

PUT YOUR BEST METER FACE FORWARD

Before and After. Can you determine which of the meter faces above is homemade and which is the manufacturer's original? The only tip-off is the trademark under the title.

***You can make professional-looking scales
with little effort and a small investment***

By DON LANCASTER

WANT to change the scale of that panel meter sitting in your junk box? Or how about that surplus bargain, an 0-50 d.c. microammeter . . . calibrated as 0-75 MR/HR/FT³ or something equally mysterious? Help stamp out sloppy meter faces! Get rid of wrong scales! You don't have to be an artist—all you need is \$2.15 and some time. You'll wind up with a meter face as good as the factory original, and to your exact specifications. And each duplicate face will cost just 15 cents.

What's the catch? You simply work five times life size. In this king-size world, mistakes are few and far between, and easily corrected. Any misalignment that might creep in gets reduced 5:1 in the final reproduction. You use all prefab letters and numerals—no ink and no mess. A nearby

photolithography firm then gives you the required reduction.

Measurements. The first step in making a new meter face is to carefully remove the *original*, and make all the measurements shown in Fig. 1. Multiply each one by five (except *c*, the scale angle), and record the results. Dimension *a* is the distance in inches between the pivot point or center and mounting screw; *b* the distance between the pivot point and title; *c* the scale angle in degrees; *d* the numeral radius in inches; *e* the lower division radius; *f* the middle division radius; and *g* the upper division radius.

Decide what the full-scale reading of the new meter scale will be, and choose a reasonable number of major divisions. Every major division, or every other one,

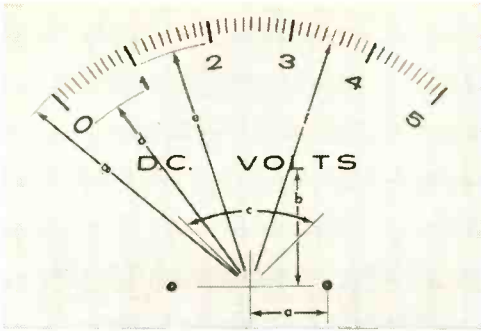
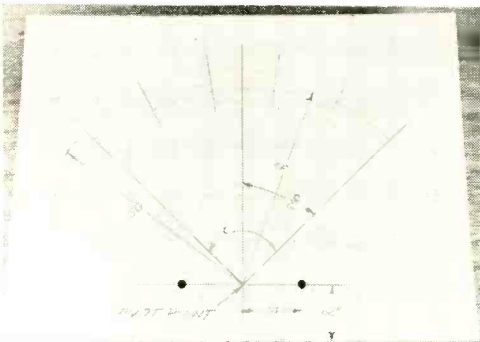


Fig. 1. Carefully measure dimensions "a" through "g" on original meter face and multiply by five. All measurements are in inches except the angle "c," which is measured in degrees with a protractor.

Fig. 2. Materials you need for making a new face include instant transfer letters, a beam compass, $\frac{3}{8}$ " printed circuit dots, $\frac{1}{8}$ "- and $\frac{1}{16}$ "-wide black printed circuit tape, and white illustration board.



Fig. 3. The new meter face is drawn lightly in pencil on a piece of illustration board working five times up. First draw vertical center line, then add a horizontal base line 2" up from bottom of board.



should have a number below it. Limit the numbered divisions to between five and eight to make the meter easy to read. The number of minor divisions should be around 50. Each minor division should correspond to some reasonable increment, say one, two, or five of the full-scale units.

