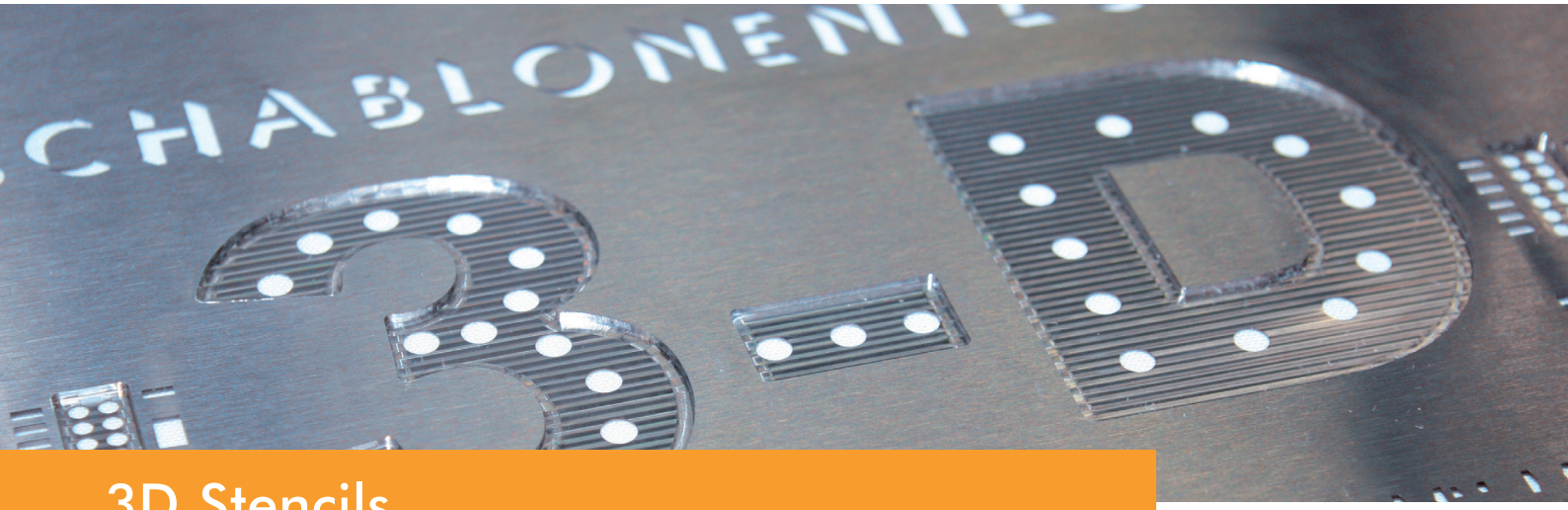


3D Stencils

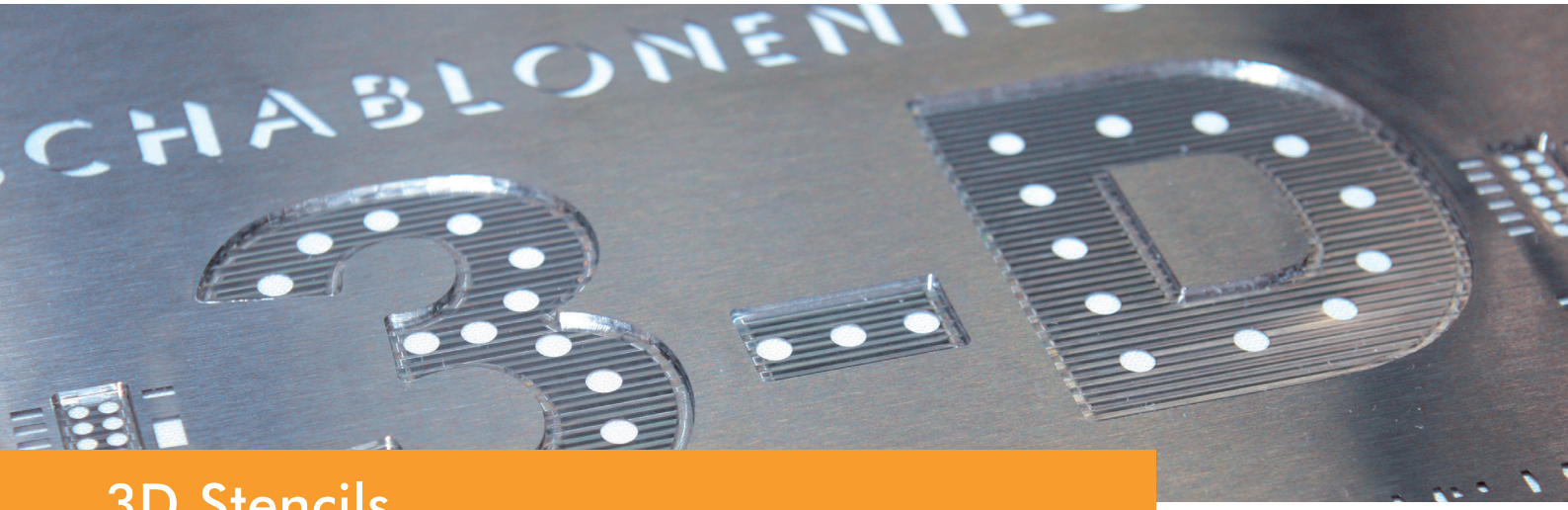
Simultaneous printing on several levels

This newly developed process differs from normal step technology. 3D technology used in order to enable simultaneous printing on several levels of a substrate or to compensate elevations or depressions on the substrate. We've developed special squeegees that follow the stencil's surface during the printing process for the use in 3D technology.

Setting up 3D stencils

3D stepped stencils can be used without great effort in all printers where the alignment between stencil and circuit board is done via the printing table. If the printer aligns the stencil with the printing table, care should be taken that the alignment's traverse paths are kept to a minimum. This is because the position of the stencil with respect to the squeegee, and thus the adjustment of the slit squeegee to the cavities, is changed by the alignment paths. Additional free space is generally needed for this during the stencil's layout.

1. Prepare the printer's work nest for the new product's set-up. In the process remove excess circuit board supports to avoid a collision during the transport width adjustment.
2. Enter the circuit board's parameters (x and y dimensions and thickness) into the printer.
3. Set the printer's transport width to the circuit board width. Pay attention here that only minimal play remains. Nonetheless it must be ensured that the circuit board is transported through the entire printer without getting stuck. Too much play between the circuit board and the transport leads to inexact positioning of the circuit board in the printer and thus to greater traverse paths of the alignment axes.
4. The circuit board should be stopped in the printer as reproducibly as possible. It makes sense to stop the circuit board mechanically for this. Most printers can place a stopper in the circuit board's path. Here it's important to take the weight and mechanical sensitivity of the substrate into consideration. If the circuit board is too heavy, it should not be stopped with a stopper mounted on one of the camera axes. It's better to use a stopper mounted firmly in the work nest or a contact-free optical stop sensor. If the circuit board has sensitive outer edges or is fragile, it should be stopped with a soft stopper or optically. If the mechanical stopper is to be used, always stop the circuit board outside of the middle so that it always rotates in an identical direction. This will also minimise the traverse paths of the alignment. If saving additional cycle time is desired, it makes sense to set the stop position close to the park position of the transport side wall facing the camera thus minimising the traverse paths of the camera axis.
5. Subsequently transport a circuit board into the machine. In the process please check the middle position in the work nest and correct if necessary. Now install the circuit board's support. Check here whether the circuit board is well fastened and doesn't sag under the pressure application from above.



