HOW TO CUSTOM DESIGN
PLASTIC CASES FOR PROJECTS

BY JOHN HUFF

An auto-clock case is used to describe cutting, bending, joining, etc.

YOUR electronic projects deserve to be housed in attractive and reasonably priced "custom designed" cases. As a modern hobbyist, you don't have to make do with utility boxes that do not complement your projects. Instead, you can design your own inexpensive and attractive plastic cases, thanks to the ready availability of acrylic plastic sheets and tubes.

Acrylic plastic is easier to work with than wood—and with the same tools used in woodworking. It can be cut, filed, sanded, glued, and even bent to permanently conform to a desired shape. Available under such brand names as Plexiglas, Lucite, and Safe-t Vue, it comes in crystal clear, color-tinted transparent, translucent, and opaque sheets in 1/16", ⅛", and ¼" (1.6, 3.2, and 6.4 mm) thicknesses.

This article describes how to work with acrylic plastic to custom design and fabricate cases for your electronic projects. To illustrate the step-by-step procudure to use, we also include a digital Kar Klok project to assemble (see box). The Kar Klok is built around National Semiconductor's new MA1003 clock module, a printed circuit assembly containing a four-digit 0.3" (7.6-mm) high fluorescent display, time base, clock chip, and all necessary driving circuitry.

Working With Acrylic. Just about any brand of acrylic plastic can be used by the electronics hobbyist because all have the same basic physical properties. However, some types of acrylic are easier to work with than are others. Most acrylic pieces made by the cast method can be cemented together with a solvent that actually dissolves the mating surfaces and forms a monolithic weld joint in minutes. More difficult to work with are the acrylics made by a continuous conveyor-belt process, which require a thickened type of cement (airplane dope) that takes an hour or more to set. Needless to say, cast acrylic, such as Plexiglas G, is your best first choice. Ask for Plexiglas G (or similar cast-type acrylic) at your local hardware or hobby/craft store.

Acrylic sheets come with a special protective paper on both surfaces to prevent scratches. This paper makes an ex-

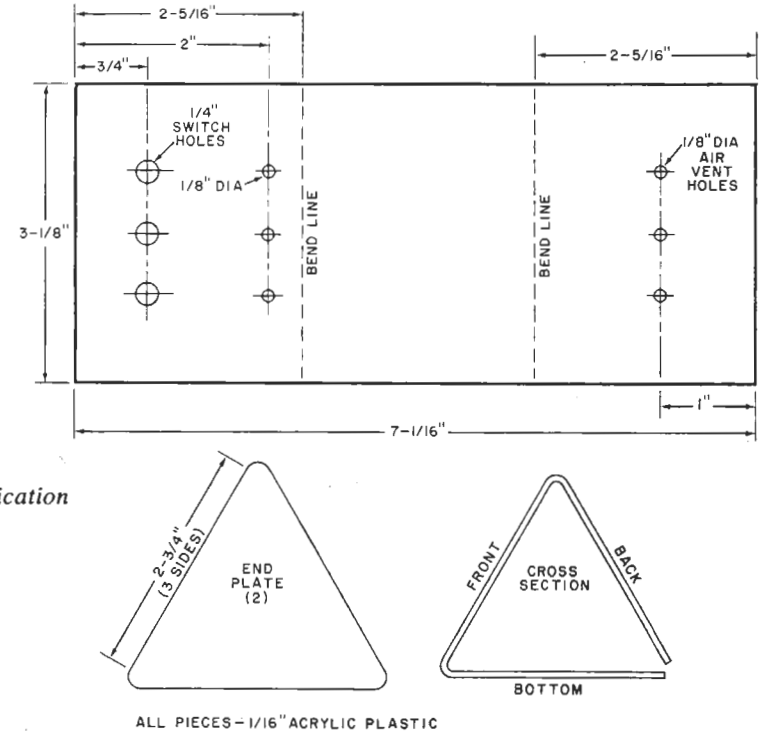


Fig. 1. Fabrication details for the Kar Klok case.

cellent surface for marking cutting lines and the centers of holes to be drilled.

