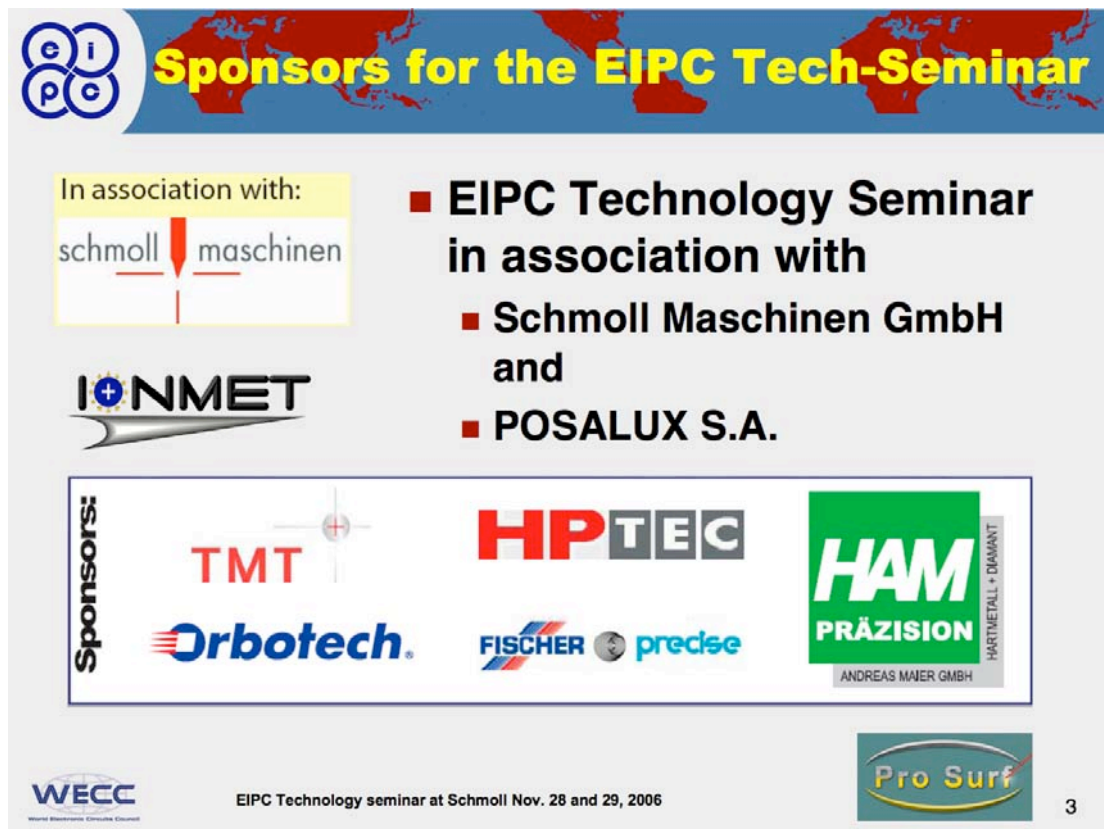


EIPC Technology Seminar on Drilling & Routing of PCBs at Schmoll Maschinen GmbH in Germany

Update on advanced drilling and routing technology of PCBs and Chip Packages

On November 28 and 29, 2006 the Schmoll GmbH in Oberrodten, near Frankfurt airport, Germany opened the doors for Printed Circuit specialists to learn about new developments in drilling of rigid-, rigid-flexible-, flexible- and multilayer Printed Circuit boards. This was one of the Industry sponsored seminars that the EIPC is organizing regularly to help engineers and specialist to learn about quality improvement, cost reduction and new technology without spending a lot of time and money to participate at such an event.



