

## EXTENDING THE GAME I/O SOCKET

Have you ever seen an Apple with two joysticks plugged in? Why not? It's a capability of the Apple. The answer is that when a standard joystick or paddle set is plugged in to the game I/O socket, the pins for one pushbutton input, two paddle inputs, four annunciator outputs, and the C040 STROBE become inaccessible there. It would do you no good to plug another joystick into the extension jack in the back, because all the standard joysticks support only Paddle 0 and Paddle 1. Your two joysticks would just interfere with each other.

Now I don't mean to imply that the extension jack gives no added capabilities. To the contrary, when a joystick or paddle set is installed in the extension jack all of the game I/O signal lines are still accessible at the game I/O socket. Additionally, even when a plug is installed in the extension jack, it is fairly easy to attach a spring loaded clip to any of the signal lines on the back of the extension jack. But the fact remains, if you want to switch between paddle and joystick or use two joysticks connected simultaneously to the four Apple timers, you need to use some sort of extension device which supports the capability.

Several game I/O extenders are commercially available for the Apple. This application note shows two extension circuits you can build yourself. One is simple, allowing you to plug a joystick or paddle set into the game I/O socket and still have a 16-pin DIP socket available with the remaining I/O pins accessible. The other is more complex, allowing you to have two paddle sets and two joysticks simultaneously connected with switched control between paddles or joysticks. This **game I/O extender** also contains an extension socket for connection to other devices.

Let's look at the simpler circuit first, pictured in the photos of Figure 7.10. This is a paddle set with an extension socket soldered on top of its 16-pin plug. Pins 6 and 10 are removed from the upper socket because these are the PDL 0 and PDL 1 inputs which are being used by the paddle set. PBO and PB1 are fed to the extension socket even though they are used by the paddle sets. Switch inputs can be paralleled, so one of several switches can operate a given pushbutton input. Potentiometers, however, cannot be connected simultaneously to a timer input. They would interfere with each other.

The benefit of the extension socket is that with the extended paddle set installed in the game I/O socket, the other signal lines are still accessible there. But the modification must be performed carefully to ensure mechanical strength. The first step is to buy a high quality 16-pin DIP socket. You will also need to buy a 16-pin plug and cover like the one used on Apple paddle sets designed for the game I/O socket. We assume that the plug to be modified on the paddle set or joystick is so thoroughly glued and sealed that you cannot hope to solder a socket to it. Here is the procedure to mount the extension socket on your paddle set:

1. Separate the cover from the plug on your paddle set. If you think you can solder a socket to this mess, proceed to step 8.
2. If you cannot salvage the old plug, remove the two resistors from it (if they are there), and cut the wires from it which lead to the paddles.
3. Strip one inch of the outer insulation from the wire bundle going to each paddle. This exposes three insulated wires in each bundle. If Apple is consistent, the green wire goes to +5V, the white