The plastic can be cut with a saw or a special scribing tool. You can use a jigsaw, hacksaw, coping saw, or saber saw for cutting. However, scribing is easier if all you have to do is cut straight lines. Curved lines and circles still require cutting with a saw.

The fabrication details for the Kar Klok (see box) case are shown in Fig. 1. Mark all necessary lines and hole centers on the protective paper on the acrylic sheet.

The scribing tool, which sells for about $2.00 wherever the plastic is sold, looks like a miniature harpoon. In use, the sharp point of the tool is guided along the cut line with moderate downward pressure, using a straight edge, as shown in Fig. 2. Once the line is scribed, the plastic is placed over the edge of a table, scribed line up and in direct alignment with the edge of the table, and struck sharply on the side overhanging the table. The snapping action yields a very straight, clean edge. The snapped edges must then be lightly smoothed with fine sandpaper before being cemented. Edges that are not to be cemented can be buffed to a crystal sheen with a drill-mounted muslin wheel and a special buffing compound (about $3.00 for wheel and compound) or with fine steel wool and soap and water.

Cutting holes is done with ordinary drill bits, as shown in Fig. 3. It is important to note that during the drilling operation, the sheet of plastic must be firmly held or clamped to a piece of wood to prevent it from riding up the bit and cracking. Square and rectangular slots can be made by drilling a small hole and cutting with a coping saw.

Since the Kar Klok case pictured in the lead photo and dimensioned in Fig. 1 is triangular in shape, it is necessary to bend the acrylic plastic sheet to conform to this shape. The trick to making accurate bends is to use a bending jig and heat only those portions of the plastic that are to be bent. Do not heat the entire surface of the plastic.

Acrylic plastic bends at about 300° F (about 150° C). It bends best if the protective paper is peeled off before the heat is applied. You can heat the plastic along the bend line in several ways, the easiest of which is to use the specially made strip heater element that sells for about $8.00 from the same dealers who handle the plastic. This heater element requires a simple wood strip that keeps it about ¼" (6.4 mm) away from the plastic. Detailed instructions come with the element.