The banner features the EIPC logo (a circle with 'e', 'i', 'p', 'c') and the title "Sponsors for the EIPC Tech-Seminar" in yellow text on a blue background with a world map. Below the title, it lists sponsors in two columns. The left column includes "In association with: schmoll maschinen" (with a red drill bit icon), "IONMET", and a "Sponsors:" box containing logos for TMT, Orbotech, FISCHER, precise, and HAM PRÄZISION (HARTMETALL + DIAMANT, ANDREAS MAIER GMBH). The right column lists "EIPC Technology Seminar in association with" followed by "Schmoll Maschinen GmbH and POSALUX S.A.". At the bottom, there is a WECC logo, the text "EIPC Technology seminar at Schmoll Nov. 28 and 29, 2006", a "Pro Surf" logo, and the number "3".

Fig. 1: Sponsors of the drilling and routing seminar at Schmoll in Germany

60 participants came to the German speaking even on the first day and 30 participated on the second day where all the presentation was in English. Members of the PCB industry initially requested the seminar. Michael Weinhold, technical director of the EIPC and Stefan Kunz managing director of Schmoll designed the program in a way that the overall special needs of the European and global market have been covered. Besides the technical details, the language was one of the issues that have been managed with the participants and the speakers form the industry. Here the EIPC office in Maastricht, the Netherlands, was highly qualified to manage the organizational part of the event. The program was very well balanced. Good

technical information about different laminates used for advanced PCBs, drill and routing entry and exit material that is need for quality drilling as well as details information on drill and router bits.



Fig. 2: View of the participants during the Germany language Drill and routing technology seminar.

During the seminar, two drilling equipment companies Schmoll and Posalux reviewed technology of advanced drilling machines. Here, the different needs of the market in Europe and Asia have been discussed. It was explained, why different drilling and routing machines are needed in different markets to manufacture different types and volumes of PCBs. The most impressive part of the seminar was the tour in the Schmoll factory, where the participants could see the new developments; the three dedicated manufacturing halls that are designed to manufacture different types of drilling and routing machines. The dedication of each of the production lines allow for consistent high quality, high throughput as well as customization for specific drilling machines that are needed in the European, Asian or in the USA market. In addition, mass production drilling machines mainly used in Asia are made in a special dedicated production hall.

The program started in the morning with the registration at 8:30 a.m. This was a request to allow many of the participants to travel in the morning and return in the evening, so that only one day was needed to participate in the this technology update.



Fig.3: View of the Seminar registration office at Schmoll in Oberrodenerödermark, Germany.

As some of the participants had a very early start, Schmoll organized a welcome coffee after the people got their registration badges.

At 9:00 a.m., Michael Weinhold technical director at the EIPC and moderator of the seminar welcomed the participants. He thanked Schmoll, Stefan Kunz, for the constructive cooperation in preparing the program and helping the PCB industry to learn about the trend and new developments and cost reduction options in drilling and routing of PCBs.

Weinhold explained that the drilling and routing of PCBs is the most cost-intensive individual process step when manufacturing PCBs. The basic principles in cost reduction programs are: The first effort shall be made at the most costly processes. This was regarded as a clear message by the seminar participants and was regarded as an invitation to listen to the speakers, to watch the demos at the drilling equipment, and to use the networking options to learn how to reduce manufacturing cost, how to improve quality and how to implement new technologies.



Fig. 4: Stefan Kunz, Managing Director of Schmoll welcomed the participants and explained the highlights of the drill and routing update seminar.

Stefan Kunz, managing director of sales and marketing of Schmoll GmbH welcomed the participants. As host and key sponsor of the seminar, he explained the history of the Schmoll organization and the goals and objective in driving technology “made in Germany and Europe” for the benefits of the European industry. The global activities of Schmoll have also being reviewed. It was explained why participation in the markets like Japan is important for the development for new drilling technology for Europe as well.

The third paper provided details about: “Materials for PCBs and Chip packages”. What have PCB fabricators to understand when using different type of laminate?” The speaker at the German language seminar was Volker Klafki and for the English-speaking seminar, it was Jürgen Willuweit. Both are working at Technolam in Germany. Technolam is the representative of NanYa in Germany and other European countries. During the presentation, the participants learned about the differences in resin systems, what impact the different reinforcements have, what impact is coming from hardners and

fillers in the resin matrix and what this will do for the drill and router tool life expectation. In addition, the use of halogen free laminate was discussed. It was explained that PCB fabricators, in many cases, may see an increase cost from the material, the pressing process, as well as in drilling and plating during the manufacturing process.

