BUILD A LOW-COST STEREO COMPONENT SWITCHBOX

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Avoid the headaches of constant rewiring when you want to change component arrangement

IF YOU'RE an audio enthusiast, you probably delight in adding external equipment to your component system. However, you'll want to avoid the trauma of rewiring the system each time a new configuration is needed. A low-cost solution to this problem, the "Stereo Switchbox" is presented here.

This device provides a simple way to deal with the interconnection problem that arises when your system contains a number of "extras" such as a second tape deck and one or more signal processors (equalizer, noise-reduction unit, dynamic-range enhancer, tick-and-pop reducer, etc.).

The switchbox allows complete flexibility for connecting the output of any device to the input of one or more other devices. For example, if you have two tape decks, there is often a need to copy from tape 1 to tape 2, or from tape 2 to 1. Or perhaps, you would like to record from disc or tuner to tape 1 or tape 2, or both. Now, add a signal processor to the system and you may spend more time behind your stereo with the cables than enjoying the music.

The switchbox is a set of switches arranged in a matrix pattern. Once it is connected to your system you can easily rearrange the inputs and outputs of external equipment with a flip of a few switches. In short, the switchbox provides you with complete versatility as well as simple operation.

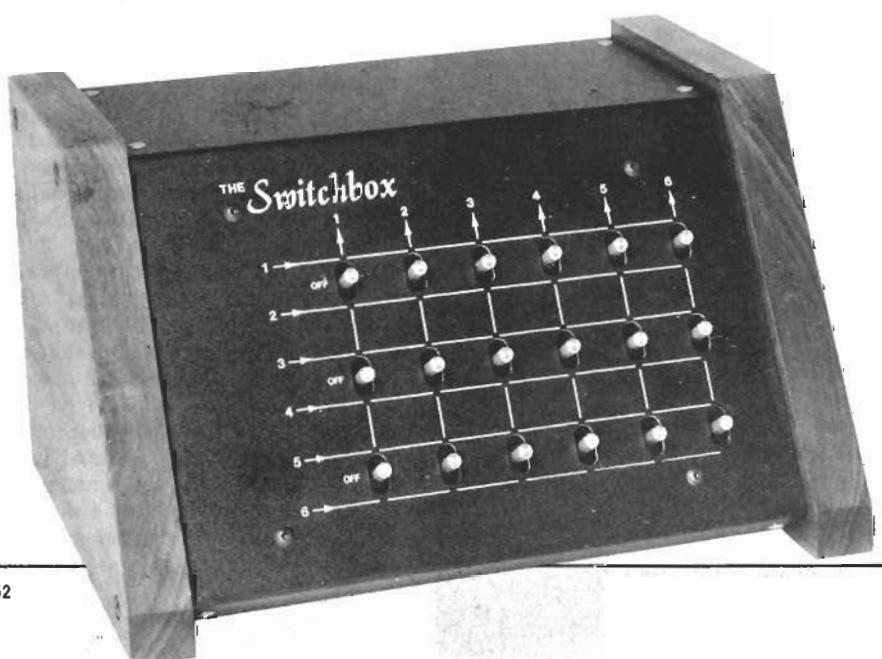
Circuit Operation. To see what a switch matrix can do for you, let's look at what it is and how it works. Figure 1 is the schematic diagram of a matrix switcher with X inputs and Y outputs. Notice that each input and output is actually a stereo left and right pair and each of the input pairs can be connected to any output pair by flipping a double-pole, single-throw (dpst) switch. For simplicity, the switch matrix can be represented symbolically as a rectangular pattern of signal paths with dots indicating the locations where switches have been closed to make a connection.

In Fig. 2, such a representation is used to show a phono preamp feeding a signal processor by the connection, labeled A, at input 5 and output 4. We will abbreviate this as 5,4. Then, the processed signal feeds both tape recorders through the connections at B(4,1) and C(4,2). For equalized playback, tape 2 feeds the equalizer with the connection at D(2,3) and the output of the equalizer drives the power amplifier via the connection at E(3,5). If we wish to hear the output of tape 1, simply switch off the connection at D(2,3) and complete the connection at F(1,3). Simultaneously, the tuner can be serving another room through connection G(6,6). Thus, once your system is connected to the switchbox there is no need to move the cables again. A few flips of the appropriate switches are all that is required to reconnect the system to any desired configuration.

