The Road Ahead For Mobile Phone Manufacturing

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Mobile phones are rapidly becoming the electronic device that defines Generation Y. With a plethora of diverse functions and ever growing ownership base – now even amongst lower-end target groups – market forces are conspiring to push manufacturers into ever-smaller profit margins. This presents difficulties for everyone involved in the mobile phone supply chain. At the same time there exist trends towards miniaturisation of mobile phones, forcing manufacturers to find more advanced production solutions. Collaboration between manufacturers and materials and equipment suppliers is recommended in order to advantageously deal with the industry challenges.

The market

The latest high tech mobile phone can perform many of the functions of a PC. It plays music, functions as a GPS device and doubles as a camera, video cam, PDA and even a video game machine. It has so many features, that learning to use them all can be a major project and can result in what one colleague calls 'feature fatigue'. Many of us are so enamored with these types of mobile phones that we may have missed two important mobile phone trends.

One trend is the emergence of the easy to use, mobile phone only device, such as Samsung's Jitterbug. This phone is targeted at the large group of people who are confused by technology and simply want to make a telephone call (Figure 1). This enormous market, perhaps 30% or so of the population in a country like the US, was neglected until recently.

The second, most recent trend is discussed in a Business Week article, Mad Dash for the Low End. This article points out the enormous opportunity to sell mobile phones to the billions of people worldwide who live on a few dollars a day. This trend makes low cost manufacturing a must.

Figure 1 – The Jitterbug addresses a long felt mobile phone need, something simple to just make a phone call (Source: Samsung)

Although the full featured, telephone calls-only, and mobile phones for the poor may seem to have little in common, from a manufacturer's perspective they share many traits. They all benefit from the modern electronics mantra of cheaper, faster, smaller and lighter. This mantra continues to place increasing challenges on mobile phone manufacturers.

'Green Marketing' is a new trend that is emerging. With the numbers of mobile phones produced each year going from hundreds of millions to over one billion in 2007, safe recycling is paramount, as witnessed in a recent article in National Geographic and discussions elsewhere in the mainstream media. A large portion of electronics waste recycling is performed in third world countries with 'backyard' processes implemented unsafely by poor people, including children. The families often eat from the same cookware that they used to smelt tin-lead solder from the eWaste they 'processed' earlier in the day. The waste from their labours is often discarded in the same fields in which they grow their crops. Safe recycling is only possible if electronic products are RoHS compliant at a minimum. So RoHS compliancy is here to stay and will be worldwide for mobile phones, if it isn't already in a de-facto sense.

Mobile phone assembly process challenges

Cost: There will be continued pressure on all aspects of mobile phone cost. Prismark published a breakdown of mobile phone costs (Figure 2). In this figure, the manufacturer sells each mobile phone to the OEM (e.g. Nokia, Samsung, Motorola, et al.) for $91. The phone's bill of material (BOM) is $80. Hence, the manufacturer has to cover all of his manufacturing cost in $11. The $11 must cover labour and benefits, facilities expenses, equipment depreciation, materials, research and development, etc. With the constant cost pressure, this lean manufacturing scenario will only escalate, lead-