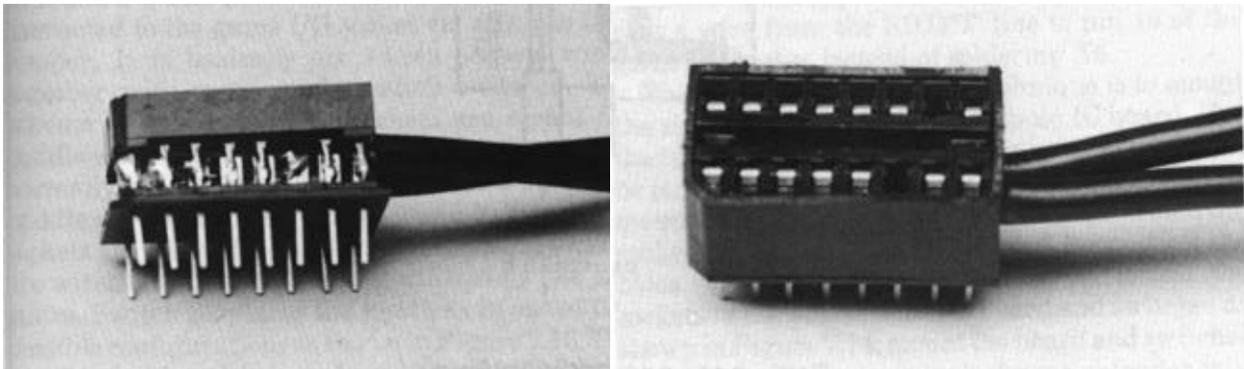
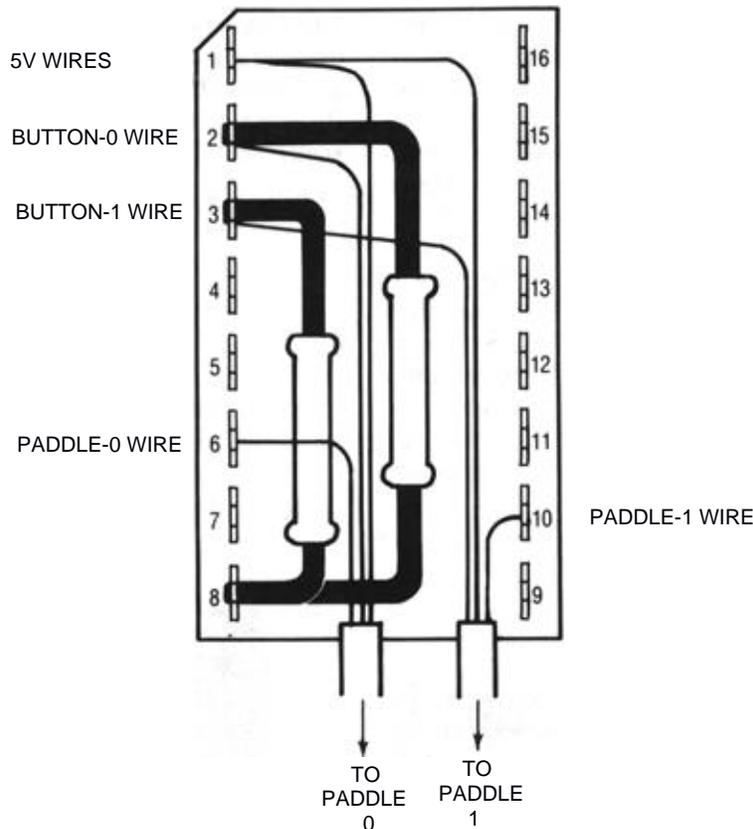
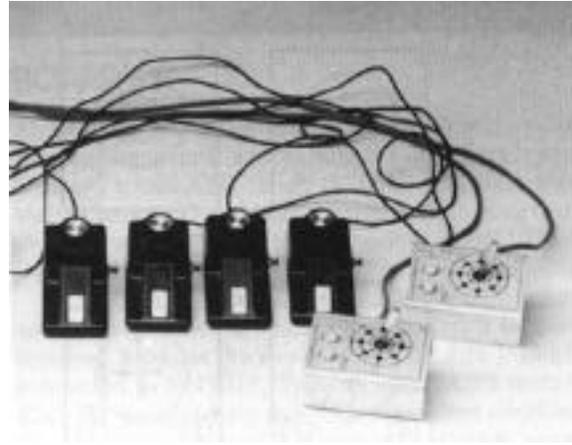
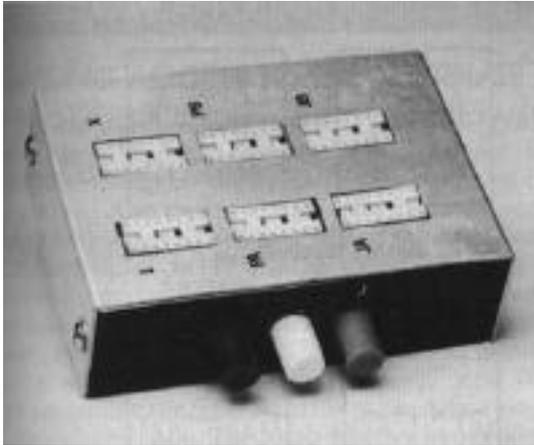


Figure 7.10 A Modified Game I/O Plug.