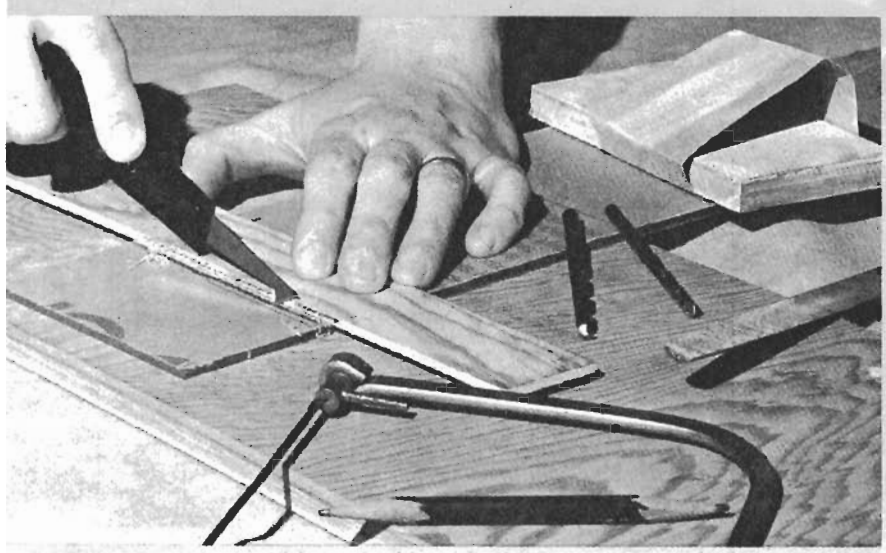


Fig. 2

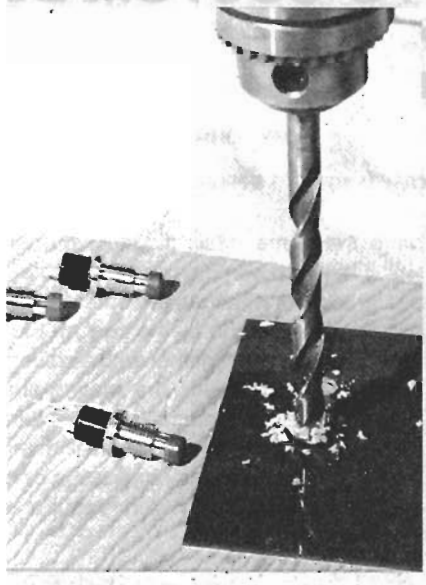


Fig. 3

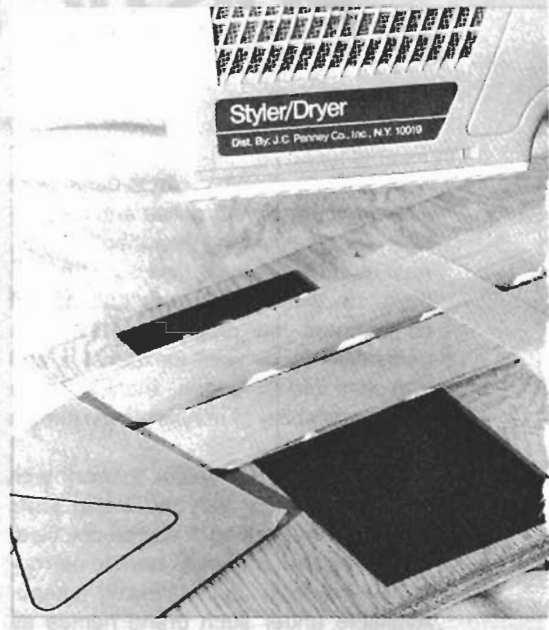


Fig. 4

Fig. 2. The acrylic scribing tool, obtainable wherever the plastic is sold, looks like a small harpoon and is used to scribe a line, following a straight edge, where the plastic is to be broken.
Fig. 3 Acrylic is easily drilled by holding the plastic firmly to a wooden base. Here, holes are being drilled for pushbutton switches. Square and rectangular slots can be made by drilling a hole and cutting with a coping saw.
Fig. 4. Acrylic bends at about 300° F. Here strips of wood faced with cloth for protection, are placed on both sides of bend mark and heat is applied by a 1000-watt hair dryer.
Fig. 5. Heat for bending can also be obtained from a 500-watt photoflood bulb.
Fig. 6. Once the plastic has been heated, it can be bent using a jig as shown here. Note that the actual crossection of the case has been drawn on the bottom of the jig. Jig corners are 4-inch nails.
Fig. 7. Acrylic solvent cement is easily applied and dries in minutes. Here one end of the clock case is being glued to the main frame.
Fig. 8. If preferred, an acrylic cylinder can be used for the body of the clock with square end pieces as shown here.

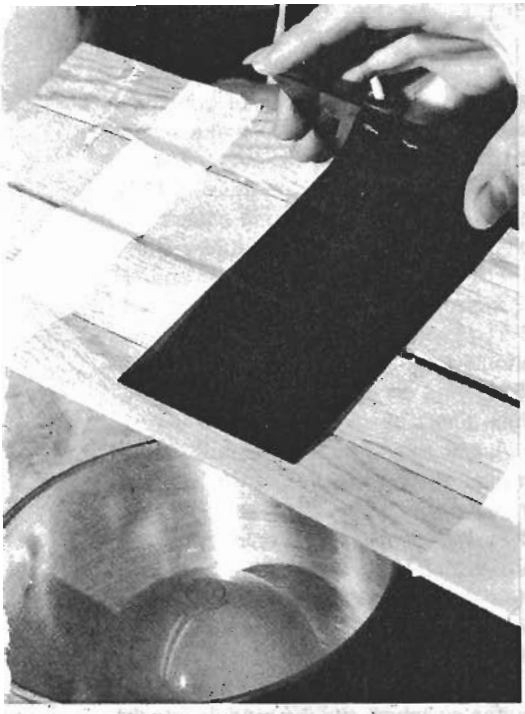
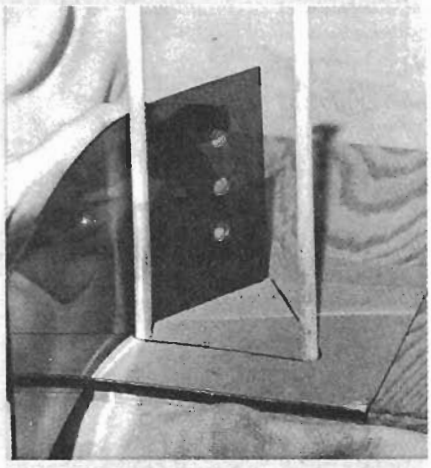


