

Integrated product development process drives new stencil printer

High degree of flexibility and accuracy

Wolfgang Lentzen, Speedline Technologies, Dreieich, Germany

Speedline Technologies is introducing its new stencil printer, the MPM Momentum, to the European market just in time for Productronica 2007. As with the Accela, known for its accuracy and throughput, the Momentum represents an entirely new machine and is not based on technology of preceding models. It is geared toward manufacturing environments demanding a high degree of flexibility and accuracy. This is typical of most mid-size companies handling a high product mix from simple assemblies to highly integrated multi-layer circuits with micro-BGAs and 01005 passive components.

In order to successfully position a system in a market segment which, especially in Europe, is served by many manufacturers with various models, more is needed than a facelift of established concepts and technologies. Creating a completely new machine involves a significantly higher amount of development time and associated costs for the manufacturer. This strategy, however, paid off for Speedline with the Accela, with its comprehensive new approach to product development. Market research and benchmark studies analyzing the technological and economic requirements of the industry and definition of the scope of development are critical to the success of a new product. With many suppliers in the industry, the competition is high, and one can only succeed if the product provides technological advantages and satisfies commercial needs. Times are long gone, when engineers were free to invent and design in isolation. Offering even the most advanced technology is no longer sufficient in today's highly competitive market segments. Total cost of ownership targets must be defined early in the development process and success-

fully translated into machine design. One of the clear goals in developing the stencil printer was to introduce a second printer with the Accela's alignment accuracy of ± 12 microns@6sigma, CP equal or larger than 2. However, in contrast to the latter, the Momentum was not geared toward manufacturers with extremely high throughput requirements, but for manufacturing environments demanding a high degree of flexibility and accuracy. This is typical of most mid-size companies handling a high product mix from simple assemblies to highly integrated multi-layer circuits with micro-BGA's and 01005 passive components.

Proven software controls

Of high importance in the product specification was the requirement to transfer successful concepts of the Accela to the Momentum to enable easy integration of further developments in both platforms. One notable example is the software concept, Benchmark, which has been successfully integrated into all of the company's new products.

Thus, future software functionality will not have to be individually developed for each platform, but is available for all systems. Therefore, the new stencil printer profits from the proven and powerful software of the Accela. A tangible benefit for the user is that all software functions are immediately available, unlike most new machine introductions that entail limited initial versions and require upgrades. Of specific note are the high-performance vision and inspection modules, and barcode controlled process verification.

Solid construction, precision drives, CANopen bus system

The Momentum features a welded steel frame made of tempered steel square sections. The warp resistant frame was derived from 3D finite element analysis (FEA). This resulted in a robust platform with extremely high

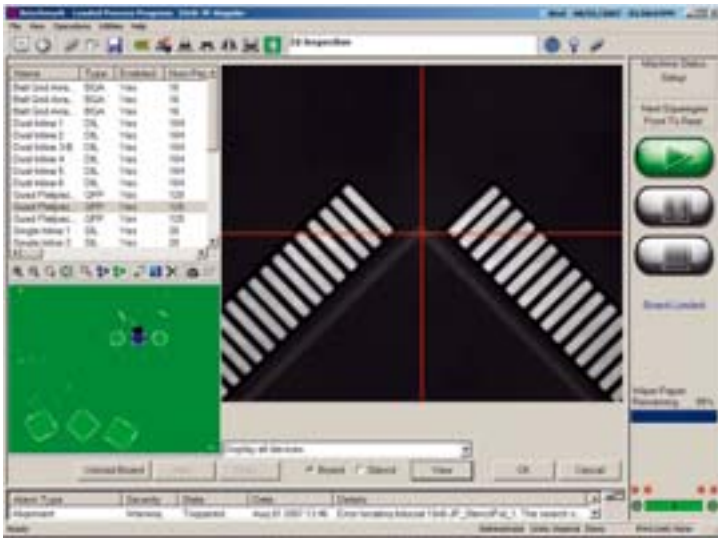
mechanical and thermal integrity. Above the steel frame, all other load-bearing components are cast parts which contribute to machine accuracy by virtue of their high stiffness. Like the Accela, the Momentum does not utilize belt drives. All axes are driven either directly or via precision lead screw. In addition to positioning accuracy and the very short settling time of a lead screw, these drives maintain tight tolerances over their lifetime. With few exceptions, the company has designed its systems with direct or lead screw drives. The higher costs of these drives pay for themselves over time with their uncompromised accuracy and wear-free and, therefore, virtually maintenance-free operation. As with the robust mechanical construction of the machine, its electric and electronic concepts are equally strong. All machine control components are located in either the front or the rear of the system. From an ergonomic point of view, this arrangement is beneficial since in-line configuration with other machines limits access to the side panels.

The strategy of employing standard industry controls was followed to eliminate the negatives associated with customized controls and electronic components. Using a CANopen bus system, the machine computer communicates directly with the control modules of the individual axes, which include the power drives for the motors. The control method used in earlier machines, using motion interface cards, multiplexer, drivers etc., was therefore limited to widely used Copley modules.

The range of features, as well as the design of the individual functional modules of the stencil printer, is impressive as well. The system uses the same high-quality digital camera as the Accela with resolution down to a few microns. Telecentric optics and LED lighting ensure undistorted images of even the edge areas and optimum illumination of the substrate surface. Inspection techniques based on the proven Texture Based method enable validation of pad coverage, bridge detection and inspection of the stencil apertures. With the recently launched SpeedVision, the scope of inspection can be dramatically increased even when components are rotated at any angle on the PCB. The results not only deliver a good/bad statement, but also the exact calculated value for pad coverage, bridge detection or stencil contamination. Traceability of these values is possible at any time via the SPC database.