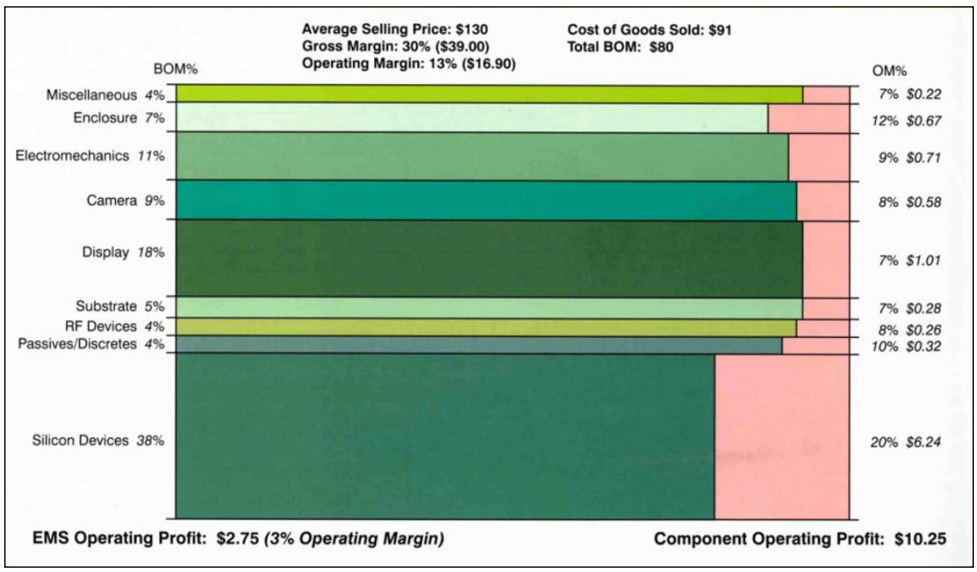


Figure 2 – Typical mobile phone manufacturing costs. The manufacturer has only $11 dollars (cost of goods sold = $91 – bill of material (BOM) = $80) to cover all of his labour, facilities expenses, equipment depreciation, materials, etc

ing mobile phone manufacturers to become experts in 'lean' manufacturing techniques such as those taught in modern Lean Six Sigma Programs.

Components: The BOM is about 85 to 90% of the cost of the mobile phone. With the added cost pressures of the future, mobile phone assemblers will increasingly go to Supply Chain Management Specialists (SCMS) for components. SCMSs purchase excess inventory components on the open market, then test and repackage them. It is often possible to obtain components at significant discounts from SCMSs; however, there is more of a risk of getting counterfeit or refurbished components instead of new ones. This risk has become greater in the last few years as more electronics are recycled and used components 'pulled' from the recycled PCBs. This work is often performed in low labour rate countries and significant effort is made to polish the used components up to make them look new. Counterfeit components are fake components that have no integrated circuits (ICs) in them or components that have their markings sanded off and are then remarked as a higher performing component. Sadly, counterfeit, used or remarked components have become an industry unto itself. So, when dealing with SCMSs, you need to ensure that they have procedures in place to detect these types of used or counterfeit components. Most first tier SCMSs have specialists that are trained to detect counterfeit components and the like.

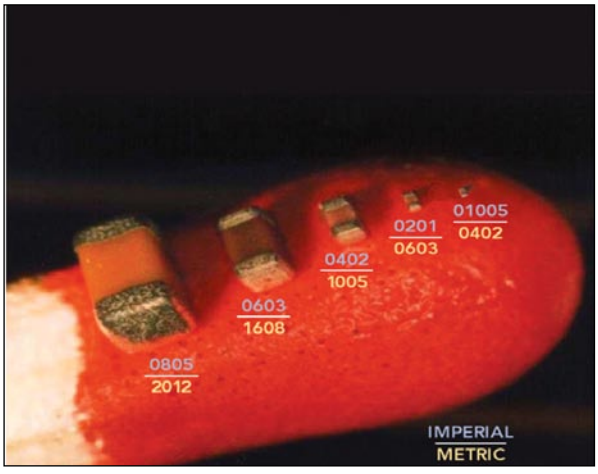
Mobile Phone Assembly Process: The 'faster, cheaper, lighter, smaller' mantra will continue to require the use of smaller passives, even smaller than today's diminutive challenge the 01005 passive (approximately 10 by 5 thousandths of an inch (mils)). This drive toward miniaturisation has also resulted in chip scale packages (CSPs) with ball spacings of 0.3 mm (12 mils).

It surprises many people to learn that passives (typically resistors or capacitors) often constitute more than 90% of the components on an assembled PCB. Passives are typically required to tune and optimise the functioning of the integrated circuits. So many passives are assembled today that the rate of assembly is about 1 billion every 6 hours. The 01005 passives (Figure 3) are so small that a handful contains about 1 million, and if you sneeze, you will blow them away. Yet, each 01005 passive assembled has to be individually handled and placed by a pick-and-place machine, often at a rate of 10 per second.

These small passives and fine pitched CSPs create significant challenges in stencil printing. The aperture openings in the stencil for a 01005 passive are typically in the 7 x 7 mil range and for the CSP about 8 mils in diameter. To achieve a reasonable transfer of solder paste, the stencil thickness must be 4 mils or thinner and the solder paste needs to have type 4 particles. Even this combination can be a stencil printing challenge; several of the deposits may be inadequate or non-existent (Figure 4).