Fig. 5

Fig. 6



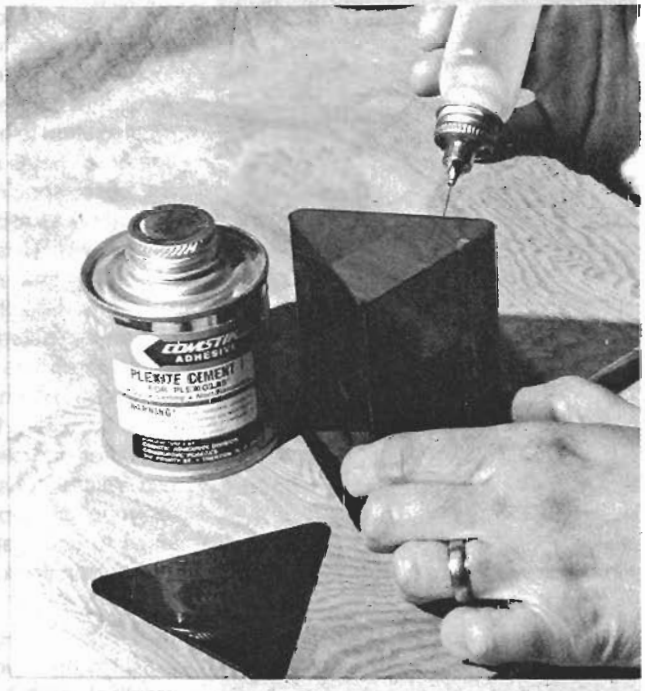
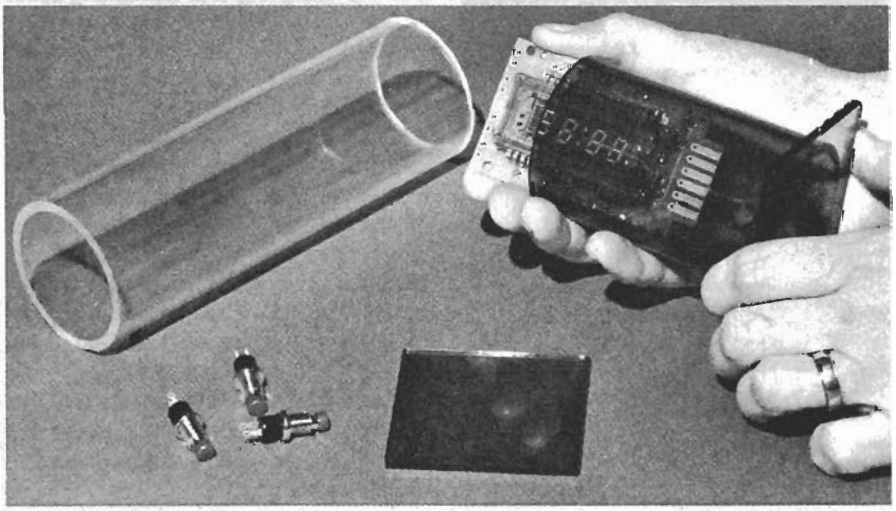


Fig. 7

Fig. 8



Another bending technique is to place the plastic sheet on a flat surface, place a ¼" thick strip of wood on both sides of the bend line (face the strips with soft cloth or cotton to prevent them from scratching the plastic), and use a blow-type hair dryer to heat along the line. Details are shown in Fig. 4. The hair dryer must be rated at a minimum of 1000 watts. How well it heats the plastic depends on the chemistry of the particular sheet of acrylic you use. Do not hold the dryer too close to the plastic or the air flow will be restricted and the heat fuse will blow.