The Design. In choosing a specific design for your switchbox there are some details to be decided. For example, how many inputs and outputs are needed? The larger the matrix, the greater the cost for switches and connectors. Since the cost of switches is proportional to the product of the number of rows and columns, it makes sense to choose a reasonable size. Except for ambitiously large systems, six rows and six columns are usually sufficient.

A standard 6×6 matrix requires 36 switches. Since good switches are expensive, the switches are the most costly item of the project. However, it wouldn't pay to use less than high-quality switches (an intermittent contact would be intolerable). It is recommended that the switches have silver- or gold-plated contacts that engage with a wiping action.

To save money on switches, don't



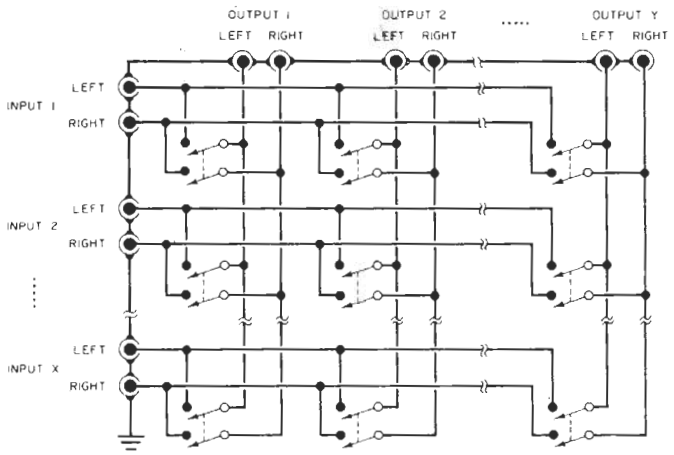


Fig. 1. Schematic diagram of a matrix switcher with X inputs and Y outputs. Each input and each output is a stereo pair.

sacrifice quality, rather look for a way to use fewer switches. First, consider that the total flexibility of a full matrix is not really needed or even useful. With a matrix that is fully populated with switches, a single output can be connected to more than one input; and, conversely, multiple outputs can be connected to a single input. However, summing multiple outputs to a single input is a job for a mixing console, not a switchbox. If a mixer is what you want, then an active circuit with controls to set the relative level of the various channels would be more appropriate. Since a switchbox is required and not a studio mixing console, a satisfactory design need not allow for channels to be mixed. This relaxation of requirements allows the use of half as many switches because, as shown in Fig. 3, a double-pole, triple-throw (dp3t) switch can serve two input stereo pairs. The up position connects one input pair, the down position connects the other pair and the center position is used as an off position in case neither input is wanted. This in no way reduces the usefulness of the switchbox, and it saves half the cost of switches and the time to mount them on the printed circuit board. (A 6×6 matrix needs only 18 dp3t switches.)

Construction. The printed circuit board layout is simple if a double-sided board is used. Certainly double-sided boards are more expensive, but the sheer number of jumpers that would be required for a single-sided design makes the choice very easy: use double-sided boards and save the hassle of loading 36 jumpers. Full-size foil patterns are shown in Figures 4 and 5.

If you make your own pc board, it is absolutely essential that it have plated-through holes to provide connections from the top to the bottom of the board. This is necessary because there is no room to get a soldering iron to the pads under the switches. To assemble the parts on the board, simply insert the switches from the component side of the board as shown in the top side loading diagram of Fig. 6. With all of the handles in the center position, turn the loaded pc board over onto a flat surface (a piece of cardboard may be handy here to avoid losing the switches). Before soldering, be absolutely sure the switches are on the proper side of the board.

Solder two diagonal corner pins on each switch first. Check to make sure that each switch is properly seated against the board. Otherwise, the pc board will not fit properly behind the front panel assembly. If any of the switches are improperly seated, reheat the two soldered legs while pushing the switch firmly into place. When you are sure that all the switches are properly installed, solder the rest of the pins.

