REPAIRING YOUR HOME VIDEO GAME

by

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This book assumes that the reader will be aware of safety precautions associated with the repair of electronic devices.

Acknowledgements

I would like to thank a few people who gave their support during the production of this book.

To Dave Gordon, and all the people at DATAMOST, Inc. for their support and faith in turning my manuscript into a book.

Also to my family, to my wife Melinda and our two sons, Andrew and Casey, for their help and encouragement which made this project much easier.

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Introduction

The popularity and success of home video games was definitely unforeseen and unexpected. Within just a few short years this industry grew from an small unknown PONG game in a few scattered bar rooms to a multi-billion dollar industry. In 1982 the dollar revenues in the video game industry surpassed the record and movie industries combined!

Along with this growth came fantastic new concepts in home entertainment. Americans from coast to coast could be found shooting tenaciously at endless invaders from space, avoiding the end of the world by saving it from hostile nuclear missiles, and munching little dots as they weaved their way through screen after screen. Yes, and all of this could be accomplished without leaving your front room or favorite easy chair.

But along with all this excitement and thrill came agony and frustration when the *&@! thing broke down! Children began to twitch and wander aimlessly, grown men were known to cry, mothers would spend endless days searching for the cheapest, fastest method for repair. The scenario that followed was often as challenging to overcome as some of the games themselves — GETTING IT FIXED.

Your choices for repair were usually two-fold. Travel hundreds of miles to your "LOCAL" authorized service center only to find that it would cost you an arm and a leg (or the equivalent of two cartridges, whichever was greater), or ship

it off to the great repair facility in "SILICON VALLEY" (which was cheaper) and then wait, and wait, and wait. Most chose the latter.

Many UPS trucks came and went, in those long weeks that followed. "Sorry, it's not here today," became the daily greeting of our friendly, patient delivery man.

At last it would arrive. Plugging it in you found that, unlike the 2,596,000 points you used to score against your neighbor, 15 was as high as you could go. Grown men were known to cry.

With this in mind, I set out to compile this book, just for you. The book is written in such a manner that a novice in electronics as well as the seasoned EE (Electrical Engineer) can learn something.

Chapter 1 is designed for the novice. It should help you learn the basics. Covering everything from elementary electronics to the tools you will need, it attempts to answer the question, "Can an old dog learn new tricks?"

Chapter 2 is a generalized synopsis on logical problem solving. This chapter will be of assistance to all who read it, regardless of the problem. It was written with everyone in mind and can apply to many different situations.

The rest of the chapters, three through nine, deal with the specifics of video games. If you are a seasoned repair person, this is where the meat of the subject lies.

So to each of you I wish a fond experience in reading this book, and good luck as you plunge into the deep dark world of *REPAIRING YOUR HOME VIDEO GAME.*

While the author makes every effort to include his experiences and knowledge, no claims are made that this book is all encompassing. A note should also be made here that some warran-

ties are void if the game unit is opened or damaged while trying to make repairs. It should be noted, however, that most warranties are only good for 90 days from date of purchase. MURPHY'S LAW states that your game will break down on the 91st day.

Chapter 1

Covering the Basics

What tools do I need?

In trying to repair any of the video games listed here you will probably need these tools sooner or later:

Needle-nose pliers
Wire cutters
Screwdrivers, both regular and Phillips

* Soldering iron (20 - 30 watts)
* Desoldering iron
* Digital multimeter (DMM or DVM)

* (Don't worry about some of the fancy names. I'll explain later what most of these are and what they do.)

What do I need to know about electronics?

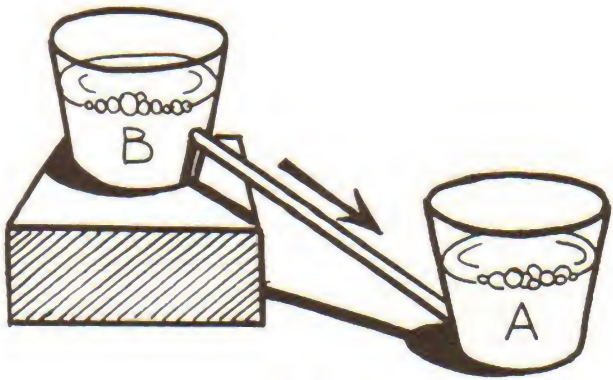
Just about all you need is a little smarts and common sense to do effective repairs. All the electronics you need to know will be covered in this chapter.

What is electricity?

Technically, it has to deal with the motion of a charged particle such as the electron or proton through some kind of conductor or semiconductor. But this is hard for the layman to understand, especially if you are trying to fix something. So let me draw this analogy:

> Imagine for a moment there are two buckets, bucket A and bucket B, each half full of water, sitting on a table. Connect a tube between A and B, near the base. Now set bucket A on the floor. What do we get? We would get a flow of water from bucket B to bucket A.

Let's write it like this:



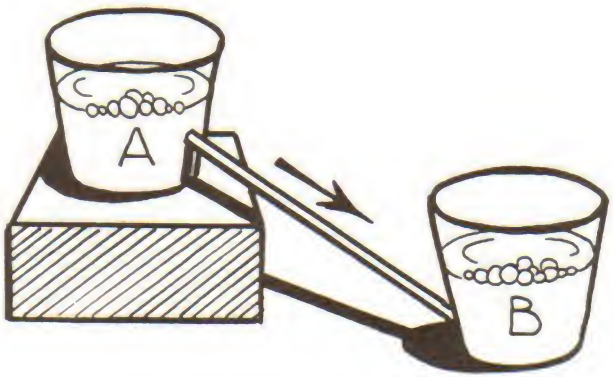
B --> A

The flow of water between the two buckets can be likened to the flow of electrons in a wire, or electricity.

