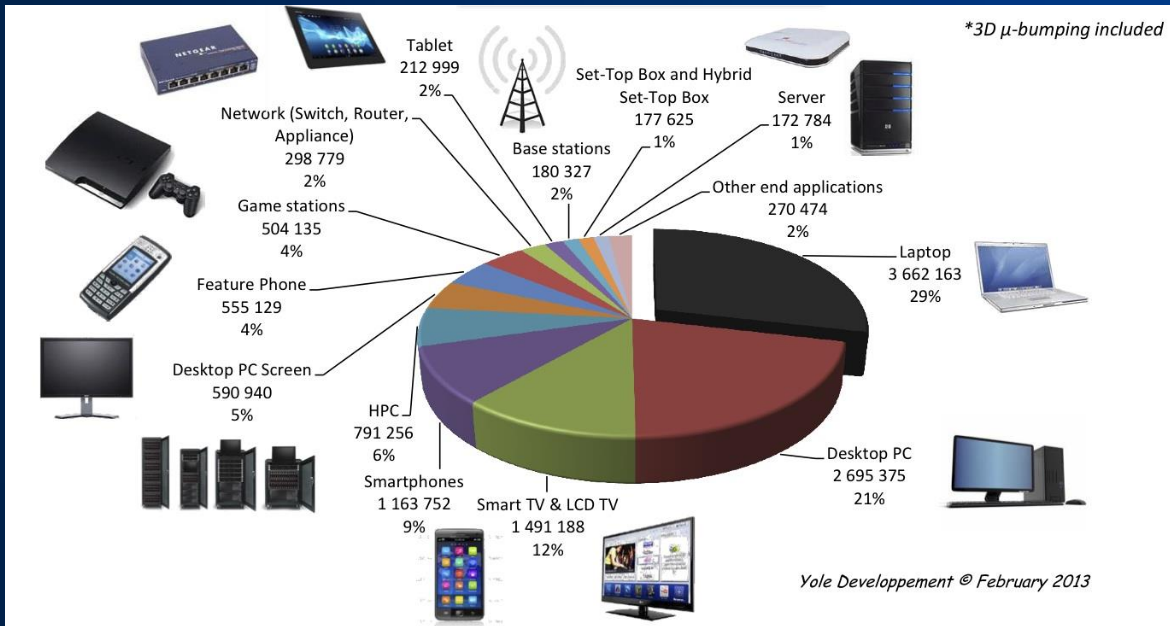
6 March 2014

Our Mission:

Through Syndication, To Commercialize World Changing Technologies With World Class Inventors

Specific Information Package – Flip Chip Combined With Mulpin Technology

Flip Chip Applications



Mulpin Electronic Assembly Patent Number - US 8649183

Mulpin Research Laboratories Limited - ACN: 154 714 011

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Overview

One of the biggest problems facing the semiconductor industry is the continued reliance on the use of gold for bonding wire in semiconductor chips.

Flip Chips currently offer a solution to this problem however with their temperature expansion and contraction causing cracking and reliability issues, Ball Grid Array (BGA) chips (which use Gold Bonding Wire for reliability) are currently preferred over Flip Chips (which do not need Gold Bonding Wire).

Flip Chip in combination with the Mulpin Electronic Assembly Technology will solve the cracking and reliability issues of expansion and contraction currently faced by the Flip Chip industry and by replacing BGA's with current Flip Chips and Mulpin technology in combination.

In addition benefits to Flip Chips with the Mulpin technology also provide many technical benefits such as;

- It increases the number of pins that can be had for a given foot print of the chip (more for less).
- It allows the production of larger Flip Chips due to improved heat dissipation.
- In most applications No Heat Sink is required as the technology provides heat dissipation through the PCB.
- It provides protection from RFI, EMI, EMR and EMP.
- The Flip Chip becomes vibration, water and dust proof.
- Considerable faster operating speeds are available (compared to BGA chips).
- Multiple chip design configurations are achievable, including the round design.

Photo of a Flip Chip when in combination with Mulpin Electronic Assembly Technology will benefit from improved performance.