Speedline's MPM Momentum stencil printer



Expanded 2D inspection capabilities

Ergonomically sensible stencil cleaning system

To win the user's confidence in a system it is important not only to provide technological innovation, but to provide easy access to the individual components. The industry demand is clear: "Make it simple!" The new stencil cleaner on the new printer is a good example. Changing the paper or setting the system up for a different paper size is easy. The wetting method is reliable and completely maintenance free. A shaft rotating in the cleaning medium transfers the fluid onto the paper. The rotation speed of the shaft is software controlled, regulating the amount of fluid transferred per time unit. This method is not only based on a simple functional principle, but also provides high process integrity. The cleaning system is programmed via templates – cleaning sequences setup globally in the software that can then be assigned to specific product programs. Thus, if a cleaning sequence has been defined and optimized, there is no need to reprogram the system for each new product; a macro can be selected. In addition to wet and dry cleaning, vacuum cleaning can be selected to remove paste residue from the apertures. The system is equipped with a strong, on-board venturi nozzle. This nozzle is situated directly at the cleaning plenum to avoid loss of performance caused by flow resistance of extra tubing.

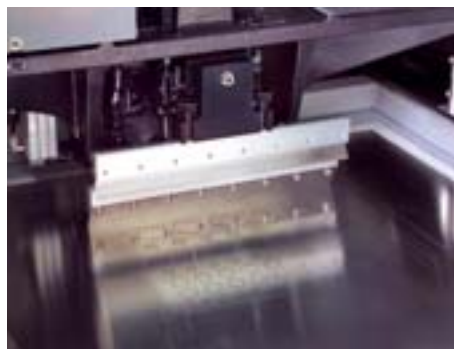
Squeegee compliance routine

The stencil printer's squeegee head features a novel concept, the so-called "compliance routine." One weak point of uncontrolled squeegee heads is that the actual force at the squeegee might deviate from the value set in the software. Usually the squeegee force is generated by compressing a spring. Since the spring constant is known, a defined compression value generates a certain squeegee force. The more the spring is compressed the higher the force. From the standpoint of physics, the squeegee blade itself acts as an in-line secondary spring, with a tendency to warp dependent on its length and rigidity. Short and soft blades bend a lot, resulting in a loss of squeegee force. The new compliance concept

counteracts this principle by calculating bending of the blade under force via additional sensors, and determining corrective values. Thus, the actual force generated at the squeegee blade is the same as the one set in the software.

Flexibility in every way

The stencil printer provides high flexibility for the user. The conveyor system can be equipped with optional input and output tracks and accommodates PCBs from 50x50mm up to 609x508mm. The substrate is fixed on the table by means of either a universal topside clamping system or by vacuum. The conveyor rails are designed such that even extremely thin substrates will not get stuck or clamped during transport. AutoPin Tooling is a new feature that will be available on the Momentum in 2008. This board support method automatically places support pins on the print table in software-defined positions. Choosing the support positions can be done either according to a selected grid or, in case of a double sided PCB, at suitable locations on the underside that are free of components. Entering the positions is based on numeric values, however a convenient method is to use the offline programming software to define positions using CAD or Gerber data. The AutoPin Tooling System is the only fully automatic support system that ensures that neither components nor solder joints are touched or impacted by mechanical stress during the squeegee operation.



Programmable squeegee head with compliance routine

Another available feature enables fully automatic product changeover. When opening a program, whether manually or via barcode, the machine changes over to the selected assembly automatically. The operator only needs to insert the stencil. To ensure that the correct materials are used, the user can be prompted to run the changeover via barcode. This means that the operator will need to scan the materials to be used, such as the stencil, solder paste, squeegee, etc., with a handheld scanner. The process is only released for production if all scanned materials match the data previously entered in the program.

Conclusion

The Momentum parallels the successful concept of the Accela and sets new standards in its market segment. Its alignment accuracy of ± 12 microns@6sigma, CP equal or larger than 2, sets it at the forefront of today's industry standards. Its operating system software, Benchmark, is well-known, proven in production, and offers full functionality from the time of machine introduction. Four years ago, when the company defined its standards for new product development, it was decided to integrate all software and hardware functions in a manner that can be transferred to future products. The new stencil printer incorporates several examples of this development strategy, including Benchmark, the stencil cleaning module, barcode process control and verification, and the Speed-Vision System, with high-speed, multiple texture-based, and quantitative inspection techniques.

Productronica, Stand A4.161

www.speedlinetech.com

ZUSAMMENFASSUNG

Der neue Schablonendrucker MPM Momentum zielt auf ein Produktionsumfeld ab, das einen hohen Grad an Flexibilität und Genauigkeit fordert. Dies betrifft die meisten mittelgroßen Unternehmen, die einen großen Produkt-Mix von einfachen Bauteilen bis hin zu hochintegrierten vielschichtigen Schaltungen mit Mikro-BGAs und 01005 passiven Baugruppen verarbeiten.

RÉSUMÉ

La nouvelle machine de sérigraphie MPM Momentum est destinée aux milieux de production exigeant un niveau élevé de flexibilité et de précision. Cela concerne la plupart des moyennes entreprises qui traitent un large éventail de produits allant des composants simples aux circuits hautement intégrés à couches multiples avec micro-BGA et blocs de composants passifs 01005.

SOMMARIO

La nuova serigrafica MPM Momentum è concepita per un settore produttivo che richiede alta flessibilità e precisione. Sono quindi interessate gran parte delle piccole-medie imprese che lavorano un vasto assortimento di prodotti, dai semplici componenti fino ai commutatori a più strati altamente integrati con componenti passivi micro BGA e 01005.