AC vs DC

When we have electricity flowing in one direction, as it was in the case of the buckets, it's called *Direct Current* or DC.

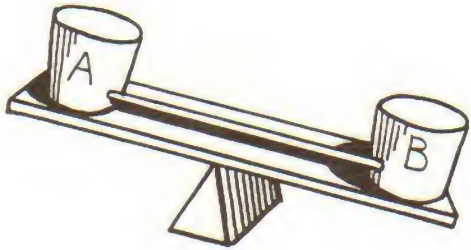
Suppose after letting the water flow for a few seconds we switched buckets. Water would now be flowing in the opposite direction in the tube, or:



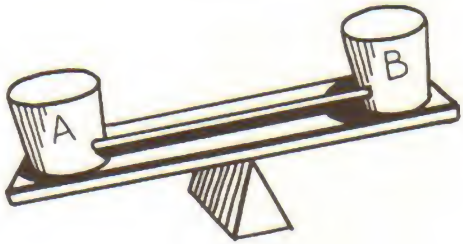
A --> B

Although it is flowing in the opposite direction, it is still called DC. Then what is AC?

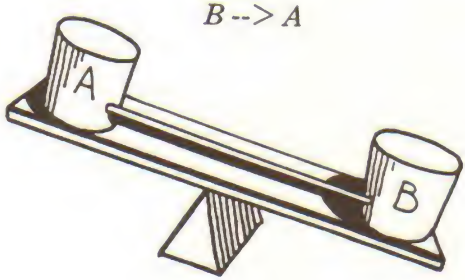
Imagine we place our two buckets on the ends of a teeter-totter. As we alternately raise and lower one end of the teeter-totter the flow in the tube would look like this:



A --> B



B --> A



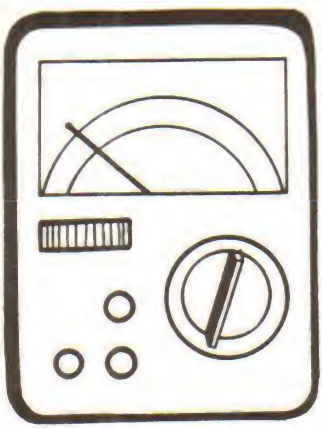
A --> B

This type of flow is called *Alternating Current*, or AC, for obvious reasons. The speed at which the flow changes or alternates is dependent on how fast you raise and lower the teeter-totter.

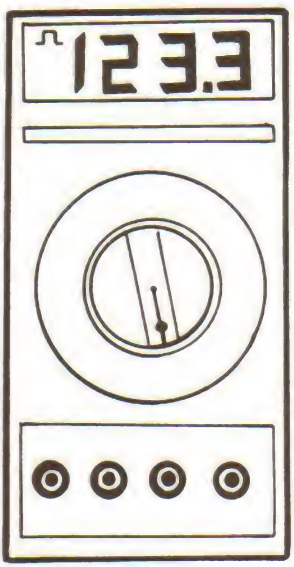
Similarly, whenever the electrons in a wire flow one direction, then stop and flow in the other, it's called AC.

How to use the VOM/DVM

Just as there is a meter which allows you to tell how fast and how much water is flowing in a pipe, there is a meter that allows you to find out certain information about electricity. This meter is called the *Volt Ohmmeter* (VOM) or *Digital Voltmeter (DVM).*



VOM

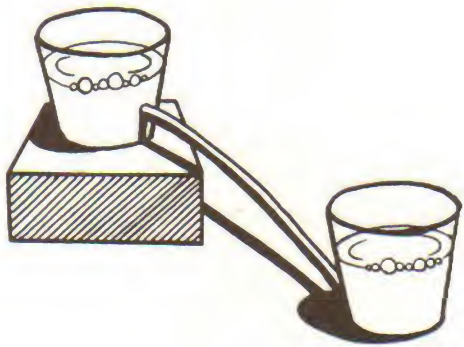


DVM

In order to understand how the VOM works, we must first understand what we are trying to measure.

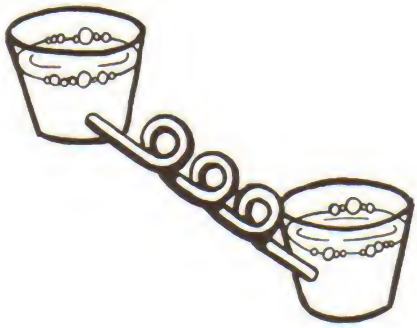
Again we will use water as an example. Let's go back to our two buckets. The speed at which one bucket empties into the other bucket is dependent on three things:

1. The size of the tube that connects the two buckets. The bigger the tube, the bigger the volume of water that will flow in it.



2. The difference in height between the two buckets. The higher we hold one bucket over the other the faster the water will flow. This is called pressure.

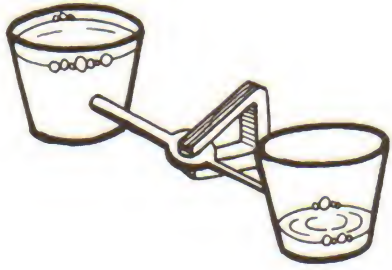
3. The resistance that the water encounters as it flows down the tube. If we were to place a small paddle wheel inside the tube which the water must turn, or if we were to place several small loops in the tube, the flow of water would be slowed down.