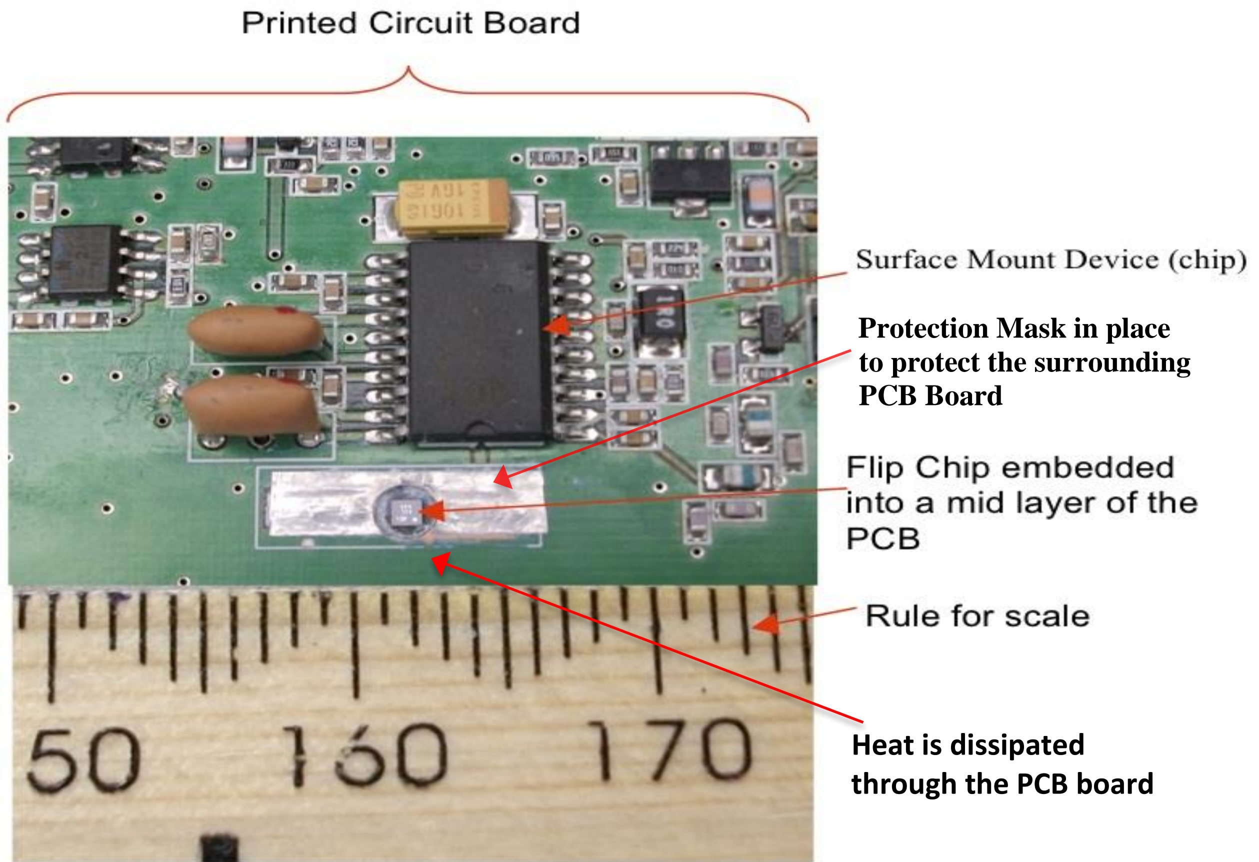

Figure 1 shows the flip Chip inserted into the PCB ready for its lid. The ruler below is in mm.

The new technology allows the entire PCB to be used in heat dispersion.

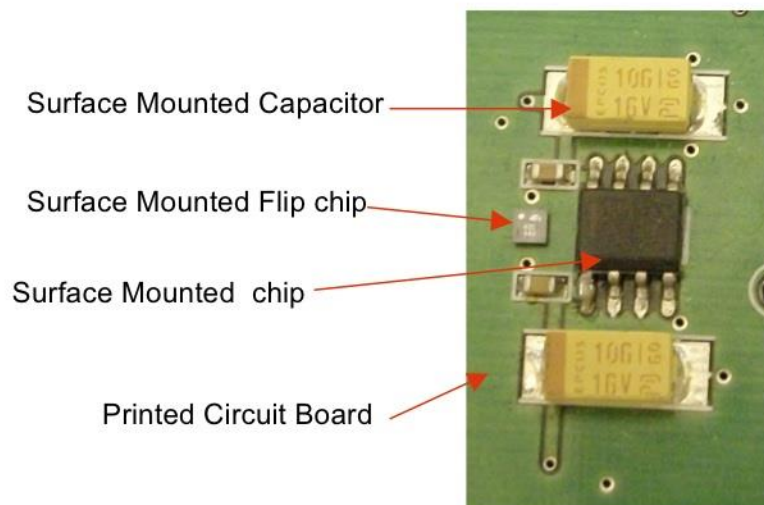

Figure 2 above shows a Surface Mounted flip Chip along with several other SMD components.

Figure 3 Left shows a previous and still current through hole power amplifier which can only deliver 2 watts of power into a loud speaker. Below that is the 3 watt Flip Chip amplifier of Figure 1 to show a size comparison.