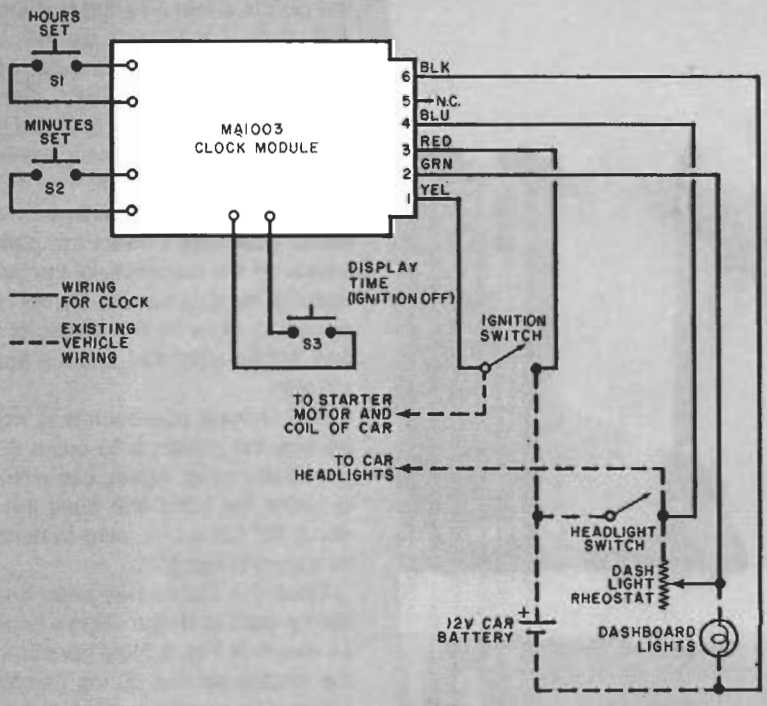
Still another approach that works for heating the plastic is to use a 500-watt photoflood lamp. Again, use wood strips to frame the bend line. Hold the plastic about 10" (25.4 cm) away from the lamp as shown in Fig. 5.

Once the plastic has been heated, it can be bent to shape using a bending jig as shown in Fig. 6. Note here that, to get the angles correct during bending, the actual-size crossection of the body of the clock case is drawn on the base of the jig. A 4" (10.2-cm) long nail is then driven into the indicated corners of the drawing and the plastic is aligned with the drawing and gently bent around the nails. When the bending operation is complete, there will be a small open slot where the ends of the plastic sheet do not quite meet. This slot is used for running the wires between the vehicle's electrical system and the clock module, without drilling holes.

Next, cut the triangular end pieces for the case from the same plastic sheet from which the case body was cut, using Fig. 1 as a guide. After sanding the edges smooth and buffing them, cement one side piece to the case body as shown in Fig. 7. Slip the clock module into the case. Then fasten down the pushbutton switches in their appropriate holes and route the electrical-system hookup wires through the slot in the body of the case. Cement the other side piece to the case.

Decide where in your vehicle you want to mount the Kar Klok and cement Velcro strips to the bottom edges of the case end pieces with the solvent cement and to the dashboard with a silicone adhesive. Finally, route the wires coming from the clock module into your vehicle's electrical system (see box for hook-up details). The use of Velcro strips to mount the clock allows you to remove the clock and put it out of sight to reduce the possibility of theft.

A Simpler Case. Perhaps you do not



ABOUT THE CLOCK

As shown in the schematic diagram, the Kar Klok is a very simple project to put together. It is built around National Semiconductor's new MA1003 clock module that requires the addition of only three momentary-action pushbutton switches and five wires to be connected into the vehicle's electrical system.