The fourth presentation focused on: "Drill and routing entry and exit material" It was presented by Thomas Michels, of TMT-company in German language and by David Aspden, of Option Technologies in the UK in English. Michels is a distributor of such materials. He presented this joined technical paper with one of the users of the new entry materials in the UK. Based on the explanation, the seminar participants learned about the new lubricated entry materials and how cost reduction and quality improvement was achieved by using this advanced entry materials with the correct hardness. This will allow a more consistent positioning of the drill entry and of drilled holes with a minimum of drill wander and deflection. During the presentation, David Aspden showed samples, made in MASSLAM technology at his factory in the UK, where besides standard resins also Polyimide and Teflon resin with special fillers in MASSLAM fabrication are done. For pressing and drilling of such materials a specific know how is required. The seminar participants learned that the samples manufactured by Option fulfilled the stringing market needs for such specific PCBs. The technical capabilities of Option have been demonstrated very well and the participants could learn how new entry material will help to improve small hole drilling under production condition.



Fig. 5: David Aspden, of Option Technologies in the UK in English, during his presentation. A users view was presented concentration on advanced drill entry and exit materials and how yield improvements had been achieved.

The fifth paper was focused on the: “Optimized Selection of Drilling and router bits for processing of PCBs”. It was presented by Martin Stumpp, Manager Technical Sales and Product Management of HPTec GmbH in Germany.

Stumpp explained, which feature of the drill bit will influence the drilling result and how much the impact is. The following different items have been reviewed:

- Helix angle between 28° - 48°
- Point angle between 120° - 165°
- Flute length example: drill bit diameter 0.3mm with a length= 3,5; 5,5; 6,5mm
- Drill geometry in accordance with the specification of the drill bit producer
- Carbide: 5 % - 12 % and Cobalt finest grain / ultra-fine grain

After the presentation it was clear that the universal drill will not exist. For optimum results, each material and copper type used in the manufacturing process of PCBs require different drill bits with differences in Helix angle, Point angle, flute length and drill bit material. The industry has often not the knowledge to select the optimum tool. The results can even impact the reliability of the drilled holes and the complete PCB.



Fig. 6: Drill quality inspection by Martin Stumpp, Manager Technical Sales and Product Management of HPTec GmbH in Germany. During his paper quality improvement, yield and cost-reduction were some of the topics.

After the coffee break, Jürgen Skrypczinski, HAM Precision Carbide Tools in Germany explained the “Advanced small hole drilling for PCBs and Chip

Packages.” Skrypczinski explained the changes when moving to small hole drilling. He showed the impact on overheating drill bits on the quality of the holes and on the drill bit life expectation. The correct spindle speed (RPM) and chip load are important for the hole quality, productivity, drill bit life and last not least the drilling cost. For example, a Helix angle of 40° and more may be needed for flexible PCBs. Only by selecting the correct drill parameters the PCB will meet the OEMs long term requirements. PCB fabricator shall learn how to get the best cost-performance ration when drilling and routing PCBs.



Fig. 7: Thomas Kunz, Managing Director of Schmoll during his presentation about linear and spindle movement technology on drilling and routing machines for PCBs. It is a clear direction that high productivity and quality with a minimum on maintenance will be achieved in an easier way with linear motor movements.

The last paper in the morning with the title: “Background in drilling equipment using spindle or linear motor movement systems”.

Thomas Kunz, Managing Director, Schmoll Maschinen GmbH presented this paper on the first day and Stefan Kunz, Managing Director, Schmoll Maschinen GmbH gave the paper on the second day during the English speaking seminar.

