There is a dramatic shift occurring in the manufacture of automobiles. Electronics are taking over in every aspect, even to the point of connecting the car with the Internet and even other automobiles. The implications and challenges for the manufacturer are far reaching. A visit to Sanmina’s Hungarian electronics manufacturing plant in Tatabanya shed some light on how one EMS company is navigating the highly regulated and competitive automotive manufacturing environment.

The electronic content in cars is expected to increase to around 35% by 2020 and by 2030 even more. Vehicles today are already filled with all types of electrical devices and functions as standard. There are for example, integrated GPS systems, entertainment systems and control devices. Park assist, safety features, lighting and many other controls are driven by the demand for greater comfort, connectivity, efficiency and safety.

Going forward, further digitalization and connectivity with hybrid and fully electric cars, as well as the driverless car, will further equip vehicles with an unprecedented number of advanced electronics. At the same time the regulatory requirements for functional safety, traceability, environmental aspects and end-of-life recycling are all contributing to the proliferation of high density complex electronics in and around the vehicle of the future.

So what are the implications for car manufacturers as mechanics intertwine with electronics? How does the supply chain need to adapt to the growing technological complexity and strict regulatory requirements?

To investigate further I travelled to Tatabanya in Hungary to visit a highly sophisticated electronics manufacturing plant run by Sanmina. Just a short 45 minute drive from Budapest, Sanmina Tatabanya is strategically located in the heart of Hungary’s Technology Triangle of Győr, Budapest and Székesfehérvár.

Hungary itself has within the Schengen Zone, in the Eastern part of the EU and enjoys direct access to a well-developed logistics and utility infrastructure that connects Hungary to Western Europe and the rest of the world. In 2004 Hungary became a member of the European Union with a fully harmonized legal system that is aligned to European safety and quality regulations for automotive manufacturing. With such a strategically important geographical location it is no wonder that many of the world’s leading automotive OEMs settled in Hungary like Mercedes Benz in Kecskemét, Audi in Győr, Opel in Szentgotthárd and Suzuki in Esztergom and, in support, suppliers and outsourcing partners are in close proximity.

Sanmina has been in Tatabanya since 1997. Alongside its established complex automotive electronics manufacturing capabilities, the facility also provides a wide range of NPI (New Product Introduction), manufacturing and test services for both complex and high-volume products in the Communications and Networking, Medical and Industrial sectors with all the required certifications in place (ISO 9001, ISO 14001, TS 16949, TL 9000, ISO 13485, AEO- Authorized Economic Operator).

The Sanmina campus covers 40,000sqm with 1,000 staff supporting the facility and 14 SMT lines in operation 24/7. But of course capacity, people and certifications alone won’t suffice to compete in the highly complex automotive manufacturing sector. What is called for is a robust manufacturing environment, in terms of equipment, experience, best practise and access to a sophisticated supply chain.

Today, the challenge is to build reliable electronic products with increasing density, complexity and sophistication whilst, at the same time, meeting the many automotive regulatory requirements and optimizing the investment in the choice of SMT equipment and their fixture sets. As devices get smaller in size, density and miniaturization increases significantly in integrated circuits demanding a need for greater capability, accuracy and reliability from manufacturing equipment.

Sanmina has invested in additional high technology equipment such as SPI (Solder Paste Inspection), AOI (Automated Optical Inspection) and ARI (Automated X-Ray Inspection) as well as best-in-class printers, high-speed, high-accuracy pick and place machines and reflow ovens, in order to harmonize the complexity and durability demanded from sophisticated automotive manufacturing.

SPI for example, measures the true solder paste volume on each and every pad to ensure perfect joints even for ultra-fine pitch components in high density PCBs. Although AOI machines aren’t new to the production line, the latest 3D technology has revolutionized this tool, making testing more robust by increasing the test coverage and reducing false calls.

Machines form the backbone of any manufacturing operation but knowledge and experience of technology, processes, applications and supply chains can be a key competitive advantage in today’s manufacturing environment where OEM’s are looking for a commitment of Zero Defects from their manufacturing partners.