These three factors are also present in electricity. The volume of flow is referred to as the *amperage*, the pressure or potential we call *voltage*, and the resistance is called *resistance*. The VOM allows us to measure any one of these at any given time. The only two that you should concern yourself with, for our purposes, are voltage and resistance.

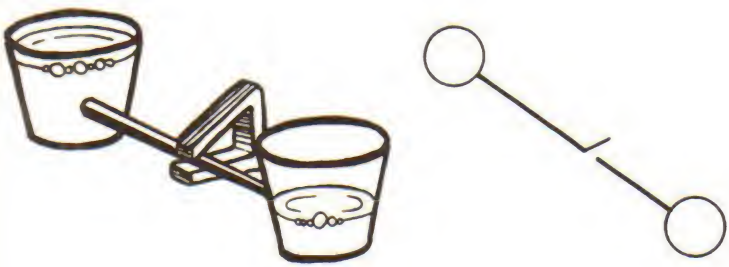
Resistance

In our bucket analogy, we had water flowing from the top bucket into the lower bucket. As we slowly pinch the tube that connects the two buckets:

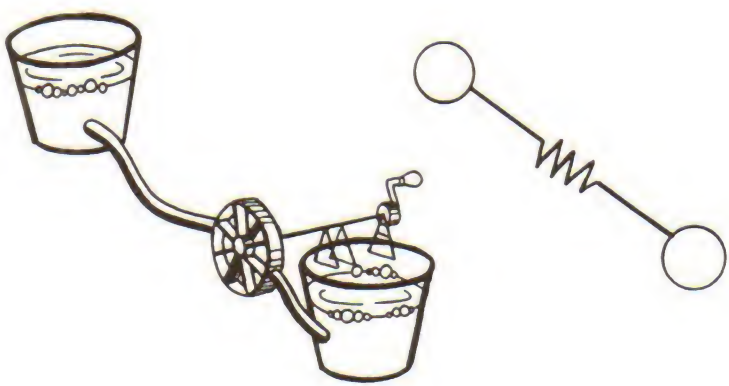


we are applying resistance to the flow of water. The harder we pinch the tube, the slower the water will flow. If we pinch the tube hard enough, the flow will stop completely.

Below is a diagram of what the water analogy would look like. On the right is a drawing that demonstrates the same condition electrically.



Another way of applying resistance to the flow is to make it do work. Let's place a small waterwheel inside the tube. Now as the water flows down the tube, it must turn the small paddles of the wheel. In the process of turning the wheel, the flow will slow down.



Unlike water, electrons turn into heat and disappear when they work. (I've had a few friends who have disappeared at the sound of work, too.)

Several years ago a man, through research and study, found that he could tell just how much work was taking place inside the "tube." By measuring how many electrons were going into the tube and measuring how many came out, he could calculate just exactly the resistance it had passed through.

In honor of the gentleman who did all the research, Mr. Georg Simon Ohms, the unit of resistance has been named the "ohm" and it is represented by this symbol Ω

For our purpose, we will only worry about two conditions; one, when there is no electron flow at all, called an *open circuit:*

and the other, *closed circuit,* when there is zero, or very little, resistance at all.

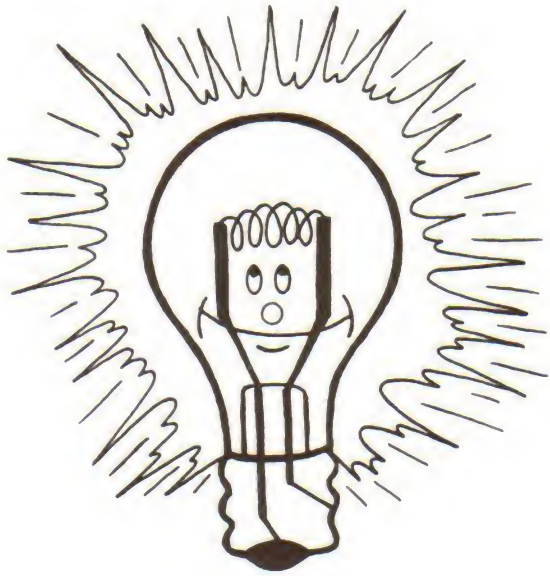
What does all this have to do with repairing a video game? Imagine, (here goes the buckets again) the water flowing into the lower bucket, suddenly stops. What could be wrong? Well, one possibility is the water in the upper bucket could be getting low. So we check, no, that's not it. What else could it be? Well, possibly something is stuck somewhere inside the tube, you say? Well that's probably it. We drain the water out, remove the tube, and try to blow into the end. Does any air come out? None at all. We replace the tube, and the water starts flowing again.

To measure resistance with the VOM we do the same thing. First we remove all power, and turn it off. The VOM then pumps a known quantity of electrons into one end of the circuit and waits to see if anything comes out the other end. If it does, it counts how many electrons came out. If as many electrons came out as went in, then there is no resistance. If no electrons come out, then there is an open circuit. How does all this relate? Well, it just works out that one *volt* of pressure will push one *amp* of electricity through one ohm of resistance.

Getting back to our example, if there is no resistance, there is said to be zero (0) ohms resistance. But if the VOM didn't count any electrons coming out the other end, it would know that there was a break in the circuit somewhere.

