

Pioneering technology for the production of LEDs and wearables

Rehm and Asys present a new line concept for reel-to-reel processing

They are regarded as an environmentally friendly, energy-efficient alternative to the conventional incandescent light bulb. They impress with their outstandingly high quality of light, their robustness and their long service life of several decades – LEDs open up new, diverse and intelligent lighting concepts. It is very often the case that LED applications are manufactured on endless, flexible substrates. However, this requires special production designs such as reel-to-reel processing (R2R). The source material is placed on a coil (film reel), unrolled, processed into a complete SMD production line, and then rolled up again as a finished product. This enables large quantities to be processed in a safe, cost-efficient and trouble-free manner. Due to its specific production conditions, the R2R technology requires innovative solutions. Rehm Thermal Systems has developed a new, compact soldering system and drying system for processing band-like, flexible substrates (e.g. polyimide film) which are used in the production of LEDs or wearables. The highlight of the system is the movable processing chamber (patent pending) which allows for continuous heat transfer during production. In cooperation with Asys, the system is available in the SMD line concept and can be ideally adjusted to the needs of each application. The complete R2R line was presented for the first time at the trade fair productronica 2015 in Munich and was even the winner of the 'productronica innovation award'.

State of the art: Challenges in LED production

Currently, systems for R2R production are only seldom used when reflow-soldering electronic components to flexible films. The constraint here lies in linking the soldering or drying process with other upstream production steps – such as paste printing and assembly. Since these processes are carried out sequentially (discontinuously), i.e. the band is idle during the assembly process, this can be problematic for the reflow process which requires continuous thermal conditions. A previous and rather inconvenient solution to this problem involved costly buffer loops such as in the form of an endless loop. They were arranged before the reflow soldering system in order to fulfil the various transport speeds and process stages and maintain the process in a somewhat continuous manner. The endless substrates are usually divided into images, i.e. equal sections arranged in rows. There are only a few millimetres of free space (interval) between the individual images. This also makes it more difficult to replicate reproducible reflow soldering profiles for each image.

With this new systems technology and line configuration, Rehm Thermal Systems and the Asys Group offer an intelligent and pioneering solution for the challenges that arise in the R2R production of LEDs and wearables. Thanks to a moveable reflow-soldering processing chamber, the sequential pace of the assembly system can be adjusted to the continuous reflow thermal requirements of each image.

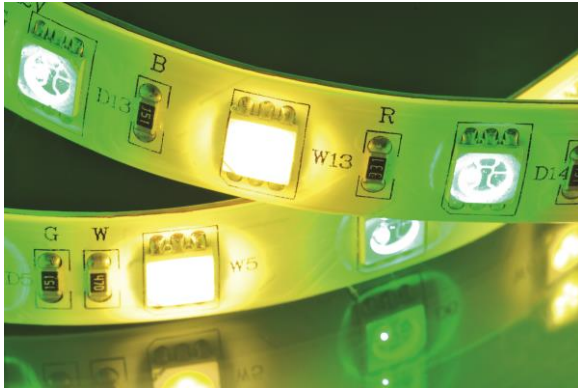


Figure 1: LED strips produced using the reel-to-reel process

Alongside the reflow process, paste printing, film handling and the assembly process also play an important role.



Figure 2: Example line with the R2R system from Rehm and Asys modules (Image: Asys)

Processing and transfer to the print system

In the first module, the rolled-up base film is processed, stretched and then transferred to the print system. The system is fitted with a film stretcher and a band guide. This ensures that the film is transported consistently and in a defined orientation throughout all the line modules. Various reel materials and reel widths can be used and processed. An integrated buffer section enables the end of the film to be easily attached to the start of the film. This produces a homogenous transition and allows for the most efficient use of material.

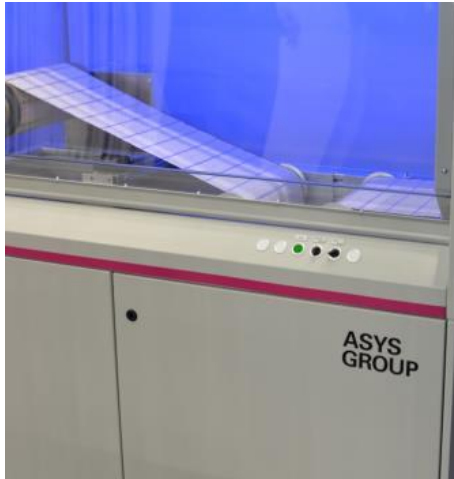


Figure 3: Processing unit with integrated film stretcher (Image: Asys)

Special film transport system for the best print quality

The screen and stencil print system subsequently prints the unrolled and stretched film. For precise media work, it is essential that the film is placed smoothly on the print nest in order to prevent discrepancies in the printed image (offsets). The printer has a special film transport system for this purpose. Various vacuum circuits, which can also be connected at different times, provide sufficient smoothing of the film, thereby ensuring it can be printed precisely. The special transport system offers another advantage: different film widths can easily be printed without the need for any reconfiguration.

