

High-end printing system based on an entirely new concept

Running processes simultaneously

Wolfgang Lentzen, Speedline Technologies, Dreieich, Germany

Great expectations were raised in the industry when Speedline Technologies launched the MPM Accela, an innovative, high-end printing system based on an entirely new concept, 18 months ago. Setting new standards for alignment accuracy and throughput, the Accela is the first printing system that can run processes simultaneously, significantly increasing throughput. This article reviews how the new printer concept has exceeded expectations of both the manufacturer and user, while meeting the ever-increasing demands of the industry.

In the relatively short time since its introduction, hundreds of Accela systems have been installed worldwide. The printer concept has proven especially successful in the European market, having been thoroughly tested in multiple production environments. Accurate paste deposition and high process speeds are no longer the main performance criteria required of a stencil printer. Features that support the extensive documentation of process settings and conditions, as well as process results, have become vital to the user. Most manufacturers of electronic assemblies feel the need for traceability, for example, integration of appropriate systems to accurately track production data. Programmable algorithms designed to eliminate mistakes during machine setup and product changeover, ensure identical product setup from batch to batch. Interfaces for bi-directional data exchange and networking of the system with a company's specific IT infrastructure must be adaptable and expandable.

A continuous manufacturing process is not only desirable from an economic point of view, but also in terms of optimum process control. Processes are most stable if they run continually, without interruption. In order to evaluate continuous process cycles, software is needed that monitors and analyzes a process station's collaboration with upstream and downstream modules. Machines offering only basic process capability are not competitive at the high end of today's market. Equipment manufacturers have great opportunities, in terms of enhancing the scope of options and functionalities of a system, to satisfy end users.

Tested in the field

The Accela has been field-tested during numerous evaluations throughout the world and at various sites of almost all major manufacturers of electronic products. With complex industrial machines of this class, start-up problems are not unusual. This is particularly true in the case of a completely new machine, not a re-development of an existing, established machine with known software, user interface and control. Such start-up problems

**Rheometric Pumphead:
closed print head as alternative to squeegee operation**

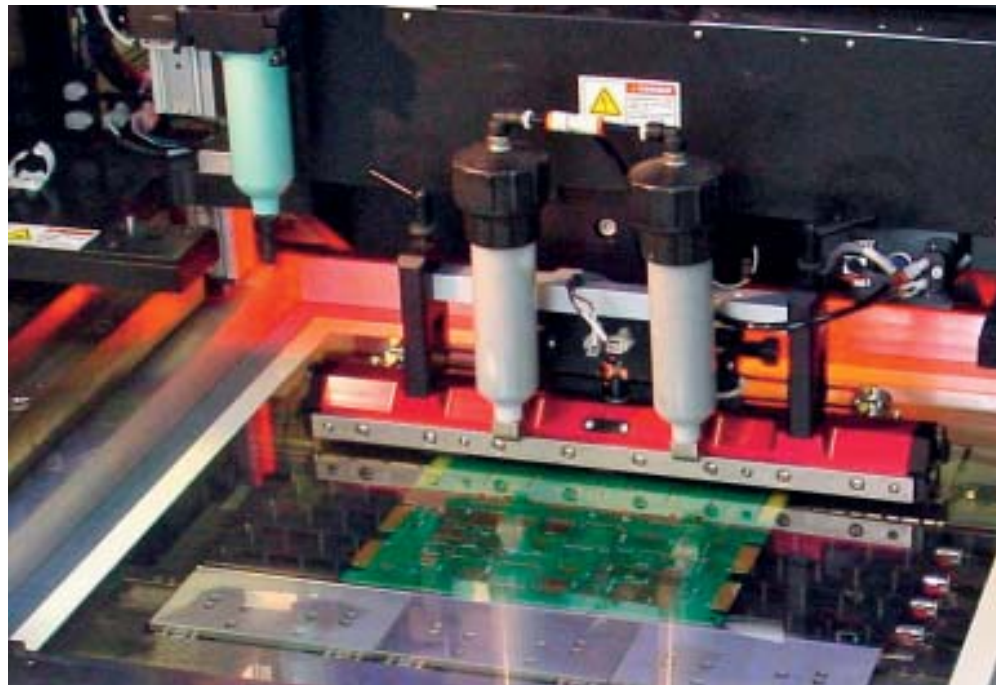
can be caused by technical defects that only show up when a new machine is put into a rigorous production environment. Likewise, problems can also occur if the user has difficulty understanding machine operation. Typically, technical personnel go through a learning curve, and trouble-free machine operation can only be achieved after a few weeks. Every manufacturer knows that this initial operational phase is critical to the acceptance of a new system, and that user related problems need thorough consideration.