This condition, no electron flow, is called an open circuit. The circuit is said to have infinite resistance.

"Well, how will this help me fix something?" you may ask. Well, picture a light bulb.



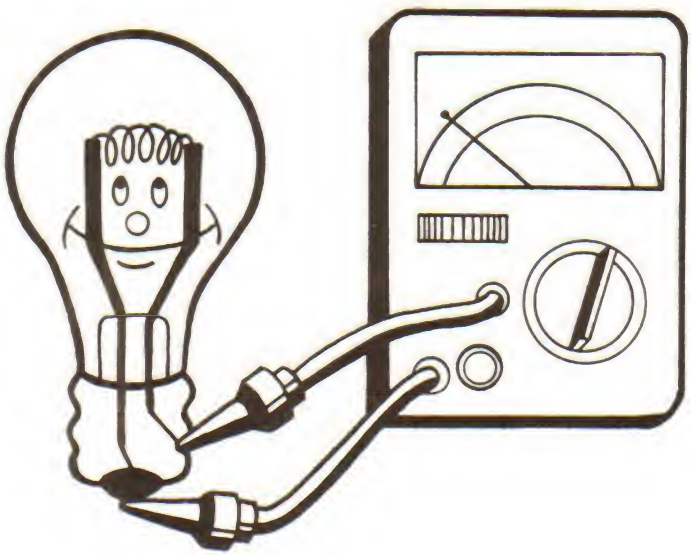
Electricity flows through a small wire causing it to glow. When the wire breaks:

the flow stops and no more light is given off. With the knowledge you now have about the VOM, you should be able to tell if a bulb is good or bad without having to screw it in.

To properly use your VOM you should check the owner's manual that comes with it for specifics. But, in general there are usually two wires, or leads. The black lead is plugged into the hole marked comm or (–), the red lead into the hole marked (+). For those meters with ON/OFF switches, don't forget to turn it on.

By touching the two leads together, the meter will see a completed circuit with 0 ohms resistance. On most meters there is an ohms adjust know which allows you to adjust your meter so it reads exactly 0 ohms.

Now if you touch the leads to the good light bulb like this:



It should show that there is a completed circuit. It may not be 0 ohms but at least it shows that there is continuity.

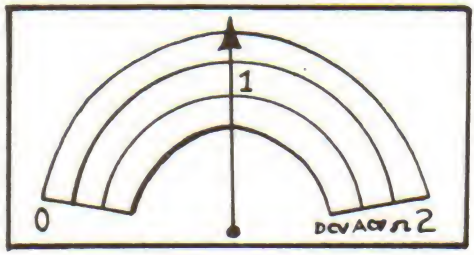
Now touch the leads to the base of the bad bulb and you will get nothing at all. It will show an open circuit or infinite ohms. We will be using this same principle in our repairs to test switches, wires, and even power supplies to see if they are good or not.

Voltage

Volts are a measure of the potential or pressure present. We are all familiar with the little 9-volt battery. Let's get one and try to measure it. To measure voltage we put the black lead in the hole marked (–) or COMM. The other lead will go into the hole marked DC volts.

Some VOMs have a selector knob on the front and others have just multiple holes marked with voltage ranges. Select the setting that reads DC voltage; the range should be as close to the voltage we are trying to measure as possible, without going under. For example, suppose my meter had a 2DC, 1 20 VDC, a 200 VDC, and a 2000 VDC setting. To measure a 9-VDC battery, you would choose the 20 VDC setting, since that is as close to nine volts as I can get without going under it.

Notice that the battery has two terminals coming out the top. One terminal is marked (–) and the other (+). To measure the voltage, place the black lead on the terminal marked (–) and the red lead on the terminal marked (+). Your meter needle will swing and point to the actual voltage of the battery. The different number scales on the face of the VOM correspond to the different dial settings or holes. Since my VOM has 2, 20, 200, and 2000 volt settings, the needle should point just below the halfway point.

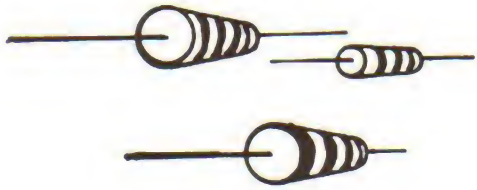


Full-scale deflection, (that is when the meter needle goes all the way over to the far side of the scale) would mean 20 volts on the 20 volts scale, and 2000 volts on the 2000 volts scale. We can abbreviate 2000 by writing 2K, where 1K is equal to 1000.

Of course, those of you who have digital volt/ohmmeters, DVMs, won't have to worry about this. The new electronics inside these fancy meters, takes care of all this.

What do you call this thing?

In electricity there are devices which have certain effects on the flow of electrons in a wire. I will list those you need to be concerned with and an explaination of what each one does.



Resistors

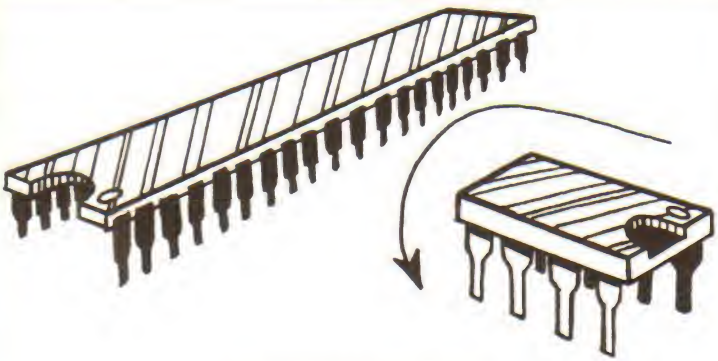
Resistors slow down, or resist the flow of electrons. When replacing resistors it doesn't matter which direction they are in. Since there are so many of them in a circuit, and we will be referring to them quite often, we will abbreviate them this way: Resistor number 1 we will call R1 and resistor number 102 we will call R102.