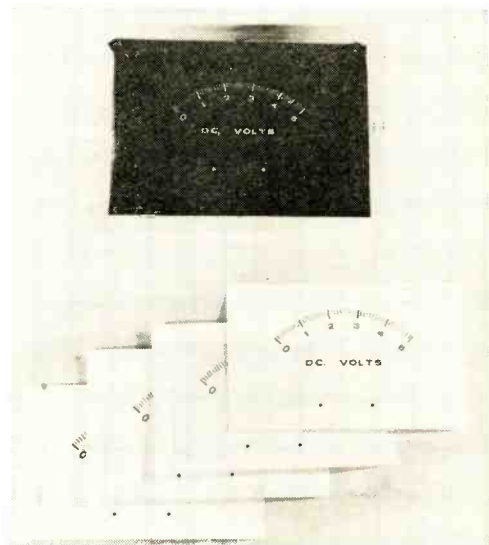
Materials and Layout. Go to the art store and buy a sheet of $\frac{1}{2}$ "-high instant transfer letters and numerals. You can also pick up a 15" x 20" sheet of white illustration board, although white cardboard or painted plywood will do. (For a meter face larger than $3\frac{1}{2}$ ", get a 20" x 30" illustration board.)

Lay out the new face as in Fig. 3, keeping all pencil lines very light so they can be easily erased. Start with a vertical center line and add a horizontal line 2" up from the bottom; use a square to insure that these two lines are perpendicular. The point where the two lines cross is the pivot point of the meter, and the basis of all the measurements detailed in Fig. 1.

Carefully and accurately locate the meter mounting holes with two $\frac{3}{8}$ "-diameter dots (black printed circuit dots are ideal for this). Using a beam compass (or a pencil and some string), swing the arcs corresponding to the tops and bottoms of the major divisions, the scale numerals, and the minor divisions. Using a large protractor, locate the zero and full-scale points.

Next, with dividers (or just a ruler), lay out all the major division marks on the
(Continued on page 108)

Fig. 4. High-contrast photolith negative (top) is a 5:1 reduction of art work. After negative is made, it is a simple matter to get photographic contact prints (below). Mount new face as described in text.



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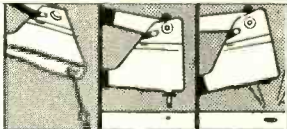
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Best Meter Face Forward

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top arc. Then lay out each minor division by dividing each major division into a suitable number of parts. Guide lines are drawn through each of these division points, aimed radially toward the meter pivot point. Add the actual scale markings using $\frac{1}{8}$ "-wide black printed circuit tape for the major divisions, and $\frac{1}{16}$ "-wide tape for the minor ones. Carefully cut the tape squarely across each arc with a razor blade or a sharp knife.

Transfer the scale numerals into place, being very careful about centering. Note that the center of a 20 is exactly between the "2" and "0," while the center of a 10 is just inside the "0." The center of each numeral group should exactly correspond to the axis of that major division. The title baseline is drawn parallel to the original baseline, and the title pressed into place. To center the title, add up all the space required for each letter and space, and then start the lettering *half* this distance away from the centerline.

Nonlinear Scales. Nonlinear scales require more thought. If the scale is clearly defined mathematically, the scale divisions may be determined by suitable algebra or geometry. An ohmmeter scale is started with a 0 and ends with infinity at full scale. The exact center of the scale is equal to R , the internal resistance of the ohmmeter; $2R$ is located one-third of the way up the scale; $3R$ is one-fourth, $4R$ is one-fifth of the way up the scale, etc. For a 1-10 log scale, lightly lay out a linear 0-10 scale. Divisions for each log point are then placed on the log of each desired number. This means the 1 goes at 0, the 2 at 3.01, the 3 at 4.77, etc. Decibel scales work in much the same manner.

Photolith Negatives. Most towns have at least one photolithographer who can make a 5:1 reduction of your art work in the form of a photographic negative. The cost of this service is about \$1.00. Don't go to an ordinary photographer, as it will cost much more, and the film used will not have nearly the contrast ratio that lithography film has (the negative is either perfectly transparent or else jet black). Take the negative to a photo store and have semigloss contact prints made; the cost of each print should be about 15 cents.

To mount a new meter face, cut the print to size, align it carefully, and cement it with rubber cement to the *back* of the original meter face. If you ever need the original again, you'll have it handy. **50**