- wire is the pushbutton wire, and the black wire is the paddle wire. This should be verified with an ohmmeter. With the ohmmeter, find the two wires connected to the pot. The resistance across them will vary between 0 and 150,000 ohms as the paddle is turned. The wire left over is the pushbutton wire. Now find which wire is shorted to the pushbutton wire when the pushbutton is pressed. This is the 5 Volt wire, and the other wire is the paddle wire.
4. Some paddle sets have a fourth wire going from the plug to the paddles. This wire is ground and should be connected to pin 8 of the plug. Presence of the ground wire indicates that pushbutton pull-down resistors are mounted in the paddles instead of the plug. The ground wire can be identified because there will be 200—1000 ohms resistance between it and the pushbutton wire.
  5. Cut the paddle wires for each paddle back 1/2 inch. Leave the other four wires at their present length. Strip 1/8 inch of insulation off the end of all six wires.
  6. Figure 7.11 shows the wiring of the plug. Install the two resistors first (if they were there), making sure the leads do not extend very far beyond the solder posts. If you are certain that the paddle set will be used only in an Apple IIe and never in an Apple II, do not install the resistors. If there are no resistors and you wish to use the paddle set in an Apple II, install 560 ohm resistors as shown in Figure 7.11. Make certain the resistors are not in the paddle body before doing this (see step 4).
  7. Connect the wires and solder. Use a low wattage iron and do not overheat the pins or the plastic base will be damaged. Insert the plug into a spare socket while soldering to keep the pins aligned if the plastic becomes soft from overheating.
  8. If necessary, sand down the corner of your socket so the plug cover will slip over it. Pull pins 6 and 10 out of the socket or cut them off if the plastic is molded around the pins.
  9. Fit the socket over the paddle set plug and hold this assembly lightly together in a soft jawed



**Figure 7.11 Wiring a paddle set plug**



**Figure 7.12 This Game I/O Extender can Support Two Sets of Paddles and Two Joysticks Simultaneously**

wise. All wires should be dressed inside the pins of the socket and the socket pins should be outside of the plug pins. Solder the 14 pins of the socket to the appropriate pins on the plug.

10. Check out the operation of your paddle set and extension socket.
11. If you desire, fill the area between the plug and expansion socket with epoxy or a sealant like RTV. This will give your assembly more mechanical strength. Do not seal the assembly until you are certain it works correctly.
12. Cut the top off the plug cover so the topless plug cover is 5/16 inches high. Cut out a small notch for the wires to pass through. Slip the cover over your assembly and glue it on with a small amount of epoxy cement. Remember that you may want to get back in there some day.

Figures 7.12 and 7.14 are photos and a schematic diagram of the more ambitious **game I/O extender**. This unit is meant to sit outside of the computer case, connected to the game I/O socket via a 16-pin DIP jumper. It is basically six 16-pin sockets wired together with some configuration switches. The scheme is this: two of the sockets are meant for paddle sets. One of the paddle sockets is connected normally but the other is connected so a standard paddle set will control Timers 2 and 3. Two of the sockets are meant for joysticks. The joystick sockets are wired so all four timers are utilized by two joysticks. Switch S2 places the joysticks in one of two possible configurations as shown in Figure 7.13. The paddles and joysticks may be connected at the same time. Switch S1 enables either the joystick or the paddles.

A third switch is necessary if you wish to use the extender with an Apple II with the SHIFT key mod installed. The SHIFT key mod works by connecting the SHIFT key to PB2, but neither the SHIFT key mod nor a pulled down pushbutton will work if both are connected to PB2 at the same time. The game I/O extender allows you to have both installed by selecting between them via S3. The normal SHIFT key mod is to connect one of the SHIFT keys to pin 4 of the game I/O socket. With the game I/O extender, the SHIFT key should be connected to pin 16 (normally not connected) of the game I/O socket. Then switch S3 can select between pin 16 and a paddle or joystick pushbutton for routing to the PB2 input.

In the Apple lie, the shift key mod is available via the X6 motherboard jumper. When this jumper is made, a pulled down pushbutton cannot be connected to PB2 for reasons cited in the previous paragraph. If you must have the SHIFT key mod in the Apple lie, two alternatives are: leave S3 in the SHIFT key mod position when the game extender is installed in an Apple lie with X6 soldered, or connect a wire from the SHIFT' line to pin 16 of the game I/O socket instead of soldering X6.

The extender construction technique is to mount the six sockets on a general purpose IC board. Use the type with feed through solder holes so wires can be connected on both sides of the board. The board is mounted in a case with six holes through which the sockets fit. A nibbling tool is good for cutting the holes. The installation procedure is: install the sockets in the board; wire the board and switches as shown in Figure 7.14; mount the board and switches in the case. The appearance of your extender will vary with your selection of switch styles and enclosure. Enjoy your extender. It's really pretty handy.