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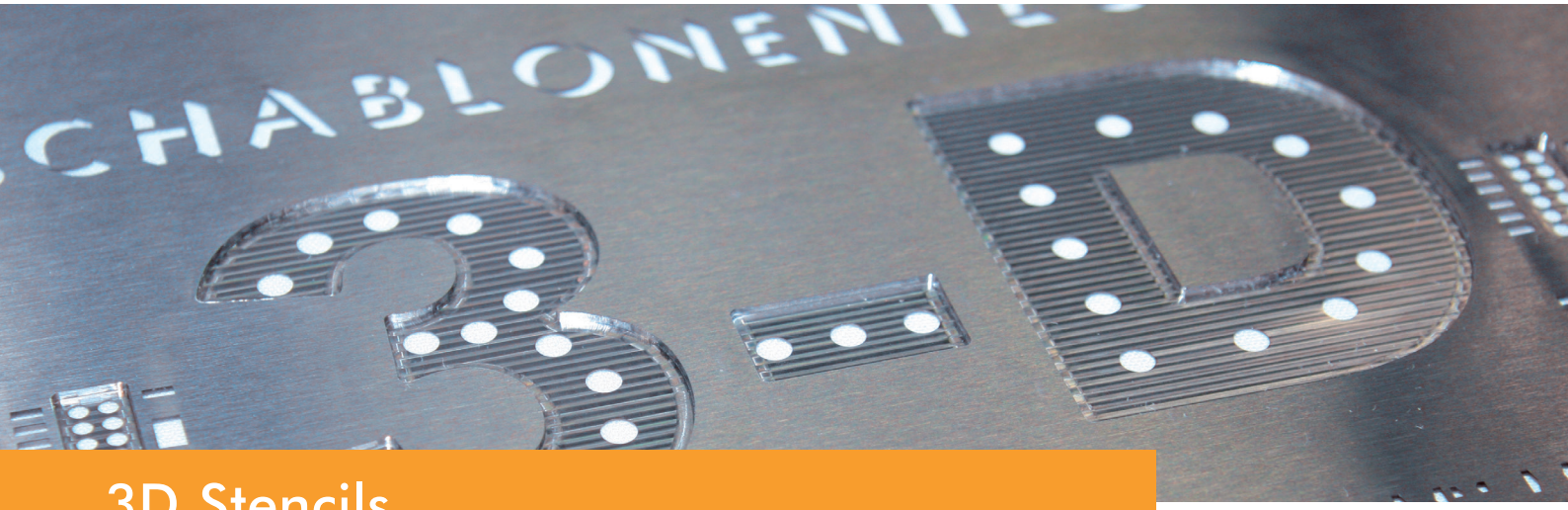
6. Now set a snap-off (clearance between stencil and circuit board) for the adjustment of the stencil to the circuit board. The value for the snap-off results from the stencil's pin lengths + (0.5–1) mm. That way it's ensured that the pins don't collide with the printer's circuit-board clamping or the circuit board when the lifting table is later raised. The lifting table is NOT raised yet.
7. The stencil is now laid into the printer. It's aligned about in the middle. The stencil is NOT clamped yet. Thus it is ensured that neither the stencil nor the circuit board is damaged during a collision and the stencil can be subsequently aligned exactly.
8. Now raise the printer's lifting table with the set snap-off to the stencil.
9. Align the stencil with the circuit board and decrease the snap-off in steps until the stencil makes contact with the circuit board's pads. Stencil clamping should be activated as soon as the stencil's position matches the cavities in the circuit board so that the contact point between stencil and circuit board can be correctly set.
10. Lower the lifting table again and now teach-in the circuit board and stencil fiducials.
11. Move the circuit board out of the machine after successful alignment, contact-point setting, and fiducial learning. Subsequently transport back into the machine and raise onto the stencil. Everything should now fit together.
12. Mount the slit squeegee blade in the middle of the squeegee holder. Pay attention here that the squeegee blades are inserted for the right printing direction.
13. Insert the squeegee holder into the printer's squeegee head and tighten.
14. Set the squeegee force to (0–10) N and lower the squeegee. The squeegee should touch the stencil and at least partly dip into the stencil's cavities. Also decrease the squeegee's speed if necessary; (5–20) mm/s is reasonable in order to be able to judge the squeegee's position during printing.
15. Start a manual print cycle and evaluate the position of the squeegee's slits relative to the stencil's cavities. It's best to stop over the cavities for exact evaluation.
16. If an adjustment of the squeegee's position is necessary, it can be done within a low range by loosening the squeegee's clamping and displacing slightly along the direction of the blade. Pay attention here that the squeegee can still be subsequently fixed to the squeegee head with sufficient firmness. The circuit board's stop position in the printer can be adjusted or the blade displaced in the squeegee holder if larger paths are necessary.
17. Examine the position of the squeegee's slits for all of the cavities in the stencil; in other words squeegee over the entire print area.
18. Subsequently examine or adjust the opposing squeegee direction in the same way. Set the correct printer parameters for squeegee force after successful squeegee adjustment. Squeegee force can deviate significantly from the normal values while being pressed into cavities. The squeegee force can be up to 2.5 times normal squeegee force depending on cavity depth. It's crucial that the stencil's upper side is skimmed cleanly in the printing area. The active squeegee length that is pressed with is used for a rough determination of squeegee force. Here (2–3) N/cm squeegee length is anticipated. If for instance printing only occurs in cavities and the circuit board's upper side stays unprinted, squeegee force is determined from the used flap length between the squeegee slits + the force necessary to travel the passive areas.