The phono connectors are inserted into the board from the bottom at the locations shown in Fig. 7, and soldered on the top side. The board

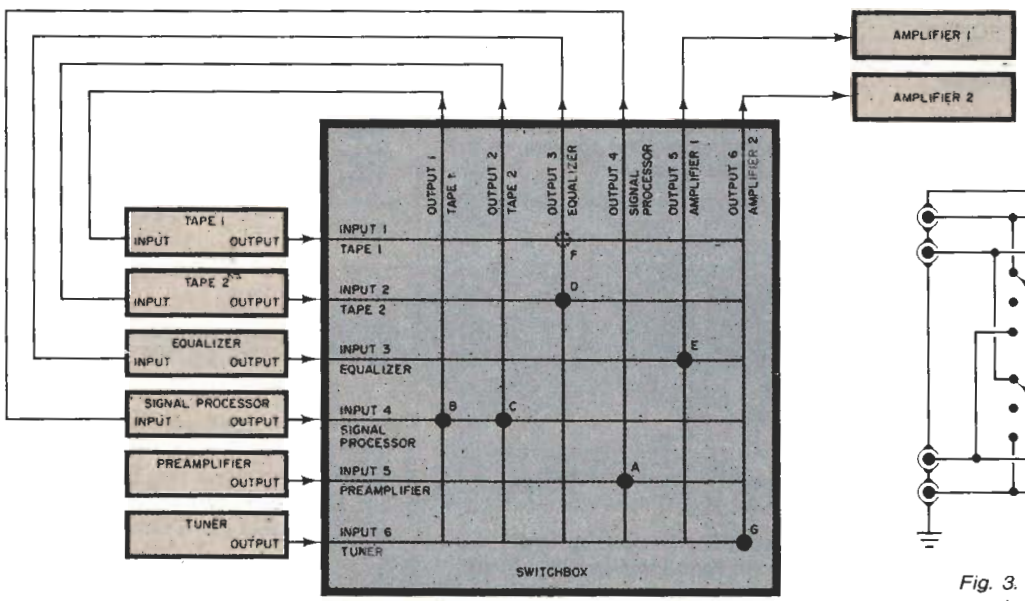


Fig. 2. Inputs and outputs of external equipment are shown with a simplified representation of the matrix.