With the Kar Klok wired as shown, the display will be on continuously as long as the vehicle in which it is installed is running. The clock remains powered even with the ignition turned off, but power is removed from the display to conserve battery power. However, even with the ignition off, the time can be displayed on demand simply by pressing switch *S3*.

Switches *S1* and *S2* provide the means for setting the hours and minutes for the correct time. These switches are activated only when the ignition is on. With the ignition turned off, the time-setting switches are disabled.

Basically, only three connections need be made from the vehicle's electrical system to the clock module. Constant dc power from the positive battery terminal, with the ignition on and off, is made to pad 3 on the module, while the negative side of the battery, or chassis ground, goes to pad 6. The ignition-controlled display on/off connection goes from the other side of the ignition switch to pad 1.

Optionally, you can add brightness control to the display by connecting a lead from the headlight switch to pad 4 on the module. Now, when the headlights are turned on, the brightness of the display is reduced by two thirds, which reduces glare under nighttime driving conditions. Additionally, if your car is equipped with a dashboard-light level control (rheostat), a final wire from the wiper lug of the control to pad 2 on the module allows you to control the brightness of the display from full to about one-third brightness. No connections need be made from the vehicle's electrical system to pads 2 and 4 on the module for the clock to operate.

The green vacuum fluorescent display consists of four 0.3" (7.6-mm) digits with a colon between the minutes and hours. The green display allows the use of blue, green, or yellow filters.

The clock module itself is protected against automotive voltage transients and reversals. It is designed to keep time with supply potentials of nominally 12 volts down to approximately 9 volts dc. The clock draws 5 mA when operated with the vehicle's ignition off).

For wiring between the clock module and the vehicle's electrical system, it is best to use 20-gauge stranded hookup wire. You can use 22- or 24-gauge stranded hookup wire between the switches and module. (A kit of parts, including the MA-1003 clock module, three pushbutton switches, and triangular case described elsewhere in this article, is available for $26.95 from: Digi-Key, Box 677, Thief River Falls, MN 56701. Please ask for the Kar Klok kit. Minnesota residents, please add state sales tax.)

wish to go to the bother of bending a sheet of acrylic plastic to make a case for your Kar Klok. In this event, you can substitute an acrylic cylinder for the body of the clock and use square end pieces (see Fig. 8). Select tubing with a 1¾" (44.5-mm) inner diameter and ⅛" (3.2-mm) wall thickness and cut it to 3⅛" (8 cm) in length. The end pieces should form squares that measure 2¼" (57.2 mm) on each side from ⅛" or ¼" thick acrylic plastic sheet.

Acrylic tubing for craft work is usually crystal clear. However, if you prefer a transparent color tint, solvent-based dyes that simply brush onto the plastic are available. You can use the crystal clear tubing as is with crystal clear or color tinted end pieces to better show off the Kar Klok's "innards."

To locate the holes for the three pushbutton switches, slip the module into the acrylic tube and note and mark where the holes should be drilled. When you drill the holes for the switches, drill a fourth hole of the same diameter for the wires that connect to the vehicle's electrical system to exit the case. Then drill a line of ⅛" holes at the top and bottom of the case, spacing them about ⅜" (9.5 cm) apart to allow air to cool the clock module when it is installed in the case.

Cement one end piece to the cylindrical body. Slip the clock assembly into the case, fasten down the switches in their appropriate locations, and route the electrical-system hookup wires through the hole drilled for them. Then cement the other end piece to the case. Finally, use Velcro strips to mount the Kar Klok to your dashboard and connect the wires to your car's electrical system as shown in the box.

In Closing. The world of acrylic plastic provides the electronics hobbyist with a practical and inexpensive means for custom designing and fabricating cases for his projects. In this article, we have detailed the basic techniques for working with acrylic plastics. With a little practice and by exercising some imagination, you can be making custom cases for all your projects in short order. For example, you might substitute wood for the end panels of your cases or use a wood base with a brushed aluminum pedestal on which to mount an acrylic-cased project. The combinations of materials and styles are almost limitless.

The Kar Klok project presented here is a practical automotive accessory that is particularly suitable for exercising your imagination in designing custom plastic cases. ◇