The difference in ball screw spindles and linear motor controlled drilling was explained. Based on examples drilling speed, the reliability and the maintenance over time have been demonstrated. By using a new drilling or routing machine, the difference between spindles and linear motor movement

controlled machines can be neglected. However, after a number of several months, the ball screw spindle shows a certain wear and precession is impacted. In addition, the positioning speed of a linear motor is faster and is limited today only by the measuring system that controls the positioning. Schmoll has its own electronics and programming division that is in charge of the drill and router controllers. As a result of this, faster developments and unique functions are provided to the users of Schmoll machines that are custom made and that are not available on the free market. The unique electronic equipment control units allow a fast and effective implementation of customer and or market needs. Schmoll have managed to controlling the manufacturing process of the mechanical as well as the electronic parts and the programming of the software. This will a allow for a maximum on flexibility and customer focus

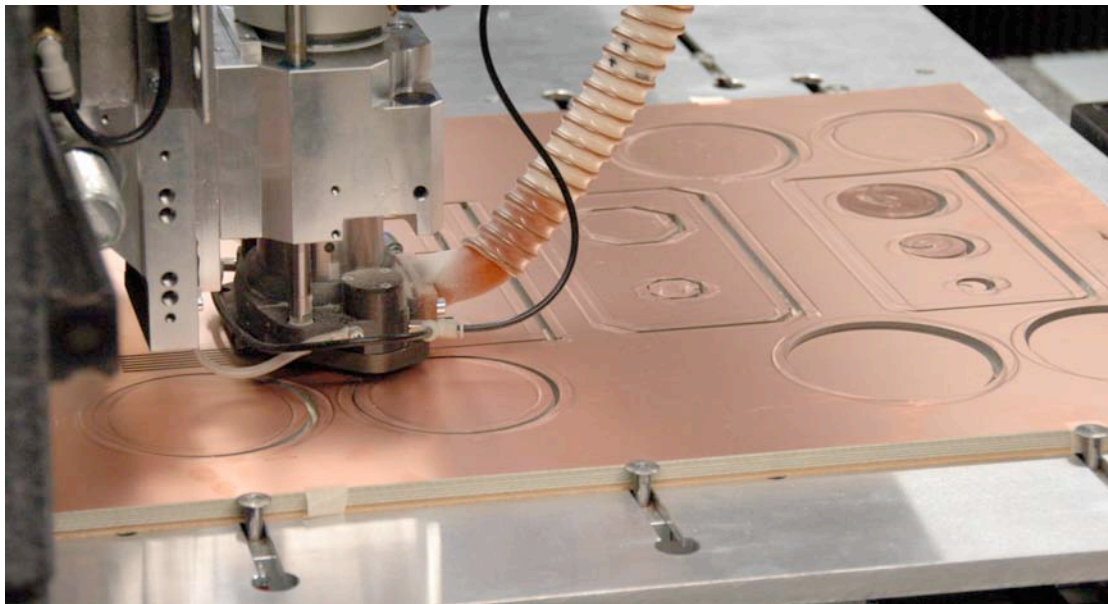


Fig. 8: Routing of PCBs have been shown as examples during the presentation and at the factory tour. Participant could see the high quality achieved with linear motor movement of tables and spindles.

At 13.00 a buffet lunch was provided. This was a good time for networking between the participants and the presenters.

After lunch, Herbert Kläy, Director at Posalux SA in Switzerland reviewed the “Development, productivity and accuracy of advanced drilling equipment”. He explained the how Posalux had achieved speed and accuracy by using advanced linear motor and controlling technology and special table construction. This enables high-speed movement and precession through weight control of the drill tables. This type of machines are also used in the manufacturing process of chip packages in Taiwan and Korea. Kläy explained also how the temperature management was made to maintain constant equipment temperatures for a correct positioning of holes even over longer work hours. Some of the panels with chip packages have drilling times of more then 6 hours. A dimensional stable machine is mandatory to manufacture consistent end products.



Fig. 9: Herbert Kläy of Posalux in Switzerland explained the drilling of HDI and Chip Packaging drilling and what is needed from a high quality drilling machines.