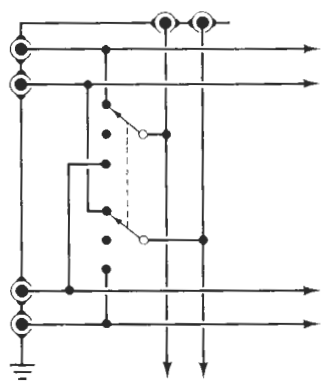
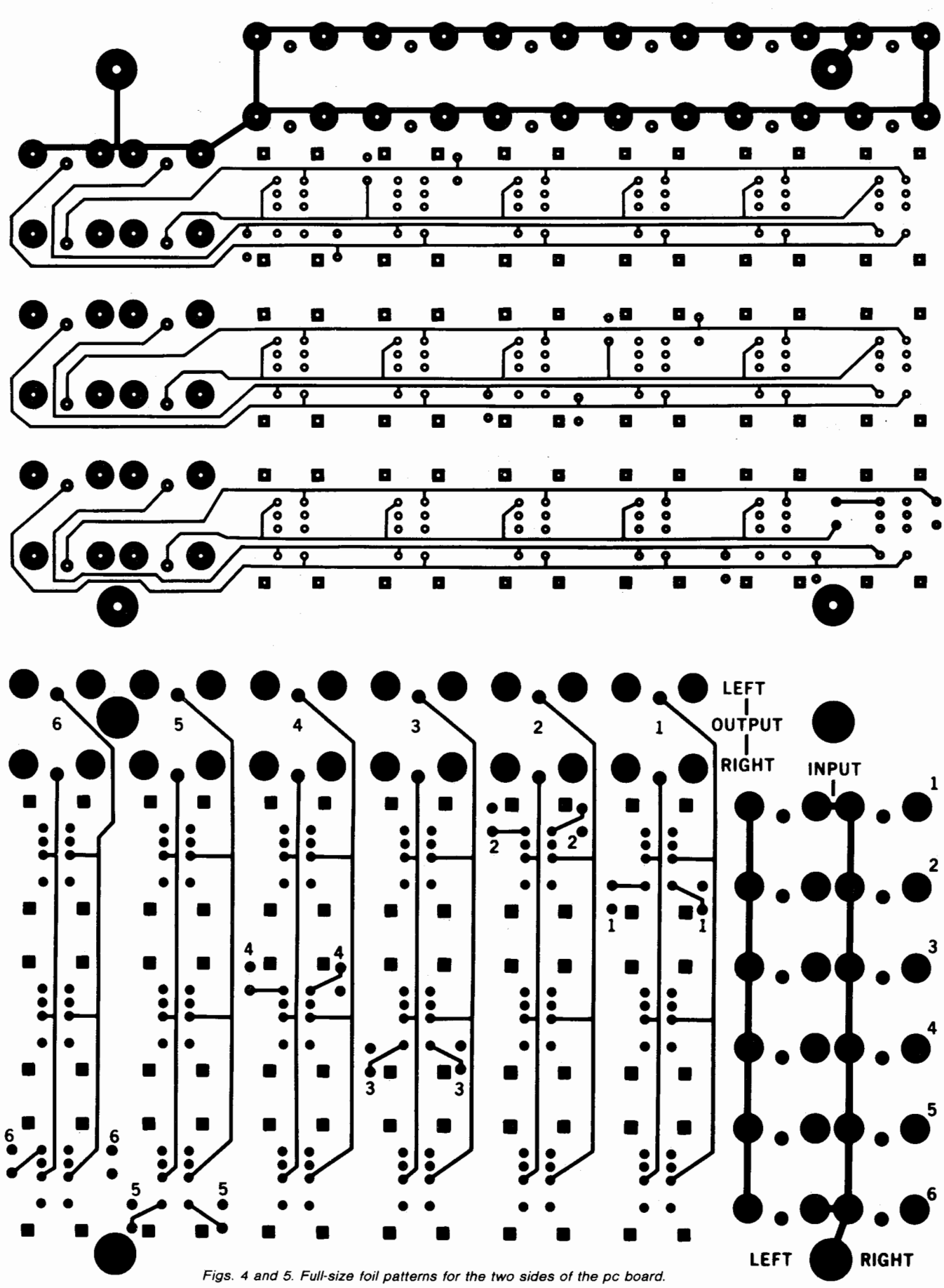


Fig. 3. A dp3t switch can serve two input stereo pairs.



Figs. 4 and 5. Full-size foil patterns for the two sides of the pc board.