Capacitors

Capacitors do not allow the flow of direct current, but do allow the flow of certain alternating currents (AC). They are called caps for short. When replacing capacitors be careful, some caps must be oriented in a certain direction. This is usually shown on the circuit board and denoted by a (+) and a (–). Caps are abbreviated CXXX.

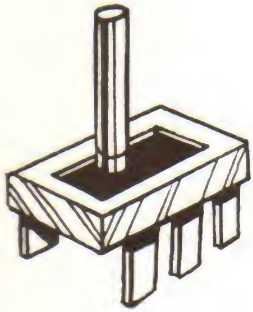
Transistors

A transistor can be compared to a valve. A transistor can control the flow of electricity, just like a faucet can control the flow of water in a garden hose. Transistors have to be mounted in a certain orientation, so make note of the hook-up before you remove the old one. Abbreviation - QXXX.



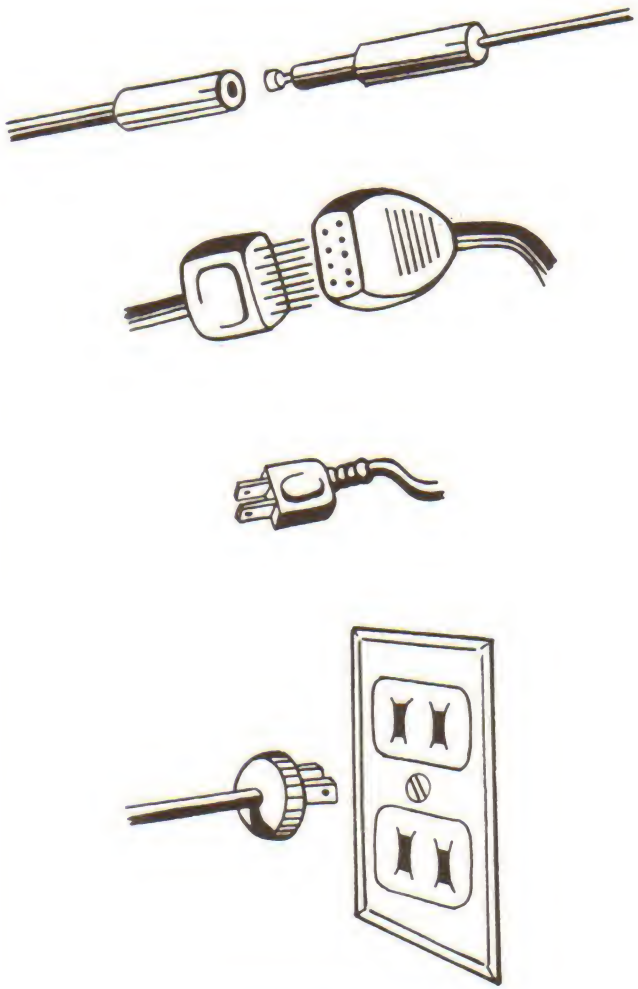
Integrated Circuits

Integrated circuits are complex devices. To make it easy, let me just say there are always an even number of pins. They can vary in number from eight all the way up to 40. The pins are placed in a certain orientation. (Note the drawing shows pin one, usually with a small bubble above it.) Abbreviated -ICXXX.



Switches

Switches simply open and close the circuit. They are zero ohms in one position and infinite ohms in the other. Switches are abbreviated - S101.

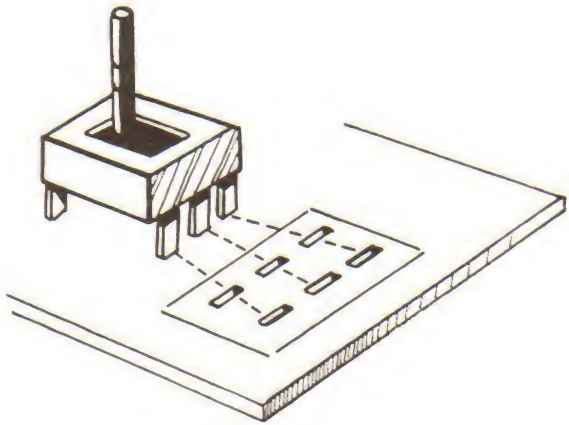


Jacks and Plugs

Jacks are devices which make electrical connections. They can easily be separated for the convenience of the user. A good example is the electrical wall outlet and the common two pronged plug.

Learning to solder

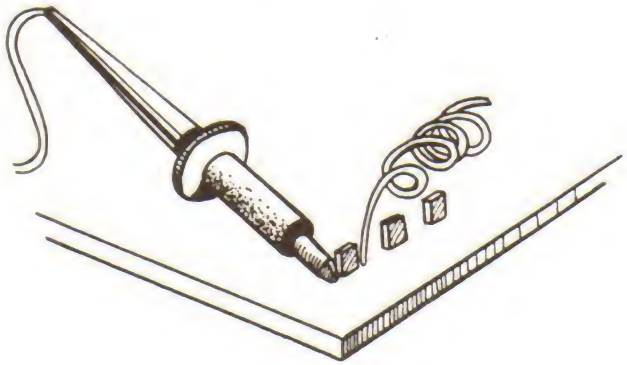
Solder is a wonderful invention. It is a metal alloy, part tin - part lead, that melts at a relatively low temperature. It serves two purposes; it forms a securing bond - like glue, and it allows electricity to flow through it.