Even with successful printing,

Figure 3 – Passives sizes in imperial (i.e. 01005 = 10 x 5 mils) and metric (0402 = 0.4 x 0.2 mm) (Source: Speedline Technologies)



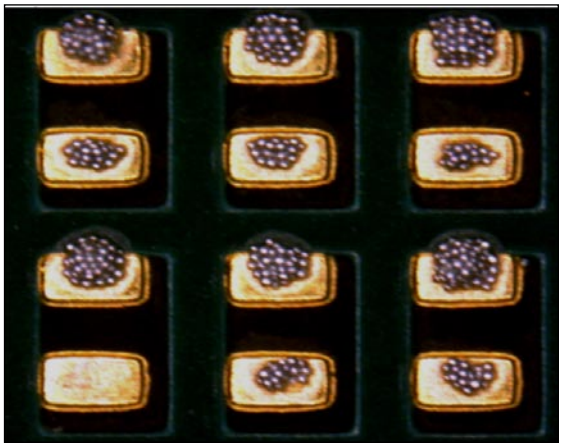


Figure 4 – Solder deposits on PWB pads from stencil printing a Type 4 solder paste with a 4 mil thick stencil. The stencil aperture was approximately 7 x 7 mils (Source: Speedline Technologies)

stencils this thin may not produce enough solder paste for the 01005 passives and 0.3mm CSPs to form good solder joints. For the 01005 passives, there is often enough room on the PWB to overprint the pad using a larger aperture opening, thus printing enough solder paste. However, overprinting is not easy with the 0.3 mm CSP, as the overprint might cause an electrical short circuit between the CSP solder balls after reflow; there just isn't enough room between the solder balls.

If successful stencil printing for 01005 passives and 0.3 mm CSP is achieved, printing for larger more typical passives and standard size QFP (quad flat packages) and CSPs will likely still be a challenge with a 4 mil or thinner stencil. Hence, the use of a step stencil (printing twice with two different stencils) may be required.

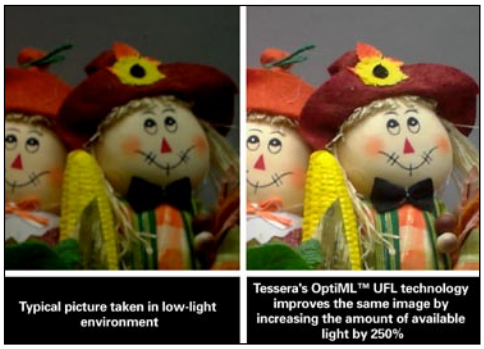
After successfully stencil printing a mobile phone PWB that contains 01005 passives, 0.3 mm CSPs, and more standard components, reflowing the solder paste is another new challenge, especially if the solder pastes are lead-free. Most lead-free solders (the de facto standard is SAC305 - 96.5% tin, 3.0% silver and 0.5 % copper) melt at about 217°C versus tin-lead solder's 183°C. Thus, the peak reflow temperature for lead-free assembly is typically about 235-240°C versus tin-lead's 210°C or so. This increase in temperature is harder on the components, but is also more likely to oxidize the small solder deposits for the 01005 passives and 0.3 mm CSPs. Solder paste manufacturers are now addressing this challenge.

Fortunately for people with little experience in this arena, the challenges of successful stencil printing, component placement and reflow for a mix of 01005 passives, 0.3 mm CSPs and standard sized components have been addressed by some equipment and materials suppliers, who are always available to meet your challenges.

Mobile phones may be the defining electronic product of this age, especially when one considers the many functions they now perform. Safe recycling of them will be paramount, and as their function increases and sizes stay the same or diminish, their assembly will pose a greater and greater challenge. Fortunately, some people are working on these recycling and assembly issues and partnering with them will likely be to the advantage of most mobile phone assemblers.

Low-Light, High Quality For Camera Phones

Tessera Technologies, a leading provider of miniaturisation technologies for the electronics industry, has announced that the company's OptiML UFL solution is now available for licensing. This new image enhancement solution enables camera phone and webcam module manufacturers to meet the increasing demand for mobile devices that provide better quality images in smaller form factors and at lower costs. OptiML UFL technology uses a combination of advanced lens design and embedded processing technology to improve low-light performance of a camera module by increasing the amount of available light by as much as 250% without degrading the field depth or other performance factors. It enables significantly higher-quality images for cameras in mobile devices without the need for any mechanical parts, providing an alternative to current solutions that require moving parts which are typically larger, slower, more expensive and less reliable. According to some estimates, the projected market penetration for camera modules in handsets will grow to more than 80 percent by 2010. Given the fact that improved low light performance with no flash is one of the two most requested features for handsets, the company is already seeing interest from several leading OEMs and camera module manufacturers.



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