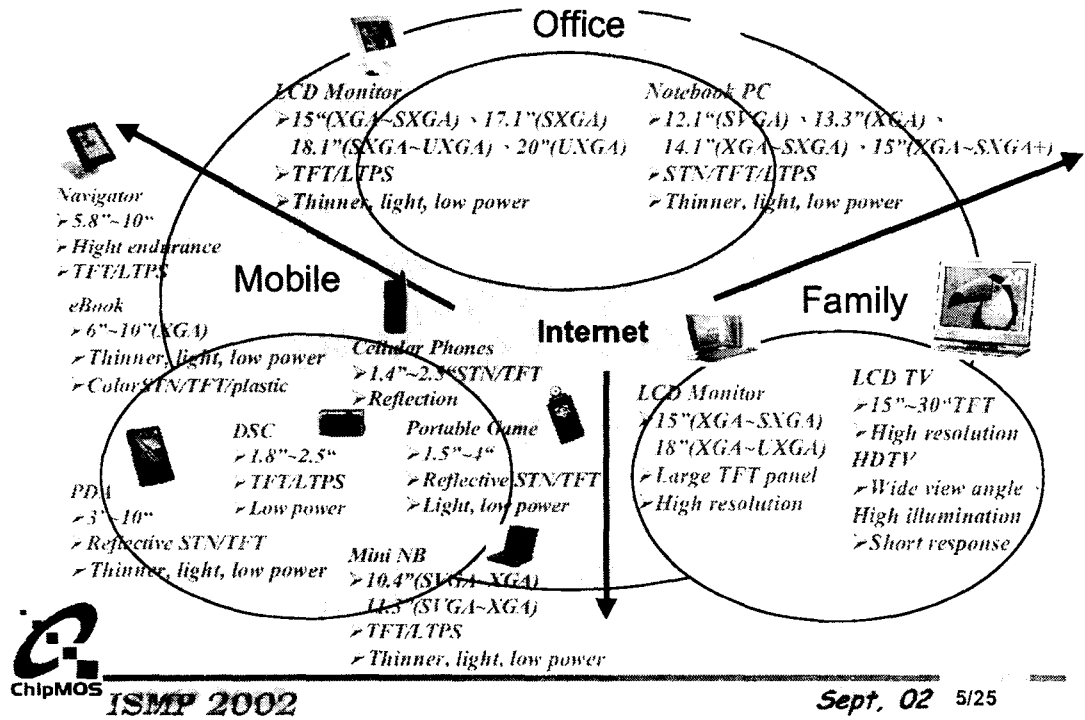
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*Application I-Product*



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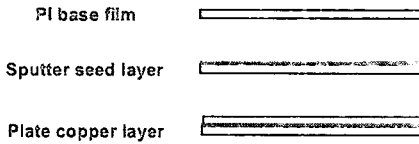
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- TCP : Tape Carrier Package
- Developed from TAB ( Tape Automated Bonding ) technology by General Electric ( GE ) in the late 1960s .
- TAB is one method to interconnect integrated circuit to a substrate by copper leads supported by a polymer.

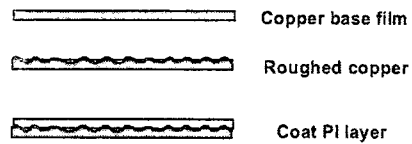
	COF	TCP
Type	Kapton EN	Upilex S
Thickness	25/38 um	75 um
Flexibility	Good	Poor
Strength	Average	Good
Bending Slit	No need	Need
ILB Pitch	~30 um	~45 um
Device Hole	No	need
Copper Foil	8/12 um	18 um
Adhesive	-	#7100
Solder Resist	SN-9000 AR-7100	AR-7100 AE-70-M11

**Plating**



- Thinner copper layer than of the casting is available.
- Good light transmission allows alignment using existing infrastructure for TCP assembly.
- Poor adhesive strength of copper and PI.
- Poor dimension stability during assembly process.

**Casting**

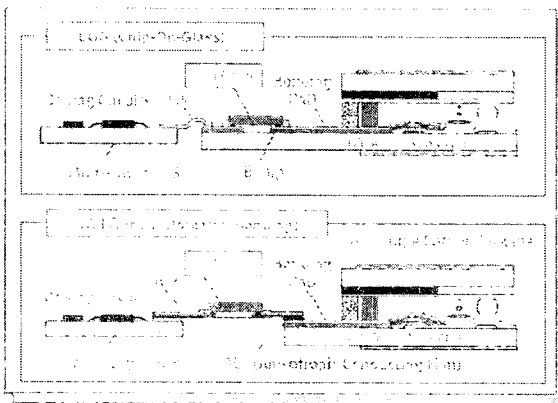


- Copper is thicker than of by the plating process.
- Poor light transmission requires new equipment for assembly.
- Good adhesive strength of copper and PI.
- Good dimension stability during assembly process.