In addition to solving the heat dissipation problems facing Flip Chips, when combined with Mulpin technology will also provide protection from exposure to Radio Frequency Interference (RFI), Electro Magnetic Interference (EMI) and Electro Magnetic Pulses (EMP).

Flip Chip Technology Test Results

Flip Chip when combined with the Mulpin Technology method has the advantage of making the larger die packages realizable as flip chips when conventional methods are hamstrung by thermal expansion. Flip chips are still realizable in smaller dies where this isn't a problem, so how does The new method compare?

If we consider two equal sized flip chips ***with heat sinks***, one standard the other using the Flip Chip Mulpin Technology, the immediate benefit is seemingly marginal. However, the function of the heat sink is to cool the device and any decrease thermal resistance of the heat sink can have dramatic improvements to the devices junction temperature. A typical thermal resistance calculation looks as follows;

$$Q_{MAX} = \frac{T_{JMAX} - (T_{AMB} + \Delta T_{HS})}{R_{\theta JC} + R_{\theta B} + R_{\theta HA}}$$

Where

Qmax is the maximum power of the device

Tjmax is the maximum junction temperature (125d)

Tamb is the ambient (70d)

ROjc is the thermal resistance of the junction (1.5d/W)

Rob is the elastomer heat transfer (0.1d/W)

Roha is the heat sink transfer (Assume 4d/W)

Then we have a maximum power dissipation of 9.8W

By utilising the Flip Chip and Mulpin technology, the heat sink thermal resistance may drop from 4d/W to 3.5d/W due to the physical connections of the surrounding metal.

By performing the calculation again, the max power dissipation now increases to 10.8W. Or conversely, if the device were to run at 9.8W the junction temperature would reduce from 125d down to 120d.

The improvement appears to be subtle but if we consider the MTBF, or the mean time between failures, the saving can be significant. For silicon devices, the MTBF degrades exponentially with temperature.

To emphasize the point, increasing the temperature is often a method used during accelerated life testing (http://www.vicorpower.com/documents/quality/Rel_MTBF.pdf).

Test Results Addendum

The amount of heat generated by a Flip Chip is dependent on its application and as such the above information is typical of how the Flip Chip technology will work when compared to an equivalent Flip Chip.

Mulpin Research Laboratories Limited has embedded an audio power amplifier Flip Chip in combination with Mulpin technology, since these are representative of Flip Chips which benefit the most from Mulpin technology due to the relatively large amount of heat generated by these types of chips.

Below is data from the Power Amplifier Flip Chip type **TS4962M,** which is the Flip Chip used in the Mulpin prototype PCB.

Uncapped Test Results

Maximum Junction Temperature:- **150 deg C**

Efficiency of device at full output of 3 Watts:- **80%**

Thermal Resistance Junction to ambient:- **200 deg C per Watt**

Thus at 80% efficient, the temperature rise is **120 deg for 3 watt out**.

Combination Technology Test Results

Maximum Junction Temperature:- **150 deg C**

Efficiency of device at full output of 3 Watts:- **80%**

Thermal Resistance Junction to ambient:- **90 deg C per Watt**

Thus at 80% efficient, the temperature rise is **54 deg for 3 watt out.**

Summary.

The operating temperature when utilizing technology with a standard Flip Chip, will be 54 deg C above ambient, whereas the same uncapped flip Chip will operate at a temperature of 120 degrees C above ambient.

Note that if the room temperature is 25 degrees C, utilizing the Mulpin Technology with a standard Flip Chip will operate at 79 degrees C, well below the maximum limit and the uncapped Flip Chip would operate at 145 degrees C. This is only 5 degrees below that which will immediately damage the chip.

From the information above it can be seen that because for silicon devices, the Mean Time Between Failure degrades ***exponentially*** with temperature, every degree cooler will markedly extend the life of the Flip Chip.

With the many benefits of the Flip Chip and Mulpin combination technology together with the speed and ease of implementing the technology at virtually no cost, Mulpin Research Laboratories anticipates the Flip Chip combination with Mulpin technology will attract significant industry advantages.

About Mulpin Research Laboratories Limited:

Mulpin Research Laboratories Limited is the developer and owner of a "Generation One Technology" (Gen One) Utility Patent, which has come about through two decades of study, research and exploration by their lead inventor who has many years experience within the Electronics industry.

Mr Green's commercialized inventions include an electronic portable hypodermic needle furnace and Dirodyne radio architecture. He has also written many articles of new technology concepts that are being used in the market place.

References:

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Reference 2 http://www.idc.com/getdoc.jsp?containerId=prUS23893912#.US7J5I4R9ot