ARCADE PCB REPAIR:

To begin inspection, have the following tools available and a well-lit area:

- Magnifying glass
- Continuity meter*
- Razor knife
- Screwdrivers (Flathead & Phillips)
- Schematics
- Note pad and pen
- Masking tape

*CONTINUITY TESTS
Open circuits are those in which the flow of current is interrupted by a broken wire, defective switch, or any means by which the current cannot flow. The test used to detect open circuits (or to see if the circuit is complete or continuous) is continuity testing.

The most common failures with older boards are broken traces and bad connections on sockets and edge connectors. When a trace is broken on the board or there is a bad connection, the failure symptoms can be anything from the board being totally dead to intermittent video problems. These types of problems can be difficult to pinpoint.

First, to debug the boardset, completely inspect both sides of the PCB. Look for scratches on the board that may be deep enough that the foil trace is broken. Most boards are manufactured with a solder mask (thin green film) that covers the foil except in the places where there is solder. Scratches are easier to locate on boards that have solder film, as the scratched area will show the shiny foil. Some older boards do not have a solder mask, which makes it somewhat more difficult to locate scratches. Use of a magnifying glass for close up inspection is suggested.

If a suspect trace is located, you will then need to use a continuity meter to check it. It really helps if you can find the two ends of the suspect trace in order to check the connection. If the scratch is on the component side of the board, locating the other end

of the trace can be difficult as it may sometimes be hidden underneath chips. If the scratch is on the solder side of the board you should be able to locate either the component pin the trace is attached to, or a via (a hole filled with solder that is used to connect a trace from one side of the PCB to the other).

If you still are unable to locate one end or the other end of the trace, you may make an electrical connection to it in order to test it. With a razor knife, scrape away some of the solder mask on the trace that you cannot locate the end. Scrape only enough so that you can get your meter probe to touch it. Be careful not to scrape so hard that you break the foil trace. Once you have scraped away the film, you should be able to probe the newly exposed area to test with (however, if the trace is indeed broken, you may still need to locate spots that you can solder to).

Once you have located the two sides of the suspected broken connection, put your meter on continuity mode and check to see if the trace is broken. If the continuity is good, then nothing needs to be done. If the continuity is bad, double check that you are probing the right connection. If you have the schematic, try and locate the trace on it and see what other components it may be attached to. Then with your meter probe on the component side to double and triple verify the trace is indeed broken.

If you find a broken trace, it now needs repair. One way is to solder on a new wire as parallel jumpers across the broken foil. The new wire may or may not follow the same physical path of the old broken foil. The new solder connections may also be several inches away from the damaged section of the foil.

If you choose to repair the trace, rather than use a jumper wire, a 30-gauge insulated wrapping wire is suggested. (Available at Radio Shack).

The best location to solder in the patch wire is at a via. If there isn't a via available, the next choice is to solder the wire to a component that is already soldered to the board. Don't solder the patch wire to a removable part such as a socketed IC. Rather, solder to the bottom side of the socket. Typically, install the patch wire on the same side as the broken trace if possible.

Cut the patch wire to the exact length you will need. Both ends of the wire should be stripped approximately 1/16" inch. If placing the wire on the component side of the

board, cut it a little longer for maneuvering around the components. The wire will later be taped or glued flat to the boardset..

Before you solder on the new patch wire, use a solder sucker to remove the old solder from the hole you are soldering to. If the connection is to a via, you will have enough room to insert the patch wire. If connecting to an existing component, once the old solder is removed, you will be able to insert the wire into the space around the component and the hole. If not, you will need to hold the wire in place touching the connection while you solder it. The solder should be just enough to hold the connection. Repeat for other side of the patch wire.

Now flatten the patch wire to the board curving it around other components so it sits flat to the board. Then secure it to the board either with tape or glue. If you choose to use glue, be sure to hold the wire flat to the board until dry.

The final step is to check your work. With your meter, probe the connection for continuity. Then, inspect the area where the original trace was broken. It's not uncommon for a large scratch to cause the foil of one trace to short with another. To remedy this, use a razor knife and score the board between the traces to ensure they don't short against each other. Then retest for continuity. Also, inspect your solder joints to ensure they are not shorting with any other connections.

Now, another common failure is bad connections. Mainly IC's not making good contact with the chip sockets, or chips that have been re-inserted and have a pin that was bent. Checking for bent pins is pretty easy. Simply remove the chip, straighten the pin and re-insert.

Anytime you are removing socketed components such as eproms or microprocessors, there are some things you need to watch for. First, be static conscious. Don't work on your board in an area that can cause static charges such as carpeting.

When removing the chip, use extreme caution as to not cause damage. If the socket is of poor quality, it may have hollow openings underneath the chip. Your screwdriver can get in there and when you pry with it you will very likely scratch the PCB and damage the traces. With those same type sockets, the plastic support bars that separate the hollow spaces can also easily break. If the chip is stuck in the socket, you may lift the socket from the PCB rather than lifting the chip. This can damage the board and also can break the foil trace around the socket.

If the board is part of a multi-board set, disconnecting and reconnecting the boards is also a good idea in order to make sure there is good contact. Also, the edge connectors can also be cleaned at the same time. Other things to check for while you are inspecting the board include burnt edge connectors, burnt components, broken components such as capacitors and resistors, and missing components. It is very common for boards to have unpopulated chips, so don't assume any empty socket

means a missing component. Always check the schematic. TTL designs require that there be a capacitor every so often and they need to be nearby each chip. It is common to see one these capacitors broken.

Now that the board has been fully inspected, broken traces repaired, socketed chips have been reseated, and broken components have been replaced, you are ready to power-up.

It's a good idea to double-check the GND and +5V are working properly and no shorts are there. You can do this by checking continuity between GND and several GND pins of the IC's, and repeat for +5V.

As for the video sync, the output should be pulsing and various pins on the processor should be pulsing as well as most of the pins on the eprom's. Hook up the video sync, and RGB. Make sure you also have your video ground hooked up to your monitor. If there is no video displayed, make sure things are hooked up correctly.

Sometimes, the pinouts in the schematics can be incorrect or the board mislabeled. Make sure pin 1 is pin 1, and if there is a key in the edge connector, make sure it matches with your documentation.

Another video problem can be making sure the game is providing composite sync, as opposed to separate horizontal and vertical sync lines, and ensuring they match with your monitor connections. Some games may have switches or jumpers for negative vs. positive video sync, but the most common is for the PCB to provide negative composite sync.

Finally, it's time to hook up the sound using the +12V and sometimes the -5V. Some games have volume control as an external component to the PCB for easy access. If the board does not have a volume control, you probably will not get any audio output until you wire it in. Some older games require an external audio amplifier. This means the board itself cannot directly drive a speaker.

You can purchase external amplifiers rather inexpensively. This will be wired between the PCB and the speaker, with additional attachments to your power supply.