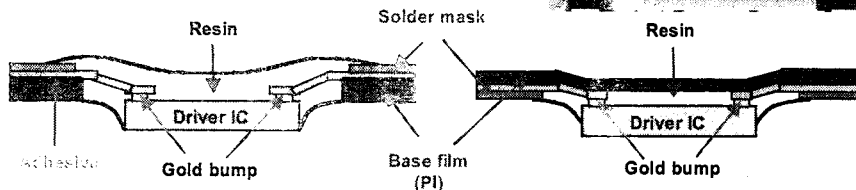
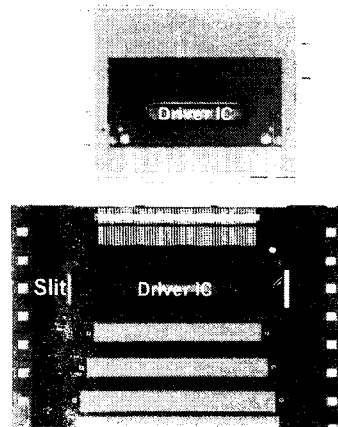


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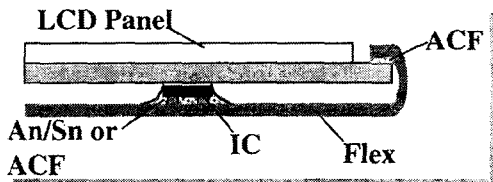
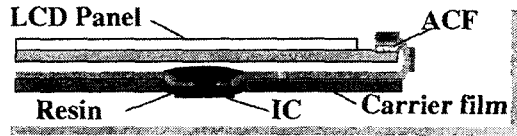
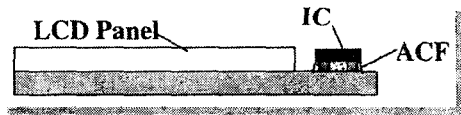
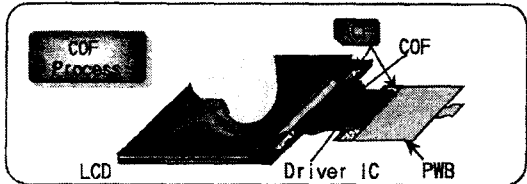
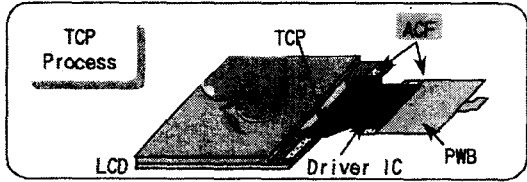
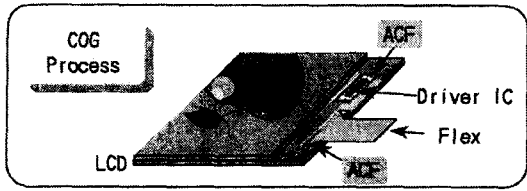


Source: Samsung's web site



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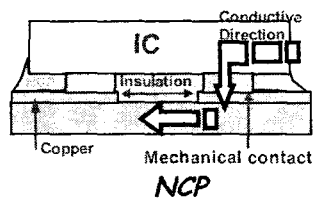
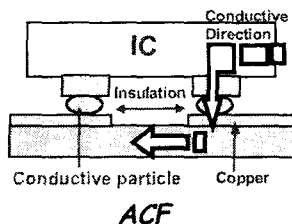
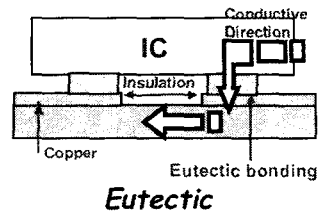
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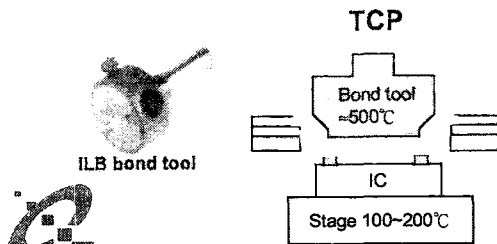
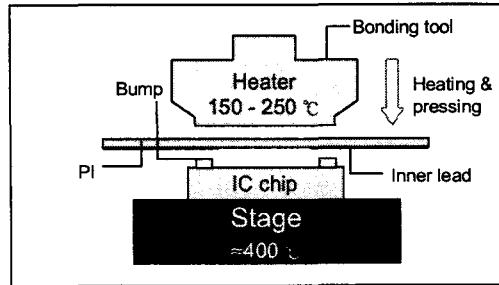
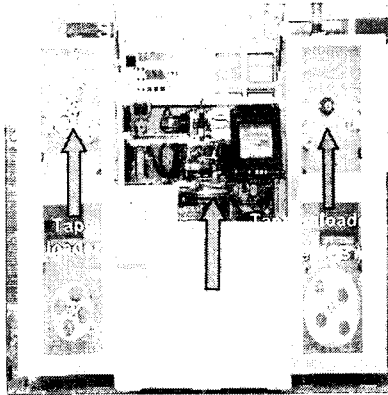
- TCP: Tape Carrier Packaging (Au-Sn eutectic)
- COG: Chip on Glass (ACF)
- COF: Chip on Film (Eutectic: Au-Sn/Au-Au) (NCP: Adhesion by paste) (ACF)