Let's plug in our soldering iron and connect a switch to the circuit board. The soldering iron should be between 20 and 30 watts. The solder should be a good 60/40 rosin core solder. Both of these are available at your local electronics parts store.

After the iron has heated up, make sure the tip is tinned properly. To tin the tip, simply try wiping off the tip with a damp paper towel. If the tip doesn't have a silvery shine to it, then you should file it off and apply some solder to it. You should get into the habit of wiping off the tip each time it is used to keep it clean.

In soldering, one rule should always be remembered. SOLDER WILL FLOW TO THE SOURCE OF HEAT. Always apply the solder to the side of the component opposite the side your iron is on. Like this:



One common mistake beginners make when learning to solder is they apply too much solder to the joint and not enough heat. When finished, the joint should look like this:

Not this:

Desoldering

In repair work, for every joint you solder, there has probably been one you have taken apart. To desolder a joint, simply heat it with the iron, remove the iron and apply the desoldering pump. The desoldering pump sucks the molten solder from the joint. There are several different types of pumps on the market, each with its own set of instructions. I suggest you purchase one and learn how to use it. It's a very useful tool.

Chapter 1 notes

Chapter 1 notes

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Chapter 1 notes

Chapter 2

Logical Problem Solving

I have spent much of my life tinkering with different electrical and mechanical devices, taking them apart and then putting them back together again, just to see how they tick. I have repaired garbage compactors, dishwashers, automobile generators, wrist watches, baby toys, lamps, mini-computers, and especially video games.

As I was doing these repairs, it occurred to me that I was going through much the same thought process, regardless of the item. Each item, although different, could be analyzed and repaired using a certain algorithm.

In solving problems, regardless of what they are, there are several hints, shortcuts, and rules I have discovered that I feel will help you.

Stop and think for just a minute

I once purchased an 8 mm movie camera from a pawn shop. I purchased the camera because it had a nice zoom lens on it.

When I got the camera home, I found even though I had put new batteries in it, when I push the "T" button for telephoto or the "W" button for wide-angle, the lens would not change.

I deduced that the motor controlling the lens movement was probably broken or disconnected. I, being the fix-it guy I am, immediately tore the side of the camera off, not only cracking it, but also losing several small screws in the process. Once inside, I found the "T" and "W" buttons merely engaged a series of gears that worked off the film advance motor. In order to work the camera I had to be push the "FILM ADVANCE" button and the "T" or "W" button at the same time. Had I just sat down for ONE minute and read the instruction booklet or reasoned it out, I would have been hours ahead and my camera would not have been damaged.

This rule would then us to stop and think about the problem before we try to repair it, making sure that we are doing everything that the manufacturer suggests we do. If there is an owner's manual or an operator's manual — READ IT! If the owner's manual cannot be found, often a manufacturer will replace it if you request a new one. (If there is a charge for the manual, it is usually nominal.) If time is a factor, try a simple phone call to a local manufacturer representative. They can be very helpful in locating another manual; either borrowing their copy, or answering your questions over the phone.

Once you have the instructions, remember to follow them explicity. As I read instructions, many times I find myself saying, "Surely that step is too elementary for me to follow. I should be able to skip over it." — DON'T!

Several years ago I purchased a desk-top calculator. Being a recent college graduate and obiviously knowing everything

about calculators, I filed the manual away without even as much as opening the front page.

Recently a friend of mine came over to help me on a project I had going. The need to calculate a square root of a certain number came up. He reached over and grabbed my calculator.

"Don't try that one, it can't calculate square roots," I said.

"It sure can," he informed me. "I've got one just like it at home. All you have to is push this button right here."

Pulling out the manual, and finally reading it, I found my little calculator could do a lot more than I thought it could.

"If all else fails, read the instruction manual."

Really should be:

"Before all else fails, read the instruction manual."

Verbalize the problem

One of the first things I like to do when trying to resolve a problem is verbalize it. If someone else has asked me to solve a problem for them, I ask them to verbalize the problem. I get a piece of paper and a pencil and write the description down. Once you have the problem written down, try to get more specific. Usually the more specific you can get, the easier the problem is to solve.

For example, if someone told me that their car would not start, I would immediately write down, "car will not start." Then I would ask more specific questions like: Does it have gas? (So obvious it is often overlooked.) Will the engine crank over at all? (This isolates the problem from a mechanical one to an electrical one.) Do the lights work? As each question is an-

swered I get more specific with my explaination. "Car will not start, has gas, engine will crank over, lights work, etc." You should see that this is a much better description than before.

Once you have the description written down, read it back to yourself or someone else. You should, at this point, have a good concise summary of the problem.

Law of superposition

This is a law I have borrowed from my background as a geologist. Simply stated, it says that certain rocks must be older than others because of their relative position. It's only logical that a layer of rocks found under a lava flow must be older than the lava itself. Since they had to be there in the first place for the lava to flow over. In otherwords, the foundation of a house must be older than the walls resting on it.