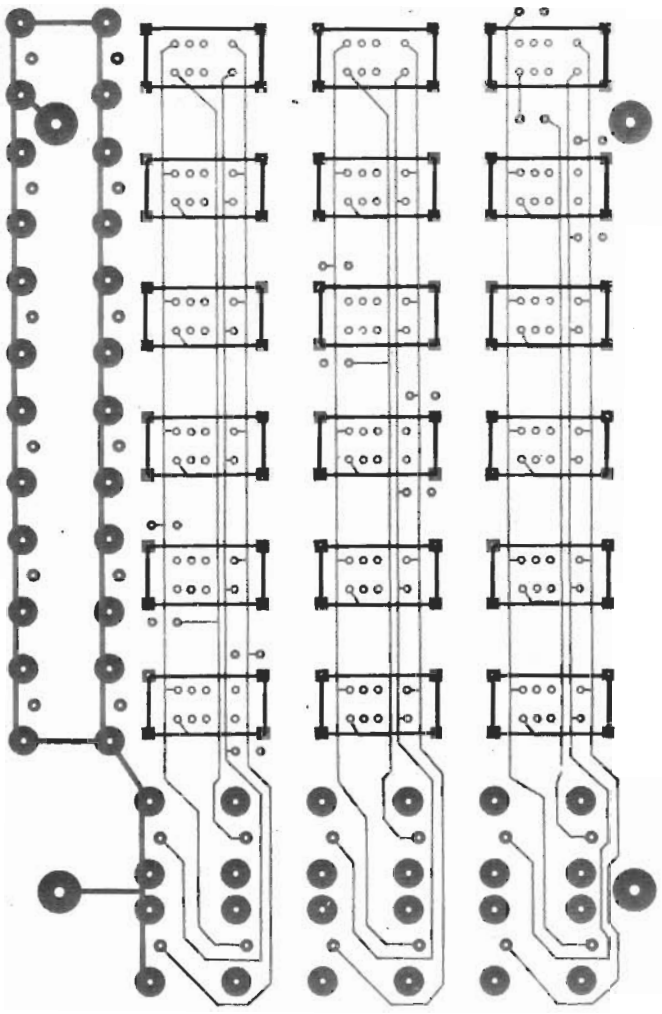


Fig. 6 Top side loading diagram shows switches inserted from the component side of the pc board.

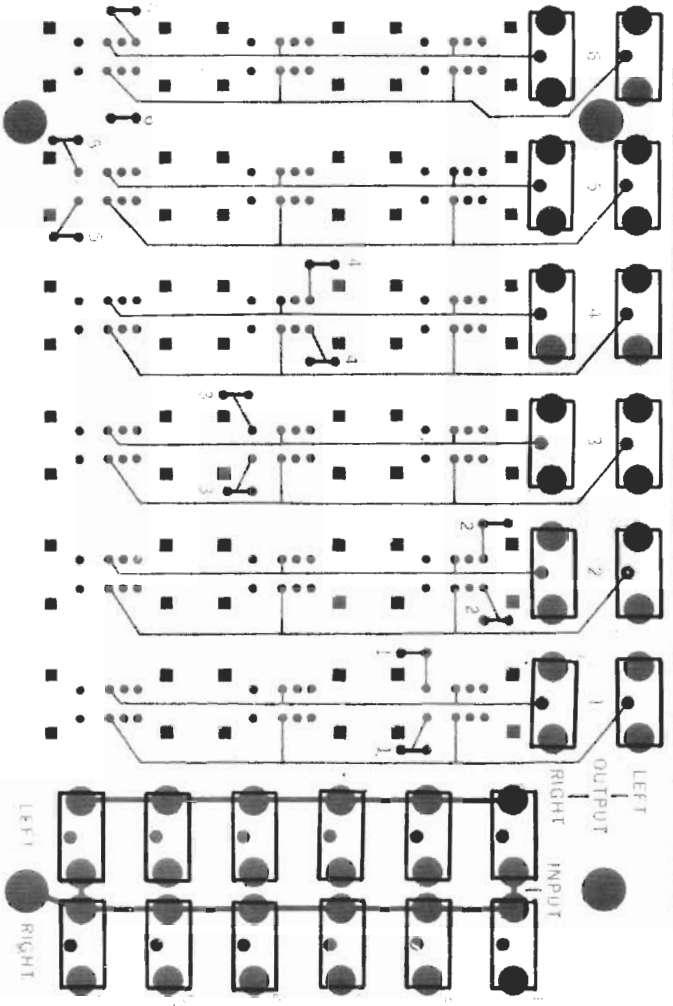


Fig. 7. Phono connectors are inserted into the board from the bottom at the locations shown above.

attaches to the front panel with four 5/8-inch standoffs that are pressed into the sheet-metal front panel. The circuit board is attached to the standoffs with 1/4-inch, 6-32 screws. The front panel and switchboard assembly are now attached to the wooden end panels with three 3/4-inch, 6-32 screws on each side, with the screw heads resting in countersunk recesses.

At this point the box is complete. Notice, however, that not all the holes in the pc board are filled. These holes are for some optional jumpers. But first let's try it out and get back to the jumpers in a moment.