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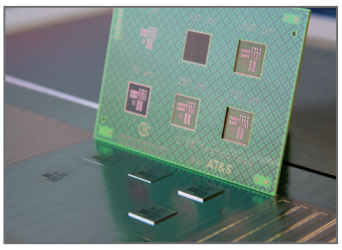
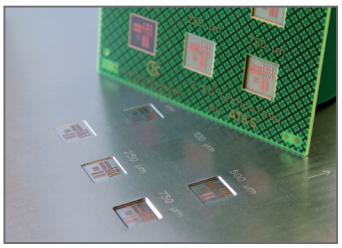
19. Now check the function of the slit squeegee for both squeegee directions with the calculated squeegee force; raise or lower the squeegee force as needed until all of the active areas have contact with the stencil's upper surface.
20. The function of the slit squeegee is now examined with solder paste; again, adjust the squeegee force as needed until all of the print areas are cleanly skimmed
21. Now the squeegee's speed can be set to the normal value once again.
22. The stencil is completely set up. Save the printer file for reuse.





Cleaning 3D stencils

- The stencil may only be cleaned manually beginning at a length of 0.5 mm of the stencil pins on the underside of the stencil.
- Whether the printer's automatic cleaning system is in a position to clean this flawlessly should be examined if openings are located between pins with a smaller length.

Causes of error and solutions

- Deficient cleaning efficiency, fuzzing or tearing of the cleaning cloth by long pins after automatic underside cleaning.
  >> Manual cleaning with low-lint cloths.
- The stepped area on the stencil's upper side isn't cleanly skimmed after the squeegee pass.
  >> Increase squeegee pressure and/or reduce squeegee speed. Please request a new squeegee if that doesn't lead to success because the squeegee is worn.
- Poor deposit quality, deficient transfer efficiency, or sub-surface migration of the solder paste.
  >> Examine correct snap-off setting. If the pin lengths are not correct, send the circuit board in for analysis in order to be able to adjust the stencil's layout based on it.

Christian Koenen GmbH
Otto-Hahn-Straße 24
85521 Ottobrunn-Riemerling
Germany

Phone: +49 89 66 56 18 - 0
Fax: +49 89 66 56 18 - 330

E-Mail: info@ck.de
Internet: www.ck.de

CHRISTIAN KOENEN GMBH
HIGHTECH STENCILS