Moreover, the printer can be fitted with an oscillating stencil cleaning system (iROCS). This enables quick and efficient cleaning, whenever it is required. The system offers humidification depending on the substrate size and ensures the cleaning paper is fed at a constant rate, whilst providing reliable vacuum generation.

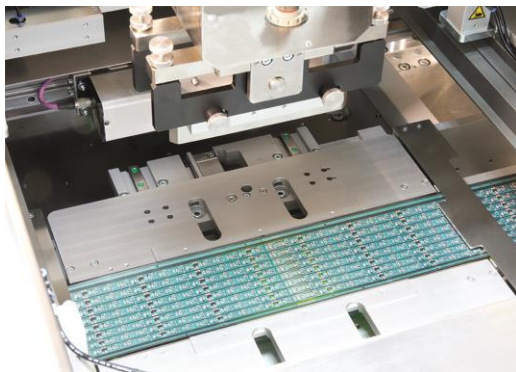


Figure 4: EKRA print system with film (Image: Asys)

The printer can be intuitively operated using the award-winning SIMPLEX user interface as well as by means of gesture control. Each function can be directly selected and performed using the touchscreen. A live display of the film previously scanned by the operator is displayed directly on the monitor. Markers can be set in a matter of seconds. The operator taps directly on the marker. The coordinates are then automatically transmitted to the software immediately. In addition, the film can be aligned via edges, markers, synthetic markers or via image comparison.

An integrated setup control also ensures that all the components entered in the print programme are logged and verified. Only once these match the stored data can the operator start production. Moreover, the whole R2R line can be connected to an overarching MES system.

Film coiling and cutting element

Once soldering paste printing, components assembly, the thermal process and an optional electrical test have been carried out, the film is subsequently transported to the coiling unit. In order to protect the components already applied, a specific spacer band (spacer) can be fed via a second reel.

If necessary, the film can be cut in the direction of transport (LED strips). Multiple individual reels are then coiled. Various cutting options (laser, knife, etc.) are available in this configuration. Depending on the coiling unit, the material feed is then integrated by means of clamping elements on the edge of the film (hitch feeder) or is available as a separate module.

Thanks to the modular design, the reel-to-reel production line can easily be expanded with additional systems, thereby providing flexibility. Electrical or optical test modules and various laser modules can be integrated for cutting or marking the film without any problems. Due to the short product changeover times and the option of adding additional processes on the line (spacer band coiling without cutting), the production concept is also appealing for moderate production quantities.



Figure 5: R2R line at the Rehm stand at productronica 2015 in Munich (Image: Rehm Thermal Systems)

Award-winning systems technology for reliable soldering and drying processes

The R2R system from Rehm is fitted with an innovative processing chamber. The centrepiece is a heat source that can be actively moved counter to the transport direction of the band-like substrates for profiling the reflow temperature while the transport for the film material is idle. The heating control and the system's heat source movement can be adjusted to the pace of the imaging process. This means that the expected reflow soldering profile can be achieved

for each image, which corresponds with the continuous passage of a unit (image) by means of a convection reflow soldering system. Various image lengths or paces can easily be provided with the necessary thermal reflow profiles for printing and assembling new applications. In particular, the novel reflow soldering system solves the problem of replicating reproducible reflow soldering profiles for each image without overheating parts of the image. With this system, Rehm opens up the possibility of processing products like LED strips in endless R2R processes efficiently and economically in large series – with absolutely reproducible heat transfer. Of course, the line concept can also be used for R2R drying tasks such as in the selective printing/coating of flexible substrates.

Rehm Thermal Systems recently won the ‘productronica innovation award 2015’ in the SMT category for this pioneering technology. With this award, the organisers of productronica – in cooperation with the trade magazine ‘productronic’ – honoured the most innovative new products and production processes in the electronics industry.



Figure 6: (from left to right) Managing Director Johannes Rehm and Prof Klaus-Dieter Lang, Fraunhofer Institute for Reliability and Microintegration (IZM) at the award ceremony for the ‘productronica innovation award’ (Photo: Messe München)

“It is a great honour that, out of the large number of applications, we were able to convince the panel with our reel-to-reel technology. The award highlights how important it is to engage in active research work and advance new ideas in the electronics industry. The trade visitors at productronica expressed a great deal of interest in the system and we are delighted by the overwhelmingly positive response,” remarks Johannes Rehm, Managing Director of Rehm Thermal Systems.

The economic production strategy of the future

The endless production of products on band-like substrates already presents an economic and efficient production method for the large-scale production of LEDs and wearables. With the innovative line concept from Asys and the new R2R system from Rehm, the two industry partners have succeeded in providing a flexible, technical solution that optimises the reflow process for a wide range of images (length, width and variety of substrates) and that does not require any additional buffers. Specific, cost-intensive additional solutions for reel-to-reel production are rendered obsolete by this systems technology.