But, you may wonder how this applies to problem solving. Well, there are certain devices that must be working before others can. For example, your car radio will not work unless the battery does. Therefore, a functioning battery *superpositions*, a working radio. The toaster will not work unless it is plugged into a good working wall receptacle. The car will not start, even with the best auto mechanic in the world on hand, unless you have gas in the car.

"I'm sorry, but I can't find anything wrong with your Atari," I told a customer recently.

"But this is the second time I have had the Atari in and each time you tell me that there is nothing wrong with my machine," the customer replied.

"There isn't. I have checked out everything you have and everything is fine. Where are you plugging in the power adapter?"

"Well, right where it has always been, in the corner socket."

"Have you tried another socket?"

"Well, no. That socket has always worked."

"Well, do me a favor, take your Atari home and try another socket."

"OK, but I'm sure it won't do any good."

About 30 minutes later, I received a phone call.

"Well, I tried another socket and it works! It just so happened that the socket was switched, and someone had turned the wall switch off. It never happened before."

And it would probably be a safe bet that if that customer's Atari ever broke down again, that would be the first place he would check.

Remember to start with the very basics. Does it have power? Are all the switches turned on? Are the batteries dead? Is there a fuse somewhere that could have blown? Don't assume anything. If you are unsure if a wall recepticle is working or not, take a lamp or radio, that is working, and plug it in. If it doesn't work, then chances are you have a switch turned off somewhere or a blown fuse.

My television has a switch on the front so I can switch between regular TV, or cable TV. One day, my son innocently flipped the switch while I was out from cable to regular TV. Upon returning, I found that I could no longer get cable TV. So, I promptly placed a trouble call to the cable TV service station. Fortunately, about an hour later, I realized what the problem was and corrected it. I called the cable company and undoubtedly saved myself an expensive service call, not to mention the long wait which would have certainly resulted.

Cut the problem down to size

At this point we have to read the owner's manual, along with the good, concise written description of the problem and checked to make sure we have a good "foundation." (See previous section.) Once we have determined that a problem does exist, we can start cutting the problem down to size.

Most problems, when first looked at, can appear to be complicated. But don't let that deter you. By using the process of elimination we can start narrowing the problem down.

If we examine any device closely, we can usually find that it is made up of many different parts. A good example is an ordinary ball point pen. It is made up of a spring, an inner ink cartridge, a top case and bottom case. Now, by looking at a written description of a problem, "ink does not come out of the pen, everything else seems OK," we can immediately narrow it down to the ink cartridge.

Often a problem can be localized by a preliminary visual inspection. Look for burnt or melted parts, broken or frayed wires, missing parts or belts, loose connections, cuts or scraps, unusually worn areas, broken switches, and intrusion by foreign objects (To name a few). Look for the obvious.

Swap and eliminate

Sometimes though, problem solving is not as simple as this. I have, therefore, implemented a process which sort of works is reverse. I can explain it like this:

"We may not know what part of our device is not working but we can eliminate those parts that are working."

For example, let's say your friend brings over his video game and says it doesn't work. By plugging in *his* video game parts, one at a time, into *your* video game, you can begin cutting the original, 15 piece problem, down to maybe one or two known bad pieces. I solve 95 percent of all my problems by using this process which I call "swap and eliminate."

Stop, look and listen

Many times a problem can be easily solved by a preliminary visual inspection. Look for burnt or melted parts, broken or frayed wires, missing parts or belts, loose connections, cuts or scraps, unusually worn areas, broken switches, and intrusion by foreign objects.

One weekend I purchased a used 35 mm slide projector at a garage sale for five dollars. I was told by the owner that one day it just stopped working. Upon opening the top of the projector, I immediately saw that the plastic fan cage attached to the cooling motor had melted and the projector bulb was burned out. Then I saw the reason why. A small screw had worked its way loose, bumping into the blades of the cooling fan and stopping it from turning. Since there was no longer any cool air coming into the projector, the tempature inside began to rise drastically. The illuminating lamp became too hot and burned itself out. The fan melted and the projector was inoperable. After ordering and receiving the necessary parts from the manufacturer (an owner's manual was also ordered at this time), I replaced the old fan and lamp in the projector, tightened down the guilty screw, and was back in business. Several weeks later, I sold the projector and manual at quite a sizeable profit.

"A dull pencil is better than a sharp mind"

I believe this quote is from Benjamin Franklin, remember it, for it is sage advice. Trust your pencil more than your memory. Always remember to take notes and write things down when you take a device apart. Make a notation or drawing of how it looks *before* you take it apart. It is also a good idea to make notations while you are taking it apart. Some things to look for, and be aware of are; screw position and size, wire colors, part positions, washer and spacer positions, etc. This rule can save you, literally, hours of frustration, trying to figure out how to get something back together.

As I have mentioned earlier, every problem should be written down. As steps are taken to fix it, make note of them also, even if they are not successful. This type of note taking may take a little more time, but if you ever have to go back and do it again it can literally save you hours of time.

A certain brand and model refrigerator/freezer is very popular in my family. I guess it's because it not only makes ice, but differs it to you in two forms, cubed or crushed. The water in our area is particularly hard, meaning it contains a lot of minerals and salts, and causes the ice maker in this particular model to start leaking water. The entire ice cube tray becomes one big ice cube.

My mother-in-law was the first to ask me to repair her ice maker, within the next few months I repaired four additional machines. Luckily, because I wrote down what I did, the second repair was easier, and the others were a breeze.