The last paper was entitled "Development of routing equipment". Stefan Kunz, Managing Director, Schmoll Maschinen GmbH explained the routing technology by using linear motors as well as dedicated software that enables high speed working. Special routing spindles are used to achieve optimum results and consistent dimensions of the finished PCB. Kunz explained that the days are over when old drilling machines could meet the technical requirements of advance profiled PCBs. Today, the required routing tolerances are so narrow and needs for productivity are much higher, that this old drilling machines will no longer provide a cost-effective solution.



Fig. 10: At the assembly hall for standard drilling machines, the technology and fabrication process was explained and how cost-effective of high quality drilling machines is achieved.

The top highlight of the seminar was the factory tour at Schmoll Maschinen GmbH. During the walked factory tour, many participants used the time was also used for good networking discussions with other PCB fabricators and suppliers to the industry.

The factory is organized in three major production sections. The first part is for special machines. These are one and 2 spindle drilling machines that may have spindles running up to 300 k/RPM. Loader and un-loader are often needed in Europe, even for prototype fabrication. In addition, X-Ray and vision systems can be installed as well. Depth controlled routing and drilling are also an option. These techniques allow manufacturing rigid FR4 PCBs with a thinned area. The PCB now can be bend to install by bending it at the thinned flexible part routed in the rigid part of the PCB. Here, designers are challenged to design this type of PCBs and application.



Fig. 11: Stefan Kunz explained the functionality of the new fully automated X-Ray drilling machine with special compensation factors to allow for even better registration of individual inner layers as reference layers.

In the second production hole, special equipment is manufactured that is customized and have a lot of features as individual table control. This enables positioning of each drill table individually according to the drilled hole pattern on the previous layer. This technology helps to minimization the positioning of hole to hole tolerances on sequential build up PCBs measured from layer to layer.

During the factory tour, high speed drilling was shown with 1000 hits per minute drilling blind via holes.

In the production hall number 3, standard six spindle machines are manufactures. It was stated that the production time of each machine is 230 hours. 30 manufacturing stations are in the hall. The manufacturing process is split in work units that are conducted during one day for 2 people. The fabrication process is divided in 13 steps. The work is organized so that each day one machine is ready for shipping. This high efficiency is only possible on standard drilling machines mainly needed in Asia.

Special drilling machines with extra features as manufactured in production hole one and 2 are more complex and need between 400 and 500 hours or even more production time depending on the extra features that are required by the PCB fabricator.

However, as Europe is NOT the market for mass production of PCBs, niche product PCBs are needed in Europe. As a result also special equipment is needed to meet the market needs.

The information exchange during the seminar and the factory tour was very open and the participants could see a professional managed company with first class tooling machines, first class engineers and staff resulting in excellent drilling and routing equipment that is manufactured at the Schmoll factory in Germany.



Fig. 12: A six spindle-drilling machine is rolling out of the factory. A radio controlled hydraulic roller movement systems takes the finished drilling or routing-machines that can weight up to 12 metric tons, out of the factory

During the final discussion, Thomas Kunz thanked the visitors for coming and for sharing knowledge concerning present and future PCB requirements that will impact the developments of advanced drilling and routing technology equipment and systems. As a final word Kunz stated that it is important to meet the needs of the PCB fabricators and words “Made in Germany” and “Made in Europe” are quality and technology commitments for everybody in the factory.

During the farewell coffee break the seminar came to its end and Stefan Kunz wished every one a safe trip back home.



Fig. 13: Some of the participants had to stay over night and used the opportunity to share their knowledge during the networking dinner

More details about the seminar including the technical presentations can be obtained from the EIPC office in Maastricht.

Contact is: Kirsten Smit-Westenberg

EIPC Head Office

Hertogsingel 49B

NL-6211 CD-Maastricht

The Netherlands

Tel: +31433440872

Fax: ++31-43-3440873

Mobile: +31-6-29517620

E-Mail: kwestenberg@eipc.org