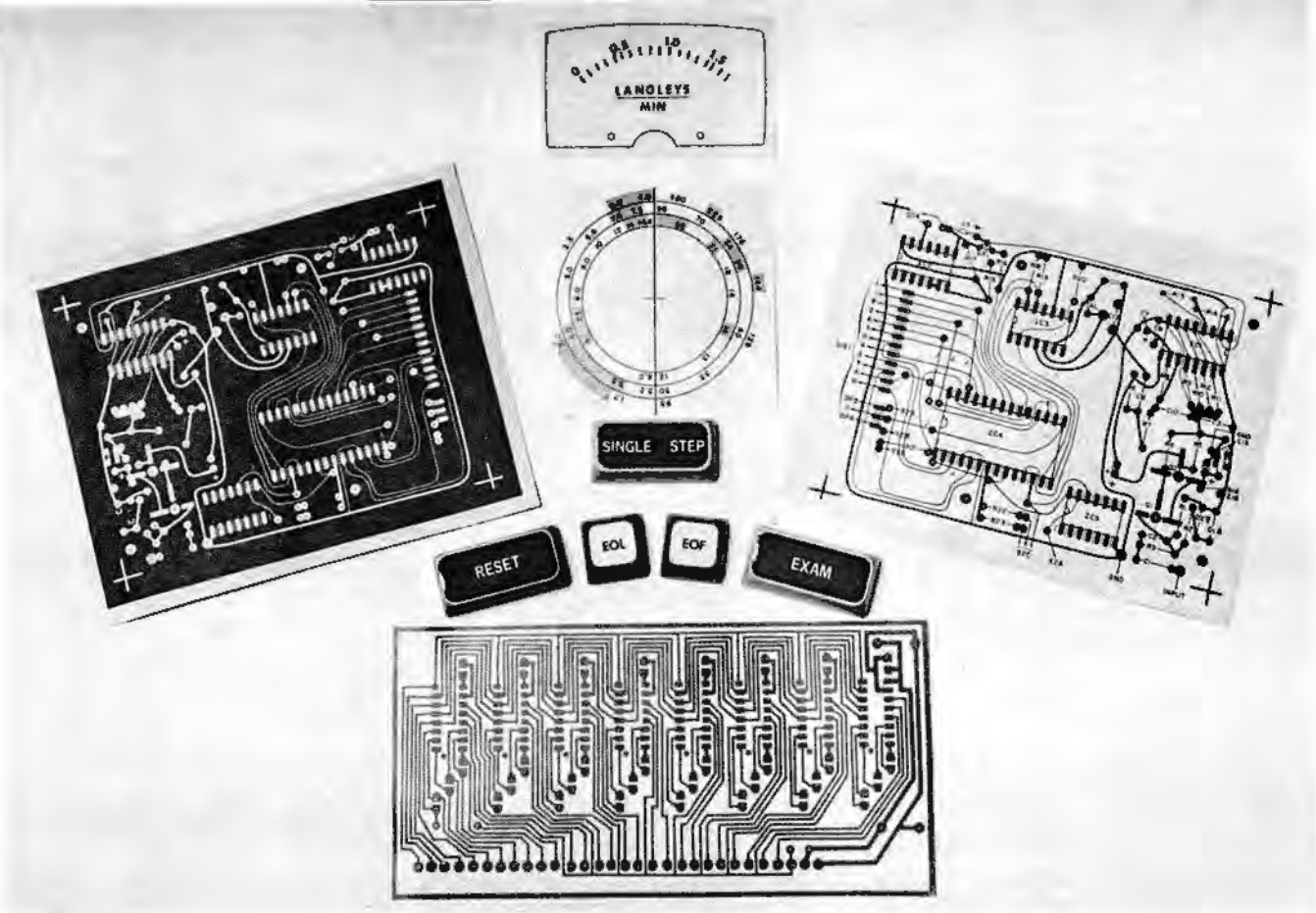

Now TRANSFER PRINTED PC PATTERNS WITH NO CAMERA OR CHEMICALS!

BY G.D. FISHER

EVERY experimenter and hobbyist dreams of being able to transfer an etching and drilling guide from the printed page to a pc blank without the mess and bother of chemicals or photography. Now you can do just that with a new direct-transfer film that has a number of other uses of interest to the experimenter who builds his own projects.