Use. As a suggestion to get started, hook up your system as shown in Fig. 8. It is recommended that you either label each channel on the front panel or use a card patterned after Fig. 8 to remind you which components are connected to each switchbox channel. This is so you can keep track of which components are being hooked together. If you don't have all the equipment shown, don't worry, just adapt the general plan to what you have. Notice that in Fig. 8, the tape loop output from the receiver is connected to row 1 of the switchbox (labeled input 1 on the front panel and on the pc board). The tape loop input of the receiver is connected to vertical column 1, labeled output 1. In a similar manner the equalizer output is hooked to input 2, and the equalizer input is hooked to output 2.

There is a difference in how we wish to treat these two devices. It will do no harm to connect the receiver's tape loop input and output together (this is what happens inside the receiver when the tape monitor switch is disengaged). But it makes little sense to hook the output of the equalizer to its own input; in fact to do so will probably start a fierce speaker-blowing oscillation as the audio signals run around in circles through the equalizer. It is also not a recommended practice to connect the tape deck output to its input. If it is a two-head deck, or a three-head deck with the monitor switch in the source position, the results are much the same as with the equalizer. If the monitor switch is in the tape position, an echo is the result. The echo will grow or decay depending on how the gains are set. Therefore, with a receiver it is acceptable to connect between the tape monitor output and input. Also, in situations like that shown in Fig. 2 where a tuner and power amplifier use the corresponding input and output, it is necessary to be able to make this connection. But for *most* components, a connection to itself may be hazardous to the health of your amplifier, speakers and ears.

This brings us to **Rule Number 1** : *Do not connect an output to the input of the same device* without at the very least stopping to think about what you are doing. To avoid the need to stop and think each time a switch is

thrown, connections on the diagonal of the matrix, points (1,1), (2,2), etc., are omitted from the pc board. If both the input and the output of a device are always assigned to the same input and output number on the switchbox, for example the tape machines in Fig. 8, then rule 1 may be safely ignored. For occasions when a connection is needed, holes are provided on the pc board so that adding a pair of jumpers will enable diagonal connections. If you want to protect against forgetfulness or a child playing with all the pretty switches, leave the jumpers out. For those places where you need to connect a row to the corresponding column, add the two jumpers for the row and column you intend to use. The jumper locations are numbered on the pc board and shown in Fig. 7.

Another word of caution is appropriate here. **Rule Number 2**: *Do not engage two switches in the same column at the same time.* Even with jumpers installed only in the right places (or not at all), it is possible to have a feedback problem. In Fig. 8, a switching arrangement is shown where two devices try to feed the same input at A (2,3) and B (4,3), while tape 2 feeds another input at C (4,2). This enables a feedback path to occur even though there are no diagonal connections. The result is the same as if a phantom connection existed at D (2,2). To avoid this, remember to turn any switch in a column off before another switch in the same column is engaged.

Now that your switchbox is properly installed in your system, complete system flexibility is available at your fingertips. If you need to reconfigure your system, just flip the appropriate switches and your system is reconfigured. For example, if your system is normally set up with the equalizer before the power amplifier for speaker and/or room equalization, it is now easy to place it into any other signal path in the system. This is extremely useful when a tape needs equalization. Or what about the tapes that were made before you bought your new signal processor? Just switch it into the tape playback path. If you want to monitor another component while recording a tape or record, just follow the example of Fig. 2. And if you are one that sets up your own bias and equalization on your tape deck, simply find an unused input and inject the signal through your switchbox. These are just a few of the 279,935 useful combinations available (there are 387,420,489 possible combinations but most are not useful because they include feeding two sources into one input). The flexibility of a switchbox in your system is only limited by your own imagination. Now that you have quit fiddling around behind your system, you can start enjoying the music. ◇