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LCD Driver IC Assembly Technologies & Status **Eutectic Process (I)-ILB**

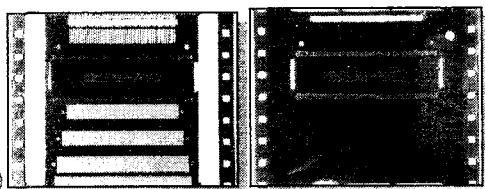
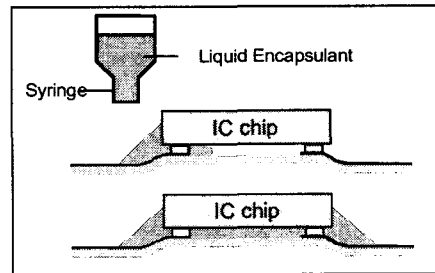
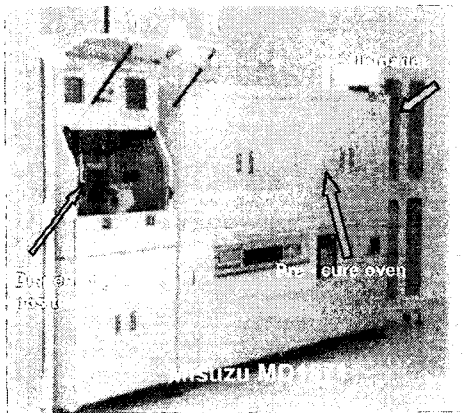


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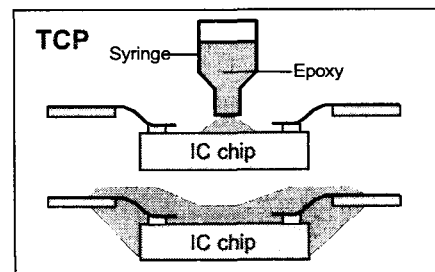
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**Eutectic (II)-Potting**



Chip backside

Epoxy resin

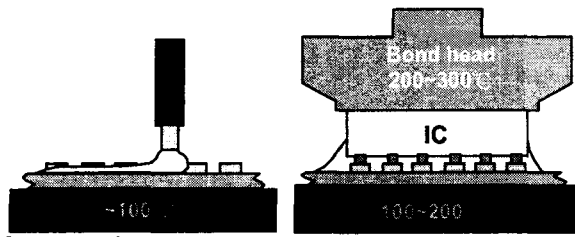


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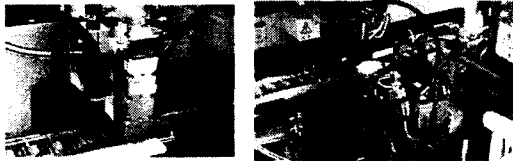
**NCP/ACF Process**



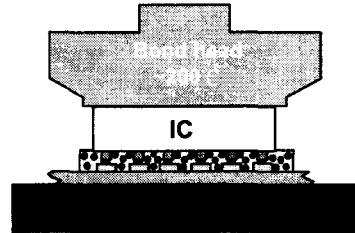
*Dispensing on tape Flip Chip Bond & Curing*



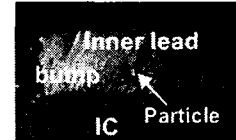
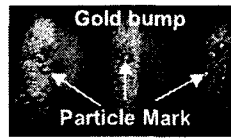
*ACF attach on tape*



**Shibaura TFC-2000**



*Pre & Main Bond*



**Sector Particle Mark on bump**



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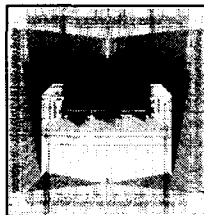
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**Reliability Program  
-Electrical Confirmation**