Called PCP-A Contact Film, this new plastic film has an adhesive on one side that permits it to be placed directly over printed artwork. Then, the only "chemicals" needed to complete the transfer are soap and water.

The PCP-A Contact Film is available in sheets of various sizes and in three packagings. The small package containing six 6" × 4" pieces of film is $5.49; the medium package with four 9" × 6" pieces is $6.95; and the large package of three 12" × 9" pieces is $7.95. It is made by Printed Circuits Products Co., 116 Harwood, Box 4034, Helena, MT 59601.

Guides made from the film are used as exposure masks for photosensitized printed-circuit blanks. They yield high-definition artwork with no stretching or distortion. Hence, they can be used in any type of pc-pattern layout.

Working With the Film. Using the direct-transfer film is extremely simple. First, you cut the PCP-A film to a size just slightly larger than the etching guide you are transferring. If the guide is relatively small (up to about 5" square), peel away the entire backing from the film and apply it directly to the paper on which the guide is printed, taking care to get it down right the first time because once it touches the paper, it cannot be lifted. For larger guides, peel the backing only part way and work slowly until the film is completely down on the guide.

Once the film is down, use a smooth, blunt instrument to burnish it in place and force out all air bubbles. (Do NOT lance the air bubbles, either in the paper guide or the plastic film.) This done, place the artwork in a dish of warm, soapy water for 15 to 20 minutes. Then start to rub off the paper with your finger, stroking back and forth with just enough pressure to assure good cleaning action. Do not use steel wool or abrasive powder cleaners.

Preparation of the Board. The copper must be free of oil and contaminants. This is best accomplished by scrubbing with scouring powder, then rinse the blank under running water and allow it to dry completely. Then dip the blank into lacquer thinner or board developer and stand it on edge to air dry.

When the board is dry, select a well-ventilated and dust-and-lint-free location in which to work, and lay it copper-side up on a couple of thicknesses of newspaper. Switch to safe lighting. (You can use a yellow bug lamp or indirect light from a 15-watt incandescent lamp no less than 8' away for safe-lighting conditions.) *Always use safe-lighting conditions during sensitizing and until a sensitized pc blank is developed.*

There are basically two types of aerosol photoresist sensitizers on the market. The one that permits you to use the film guide directly is called "positive" photoresist, such as GC Electronics' No. 22-230 (use only GC No. J4-630 devel-

oper). While you can use "negative" photoresist, you must first reverse the image on the film guide before you can expose the pc blank. (Note: Some magazines, including POPULAR ELECTRONICS, print etching-and-drilling guides in both the positive and negative formats. In the positive format, the copper trace pads and lines are black on white, while in the negative format the pads and lines are white-on-black. If you transfer the *negative* format on your film, use only negative resist and its appropriate developer; do NOT reverse the image. Transferring the positive format to film requires the use of positive photoresist or a reversal to use negative resist.)

Spray the resist onto the copper surface of the PC blank in continuous, even strokes from a distance of about 10" (25.4 cm) away. The sensitized blank can then be air-dried overnight while lying flat (switch off all lighting, including the safe light, during this period), or it can be force dried in a warm (about 150° F) oven for 20 to 30 minutes. Do not rush the forced drying by using higher heat; if you do, the resist will bake on and lose its photosensitive properties. Needless to say, when you transfer the wet blank to the oven, use safe lighting all the way.

Processing the Blank. The next step is to expose the sensitized blank either directly through your previously prepared film guide or through a separate reversed exposure mask (see above).

It is best to use a contact frame to keep the exposure mask in intimate contact with the PC blank during exposure. (Exposure frames are available from most pc supplies dealers.) Alternatively, you can sandwich the mask and blank together with two sheets of plate glass—*not plastic*—and hold them together with a clothes pin at each corner.

From this point on, until you are directed to do otherwise, use only safe-lighting conditions. Now, place your sensitized blank in the contact frame, copper side up. Place the exposure mask over the blank and close the contact frame.