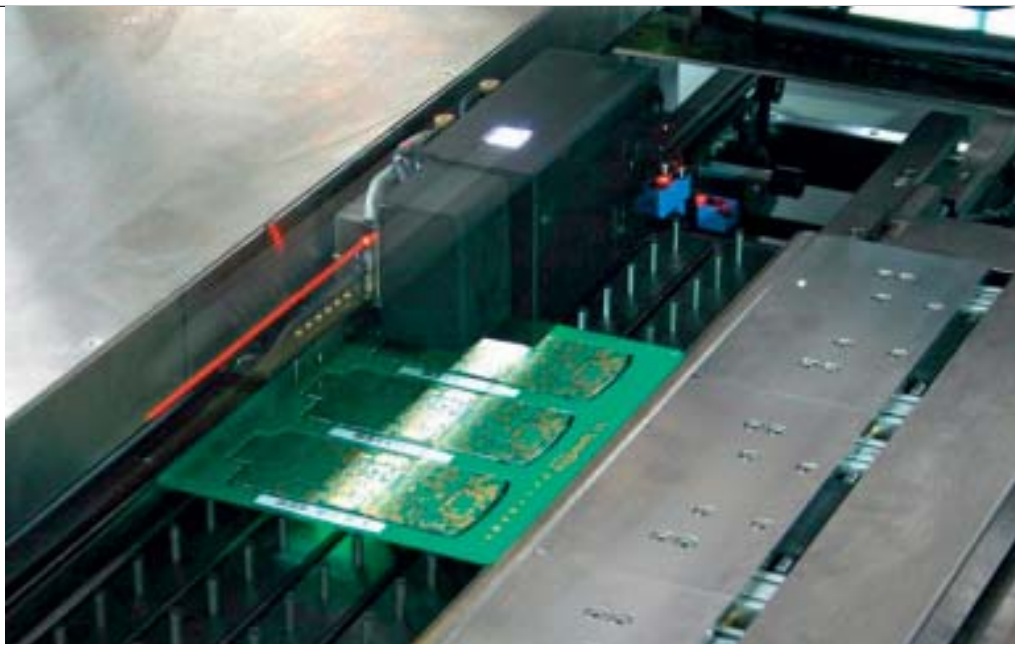
The Accela's software concept received very good reviews from numerous facilities. Its operation was extremely easy to learn and logically structured so that the learning curve proved to be unusually short. One major benefit is the graphical user interface which includes very little textual information, but rather provides graphical help functions and descriptive icons. For program setup the user is guided through a series of pages with input boxes in which all relevant data needed for machine operation is entered. Specific program modules such as programming the stencil cleaning system, the vision system, etc. use macros. These need to be set up only once, and can then be linked to any production program. This method allows standardization of the entire process and eliminates



From left to right: S. Nahm, A. Nigel, Continental AG, A. Gerspach, GPS Technologies

working with parametric variations that are specified individually, and might include unwanted inconsistencies. If a specific process unit needs to be modified at a later time, this change will affect all production programs that include this process unit. For specific requirements the user can, of course, modify individual process units for one application only, without affecting any other process programs.





Camera system performing high speed inspection



Barcode setup for external scanner or internal camera system

Minimal operator training

With this concept, the required programming of the system is greatly reduced and can be achieved in a very short amount of time. Its success and positive evaluation by the users exceeded even Speedline's expectations. Rarely has a system this complex been installed with users quickly able to operate it having undergone minimal training. This benefit was applauded especially by users who had previously used other manufacturers' systems. In addition to programming the system directly on the machine itself, the user can generate a machine program off-line at any network computer workplace without limiting machine uptime. For several years, Speedline has successfully worked with the software company, Aegis, whose software solutions are available to program and monitor all newer Speedline systems. CAD or Gerber data can be used to program the machines and customized input masks poll all data relevant to machine and process setup. A program generated this way can be transferred onto the machine via computer network.

Not only the software concept proved to be very reliable and stable, but also the entire electrical and mechanical machine concept provided trouble-free production. The operational chain of command has been simplified in comparison to earlier models and only high-quality, industry-proven electronic components are used. Since the system's launch 18 months ago, there have been no significant 'early production' problems, and only minor mechanical/

control system modifications have been required. It is noteworthy, indeed, that all customer evaluations of the Accela in Europe were successful, and that the Accela has been included in the approved vendor list (AVL) or preferred supplier list (PSL) of every single participating company. Exceptional ease-of-use and system reliability were common themes mentioned by virtually all users.