Q-TCP Sample: By Socket Tester

**Q-TCP Sample**

Size: 48x48 mm<sup>2</sup>  
Pin Count: 532  
(input max. 133)



**Q-TCP Socket**  
YAMAICHI  
IC51-5324-1551  
TTL:10 DUTS  
(10 pcs/DUT)

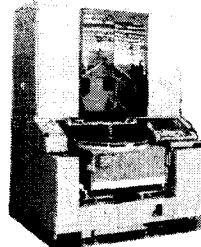
(Bias and operation reliability needed)

TCP Reel Sample: By Auto-Tester



**Tape product (on dummy reel)**

**TCP Tester**  
(ANDO AHM-861)



(Min. 12 ea)

(Suitable for all customer's TCP)

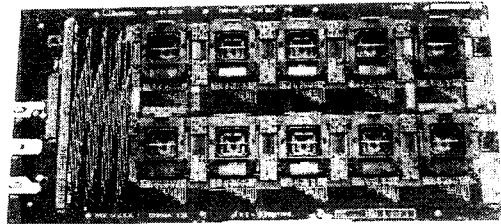
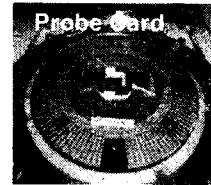
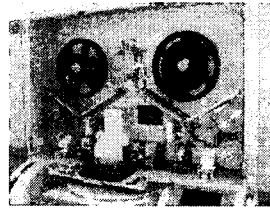
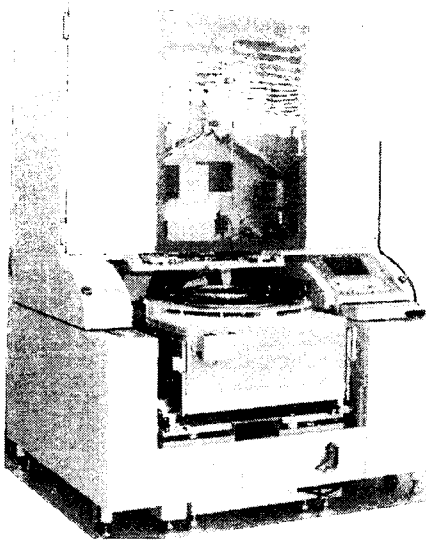


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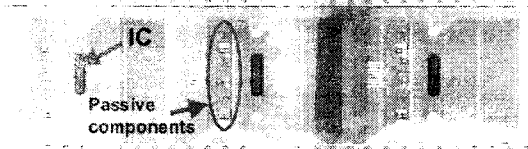
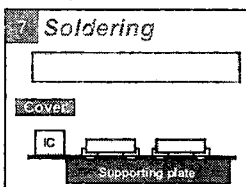
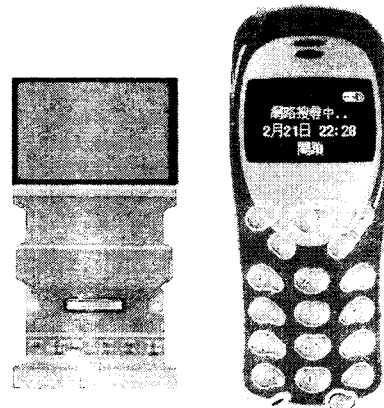
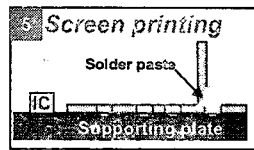
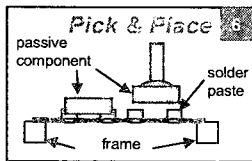
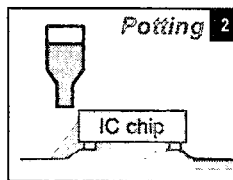
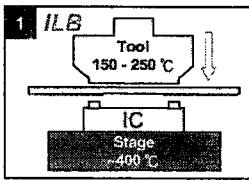


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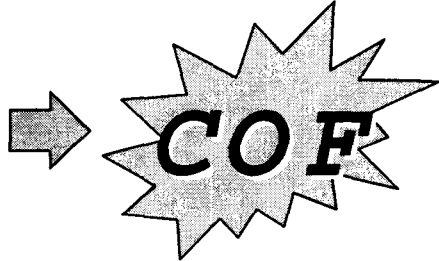


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## Next generation trend

- For cost effective
  - Chip shrink/fine pitch requirement
- For high resolution
  - Fine pitch requirement
- For thinner, smaller application
  - Flexible & integrated requirement



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