To expose the blank, you can use any good source of strong ultraviolet radiation, such as direct sunlight, a photoflood lamp, fluorescent lamp, etc. It is a good idea to make up a few test pieces of sensitized blank to determine the proper exposure time for the UV source you decide to use. Times will vary from 2 to 15 minutes, depending on the intensity of the UV radiation from the source. In any event, do not place the source closer than 12" (30.5 cm) from the frame or you will run the risk of "under cutting" and lose the sharp quality of the pattern.

Once the blank is exposed, you can switch back to normal lighting. Open the contact frame, remove the exposure mask and set it aside, and immediately immerse the exposed blank in board developer solution, copper side up. (Note: do not use plastic trays for the developer because the solution will dissolve most plastics. Use only glass or metal trays.)

Agitate the developer gently over the blank with a slow tilting of the tray. After a short time, you will begin to see the circuit pattern taking form. Continue to agitate until the resist is completely removed from the areas to be etched and the copper shows through bright and shiny. Remove the blank from the developer and rinse it under slowly running water to stop the developing process. Do not touch the blank, except by its edges, at this time or attempt to dry it with a cloth or paper towel as the resist will be soft and easily damaged. You can let the blank air dry overnight or place it in a 150° F oven for 20 to 30 minutes to force-dry it and set the resist.

Pour the developer back into its container for later use. The developer can be used several times, until it becomes saturated. You will know the saturation point has been reached when the developer no longer removes the resist from an exposed pc blank.

To etch the board, you must use a plastic or glass tray. Never use a metal pan because the corrosive action of the etchant will eat it away. Place your pc blank in the tray and pour over it the etchant to a depth of ¼" to ½" (6.4 to 12.7 mm). Left alone, the etchant (ferric chloride or ammonium persulfate) will completely remove unwanted copper from a pc blank measuring up to 5" square in 10 to 30 minutes, depending on the quality of the etchant. You can speed up the etching process by rocking the tray to agitate the etchant, preheating the etchant (place the bottle in very hot water for 10 minutes or so, never in a pan and heating over a burner), and using a heat lamp over the tray.

Leave the pc blank in the etchant bath only long enough to remove all unwanted copper. If you leave it in the bath too long, the etchant will begin to undercut the copper traces. When etching is completed, use a pair of plastic tongs to remove the board from the tray and thoroughly rinse it under running water to stop the etching action.

Finishing the Board. The etched board can now be stripped with a lacquer-thinner-soaked cotton ball. Follow up with a vigorous scrubbing with scouring powder and steel wool and a thorough rinsing.

Trim the board to the required size and then drill all holes. Since most pc board drilling is with small-size drill bits (No. 58 through No. 64), it is best to use a Moto Tool or a battery-powered hand drill, such as the Radio Shack No. 64-2178 drill to obtain maximum control and minimize bit breakage. Of course, if you have a drill press, you can use it if it will accept very small size bits.

Last but not least, you can tin plate your finished board with plating solution, such as Dynachem No. EBS-250 (Dynachem Corp., 2632 Michelle Dr., Los Angeles, Cal). The tin plating seals the copper traces against the elements to resist corrosion and makes it easier to solder when wiring the board.

More Film Uses. The ability of the PCP-A film to retain its adhesive property after the transfer process can be put to good use. For example, you can copy the component-placement guides that generally accompany etching and drilling guides in published literature and stick them down right on the boards before mounting the components. (If the guides are a different size from the boards, as is frequently the case, you can stick them to an inside surface of the enclosure used for the projects.) Once you put down the guide, seal its edges to the board with clear lacquer, punch through all holes with an awl or other sharp instrument, and mount the components in their respective locations.

Another good use for the film is to transfer custom meter scales from the printed page to standard meter movements. Just place the film over the printed scale, burnish it down, and rubber cement it to the meter movement.

You can also transfer custom front-panel decals, make custom keytops, etc., as desired. The film is designed to pick up and transfer just about anything on a printed page, including colors. In all cases, once the film is down, seal its edges with clear lacquer. Also, if the decal is to be applied to a painted surface, it is best to place it down while the paint is still tacky.

Decals made with the transfer film are virtually scratch-proof. In addition, since the transfer images are on the adhesive side of the film, they cannot wear away when they are touched. ◇