Evaluations, however, are not only important for the user, but provide critical information for the supplier. Such benchmarking helps to guide system development and allows accurate positioning of the system in the market. Typically, machine evaluations are conducted by highly qualified personnel on the customer side who have thorough knowledge of internal requirements, current and future. In addition to machine functionality, evaluations are done on security features and quality assurance measures.

Printer of choice

Automotive supplier Continental AG was the first European company to select the Accela as their printer of choice, now employing the system in almost all of their European manufacturing facilities. The Automotive Systems division of Continental AG is specialized in cross-system development of innovative technologies for vehicle safety, comfort and powertrain systems as well as in networking of active and passive safety features. Continental's comprehensive product portfolio includes highly specialized systems such as electronic and hydraulic brake, stability and chassis control systems, electronic air suspension systems, engine management systems, transmission control, sensor technology, drive assistance systems, telematics, comfort and safety electronics, hybrid electric power and much more.

There are few fields in electronics that have quality requirements as stringent as those in the automotive industry, demanding compliance not only with extremely tight quality regulations, but also with documentation of the entire production process. These requirements were of significant importance during development of the new software concept. Steffen Nahm, Manager Production En-

gineering PCB-Assembly of the plant Ingolstadt/Nürnberg, names doubled alignment accuracy, shorter cycle times due to parallel processing, as well as the simplified and very accessible machine construction, as reasons for Continental's decision to purchase the system.

The newly developed cleaning system with longer operation intervals, simplified paper exchange and optimized solvent deposition enhance process stability. For Nahm, the significantly increased throughput translates into economic benefits. He says, "With the Accela we were able to increase productivity by up to 35%. The system's extraordinary accuracy provides significant improvements in print results. An improved cleaning process and more inspection options guaranty reaching our high quality goals when processing current fine-pitch components."

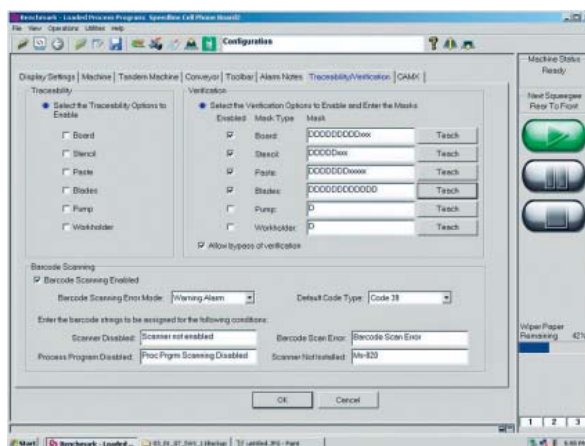
Andreas Nigel, Production Engineering, PCB Assembly, says, "After successful off-line testing and internal process acceptance procedures we were able to integrate the Accela into line operation after a very short off-line period. Its logical menu navigation and ease-of-use led to immediate acceptance from our operating personnel, because it took them very little time to get accustomed with the machine. For me the printer's clean construction, very good accessibility of individual machine parts and the ease of maintenance are a quantum leap in these types of systems. Its extremely high alignment and print accuracy of 12.5µm and 25µm@6s, Cp>2 reduced the number of defects for assemblies with high fine-pitch ratios by up to 80%."

Integration of the new systems was directly supported by personnel from GPS Technologies and Speedline. During the integration phase solutions were found and implemented for modification requests. An upcoming software release has recently been announced that will further enhance the Accela's broad range of applications. The new machine software will include even more traceability functions for production data and results, and further refine the setup procedure, addressing requirements from the automotive industry as well as others. With the help of barcode readers, it is now possible to halt the production run until the machine is equipped with all necessary materials

required for a specific process. This setup procedure begins with choosing the correct program generated for a specific PCB from a list of all possible process programs. Unlike manual selection of process programs, the software automatically searches for the correct program, using barcode control, and will not allow incorrect programs to be loaded. The software then verifies whether the correct stencil, squeegees, board support, solder paste, etc. have been chosen. Individual process components are identified by their barcode. If a user chooses any incorrect process component, the software will not release the machine for printing. A secondary barcode reader or the vision system's camera collects and documents the data of each board entering the machine and verifies its compatibility with the current process program.