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The risks are high. Manufacturers without ever more competitive environment with a product lifecycle and drive innovation in an electronics blur, high-tech manufacturers the lines between consumer and automotive miniaturisation of components increase and market release. As complexity, density and products are required to be ready for manufacturers is the speed at which New Product Introduction quality.

This is just one example of the many ways Sanmina leverages their experience inside and outside the automotive sector to improve processes and outcomes, saving money, increasing yield and improving quality.

For example, large through-hole connectors mounted on PCBs are traditionally hand-loaded prior to a wave soldering process. This adds additional labor cost and an additional process step. By leveraging their expertise from other industries, Sanmina Tatabanya pioneered the use of pin-in-paste technology as part of the SMT process for large automotive connectors and was able to improve reliability and cost. Over two years of development and testing were invested to ensure the solution met the required standards and cost efficiencies. It paid off with the receipt of a Quality Award and a Pin-in-Paste Solution that provides greater reliability at a lower cost than more traditional processes. In order to inspect the hole-fill rate of the through-hole components using pin-in-paste technology and to inspect the solder joints under BGA components in, AM machines have been strategically added to the SMT line in the facility. The additional features offered by the latest generation 3D equipment are balanced with the requirements of fast coverage, level of false calls and yield rates. The carefully implemented approach achieves an optimum solution that reduces cost and maximizes quality.

For the manufacturing process, equally rigorous and robust parameters and controls are set to meet and fulfill automotive standards and requirements. Tooling, mounting programs, inspection programs, reflow profiles and every key process parameter is verified continuously in order to ensure optimum tension balance between product quality, cost and delivery. Both automated and manual assembly solutions using standard or specific custom designed handling equipment are validated by applying intelligent testing and inspection functions at the end of the lines.

While non-conformities call for a repair process, highly skilled and qualified operators are used for repair, along with specialized equipment such as automated vacuum controlled equipment for high value/high complexity components like BGA’s and processors. After replacement of through-hole or BGA components the hole-fill rate and the solder joint of the BGA balls are checked by trained operators with 3D X-ray machines.

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Sanmina Tatabanya’s processes are strictly controlled. Upon material receipt all boxes are opened to the lowest packaging unit level and are opened and verified. Each item then gets assigned a designated Sanmina ID, which acts as its unique identification during the entire manufacturing process. From that point onwards all further handling is paperless and fully automated by using intelligent bar code readers driven by Sanmina’s sophisticated ERP (Enterprise Resource Planning) system. These processes ensure complete component and process traceability from receiving to final product shipment.

Based on 30 years’ experience in traceability business segments such as medical and automotive, Sanmina in fact developed its own system which it calls SFDQC (Sanmina Full Traceability System) which, in combination with Fuji’s TRAX software on their SMT equipment, provides fully integrated and complete traceability throughout the entire manufacturing process.

Each raw PCB is also marked with a unique bar code and, after every process step, automated or manual bar code readers send a confirmation to the SFDQC system to confirm that the process step has been performed and completed. Any results from testing functions are logged in the system and the next process step is determined by the result. None of the process steps can be performed until the previous was successfully completed. During the final packaging stage, the history within the SFDQC is re-verified to ensure non-conforming products are not shipped.

The PTS system works together with SFDQC and determines the connection between the component part number, the SMT feeder ID, the particular machine position and the PCB bar code for full component traceability. This combination provides full component batch traceability.

The direction for electronic content within the electronics industry sectors, including automotive and medical, energy, defense, telecommunications and emerging markets, requires more than 20 years’ experience in multiple markets once again takes center stage.

The days of a year or two being available for electronic manufacturing industrialisation are long gone. Six months and even three months are becoming the norm and that is where an in-depth technical understanding gained through years of manufacturing experience in multiple markets once again takes center stage.

Smart Factory

Traceability has generally been a requirement for many industry sectors including automotive and medical. Principally in these market segments, production is impossible without strict adherence to regulatory requirements such as TS 16949 and ISO 13485, and with the necessity for disciplined measures and processes that track and record each manufacturing step to achieve compliance. Even part traceability is a requirement for all automotive, and medical products.

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