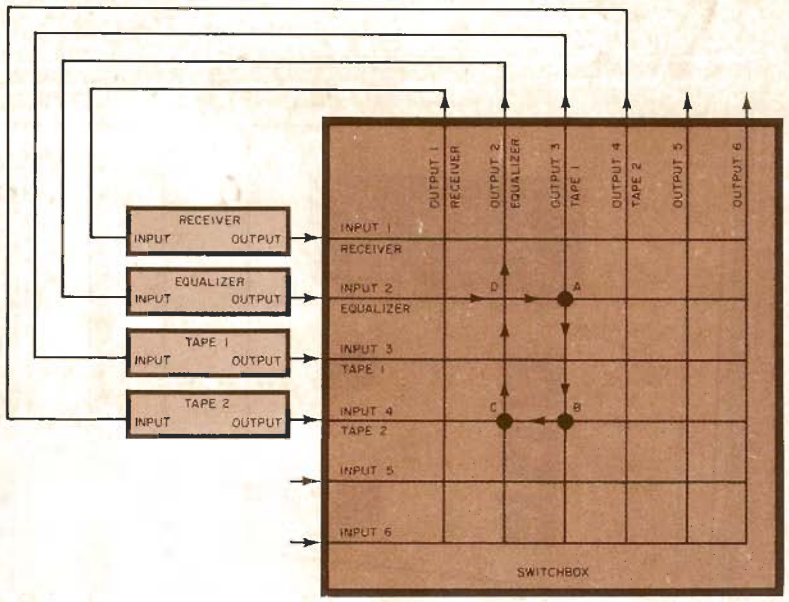
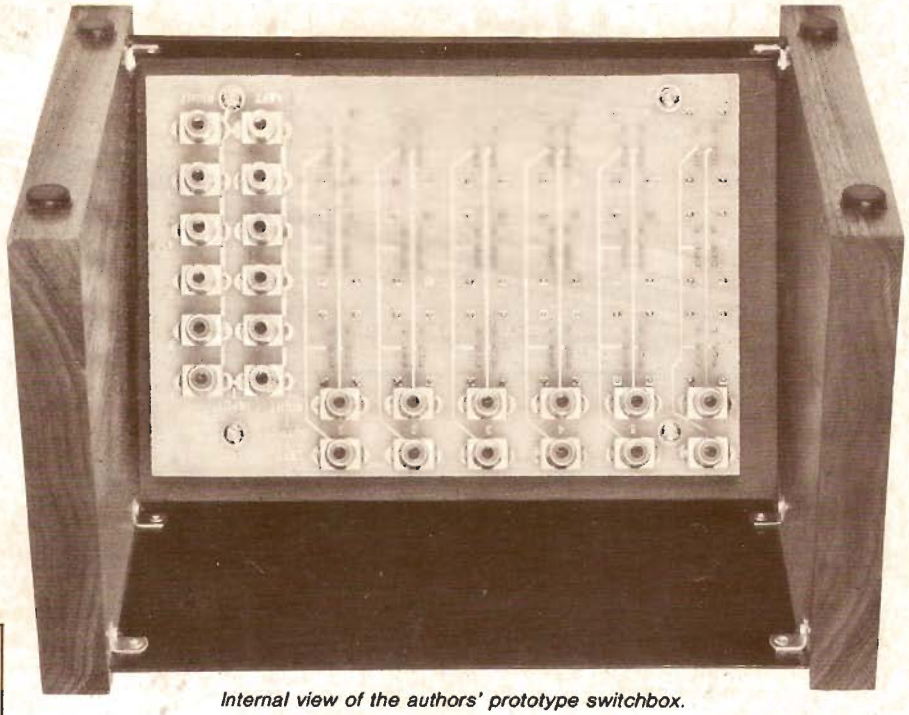


Fig. 8. Typical system hookup of four components. However, the switching arrangement would create undesirable feedback.



Internal view of the authors' prototype switchbox.

KIT AVAILABILITY

The following are available from Sound Technics, 2115 Derby Hill Dr., Loveland, CO 80537: Complete kit of parts including 18 dp3t switches (UID part #MG-023-12-6-P-2W), 24 pc-mount RCA phono jacks, pc board, epoxy-finished front panel, unfinished walnut end panels, feet, and screws, for $95.00. Also available separately is a pc board for $24.50 (not separately available after 9/30/82); six-foot stereo-connector cables with dual-phono connectors on each end at $2.50 each or six for $13.00. Add $3.00 for shipping and handling. Colorado residents, add 3% sales tax.