Inspection capability enhanced

In addition to the important issue of traceability, Speedline has enhanced the performance of the system's inspection capability. To achieve increased inspection depth, without increasing time, an inspection system with two digital cameras is now available. While camera #1 inspects the printing results on the board, camera #2 checks the stencil for contamination. Proven texture-based inspection methods can detect solder ball deposits in and around the stencil apertures. When a pre-defined rate of contamination is reached, the cleaning cycle is initiated. The second camera simultaneously inspects pad coverage, as well as any bridging between adjacent pads. The main performance increase, however, is achieved by using completely new software algorithms allowing for a significantly higher number of pads to be analyzed per inspection site. "This enabled us to increase our scope of inspection from a previous level of around 1% up to 80%," Andreas Nigel explains. The software calculates the optimum travel path and simultaneously measures all pads that fit in the camera's field of view, independent of their component affiliation. This new method can increase inspection speed by several hundred percent, de-



Traceability setup, definition of data acquisition

pending on the arrangement of the pads on the board. In addition, inspection is now no longer limited to devices that are positioned perpendicular to the coordinate system of the vision system, but can include pads rotated at any given angle. With these enhancements the Accela's inspection system advances into a performance category that, until now, was exclusive to pure AOI systems, and can provide a viable alternative. The system can now handle substrates carried in Auer boats in addition to all common board formats. The software offers numerous programming options to adapt the system for customer-specific Auer boats. Before printing, each substrate is lifted out of the boat, fixated, reviewed by the vision system, and aligned with the stencil. The software detects missing substrates at any given location in the boat, indexing the boat to the next substrate. Naturally all other machine functions, such as inspection, are also available for Auer boat processing.

Conclusion

Eighteen months after the official launch of the Accela printing system, Continental, Speedline Technologies and GPS Technologies have drawn very positive stock of the market introduction. The immediate acceptance of the system in the market, not only proven by the number of worldwide installations, but also by numerous successful customer evaluations, shows that the system's concept provides definite benefits to the user. Accolades from

the press and reputable manufacturers have proven that the Accela not only provides technological innovation, but also high reliability under a variety of production conditions. Automotive supplier Continental trusts the Accela's concept at numerous European manufacturing sites. Feedback from their manufacturing personnel affirms the company's decision to purchase this innovative printer. High alignment accuracy and increased throughput with parallel processing provide economic benefits, and the overall ease-of-use of the system led to fast and encompassing acceptance by technical personnel. The next software generation will provide another significant performance increase and will address customers' requirements for more traceability of production conditions and output.

SMT, hall 7, booth 430/Nepcon, stand E40
www.speedlinetech.com

ZUSAMMENFASSUNG

Der Automobilzulieferer Continental vertraut dem Konzept von Accela in zahlreichen Europäischen Produktionsstätten. Das Feedback von ihnen in der Fertigung Beschäftigten bekräftigt die Entscheidung des Unternehmens diesen Drucker zu kaufen. Große Ausrichtungsgenauigkeit und verbesserte Durchsatzleistung mit Parallelbearbeitung bieten wirtschaftliche Leistungen, und die einfache Nutzung des Systems führen zu schneller und umgreifender Akzeptanz durch das technische Personal. Die nächste Software-Generation wird eine weitere bedeutende Leistungssteigerung bieten und richtet sich an die Ansprüche der Kunden nach mehr Rückverfolgbarkeit der Produktionsbedingungen und des Ausstoßes.

RÉSUMÉ

L'équipementier automobile Continental s'en remet au concept Accela sur nombre de ses sites de production européens. L'enthousiasme du personnel de production confirme la décision de l'entreprise d'acheter cette machine de sérigraphie. Précision d'alignement extrême et productivité accrue grâce à une production en parallèle apportent des avantages économiques et une facilité d'utilisation du système qui ont vite convaincu le personnel technique. La prochaine génération de logiciel apportera une nouvelle amélioration de productivité significative et répondra mieux à l'attente de la clientèle en terme de traçabilité des conditions et du débit de la production.

SOMMARIO

Il fornitore di componenti per l'industria automobilistica Continental si affida ad Accela in numerosi stabilimenti di produzione europei. Fonti del personale addetto alla produzione sostengono che l'azienda abbia deciso di acquistare questa macchina per la stampa serigrafica. L'elevata precisione di allineamento e il maggiore volume di lavoro con elaborazione parallela offrono benefici economici, mentre la facilità d'uso del sistema ha determinato la rapida e totale accettazione da parte del personale tecnico. La prossima generazione di software determinerà un ulteriore miglioramento delle prestazioni e risponderà alle necessità dei clienti in termini di una maggiore tracciabilità delle condizioni di produzione e output.



Data acquisition of paste cartridge with external barcode scanner