Cause and prevention

This is probably the most important hint of all. Try to find out what caused the existing problem and, *what can be done to prevent it from happening again?*

In the case of the refrigerator/freezer, I had decided that the minerals in the water were wearing on the O-rings and eventually caused them to leak. I solved this problem by placing a small charcoal filter in the water supply line. This filter reduced the minerals in the water enough that none of the freezers have had any more problems.

Look for obvious signs that might give you a clue as to why a device has broken down. Has it been dropped or stepped on? Has it been physically abused? Has water leaked in somehow? Are there any foreign objects stuck inside, such as paper clips, pencils, etc.?

Sometimes the reasons may be hidden. Static electricity, the little shock you get when when you walk across the carpet and touch a window, is very damaging to electronics components. It does its damage in a fraction of a second, and then is gone. Invisable troublemakers, like static, can be very difficult to detect. But, don't overlook it as a very sly and elusive culprit.

Many times a device will almost seem like it's trying to give you a warning that something is going wrong. Listen for any strange, loud or unusual noises that are not normally present. If you notice such noises, give it your immediate attention. I believe it's natures way of crying for help.

Remember:

AN OUNCE OF PREVENTION
IS WORTH A POUND OF SOLDER

Chapter 2 notes

Chapter 2 notes

Chapter 2 notes

Chapter 3

The Video Game Overview

Every video game mentioned in this book can be broken down into five components: the power source, the hand controllers, the TV/Game switch, the game cartridges, and the game console itself.

Since the first four components are conceptionally the same, regardless of the the manufacturer or model, we will cover them on a generalized level in this chapter. If any specific differences exist, I will make note of them when appropiate to do so. The individual game consoles will be covered in the following chapters.

Power adapters

All video games must have some sort of power supply. With the exception of Intellivision, all video games mentioned in this manual have an external power supply. It is usually a small black box that plugs into the wall outlet and then into the game. Using our law of *superposition*, we know that nothing can work unless the power adapter works. This should be the first item suspected when the video game quits working.

Most adapters have their input and output requirements printed right on their cases. For example, the Atari CX-2600 adapter should say "Input: 117VAC. Output:9VDC 500MA." This means it needs an input of 117 volts alternating current. It then changes or transforms (hence the term *transformer*) this voltage into nine volts direct current. The term "500MA" again means that the volume of electricity it can handle is 500 milliamps (1 milliamp = .001 amps). Knowing the input and output of a power adapter or transformer, allows you the flexibility of purchasing one at your local electronics store, or wherever you can find it the cheapest.

To find out if the power adapter is bad or not, you can either use the *swap and eliminate* method or you can test it with your VOM/DVM. Refer to the previous section on measuring voltages.

Most adapters have a hard plastic case which must be broken to do any repairs. If you know the transformer is broken, I strongly recommend purchasing a new one rather than trying

Helpful hint

When a good power adapter is plugged into the wall, it is supplying electricity to the other end of the cord, regardless of the fact that your game is turned on or not. So, when you or your children plug and unplug the cord into your video game, even for a split second, you are shorting out the transformer. This will eventually make it go bad.

To make your AC adapter last longer, I suggest that you unplug the adapter from the wall first, turn your video game on (this drains any charge that may be stored up in the adapter) and then unplug it from the video game. This will definitely make it last longer and save you money in the long run.

to repair the old one. If you cannot locate an adapter at an electronics parts store, then write to the manufacturer and request a new one.

The Intellivision does not have a separate power adapter. The power supply is a small board located inside the main console. Don't worry about this now, I will cover this subject in the chapter on the Intellivision.

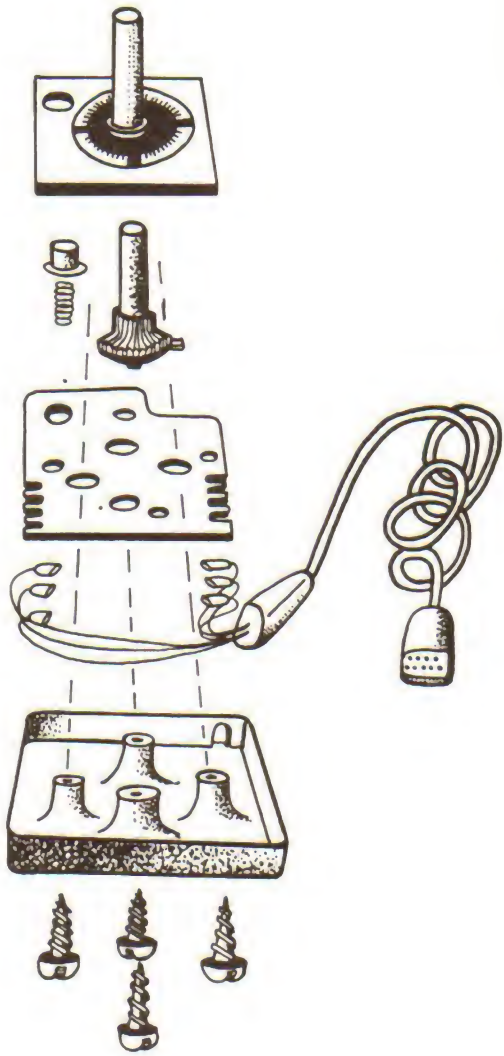
Hand controllers

Because each manufacturer and model is different, I will briefly explain each major control and its method of repair.

Joysticks

Atari CX-2600, CX-2600A, Sears Video Arcade Games

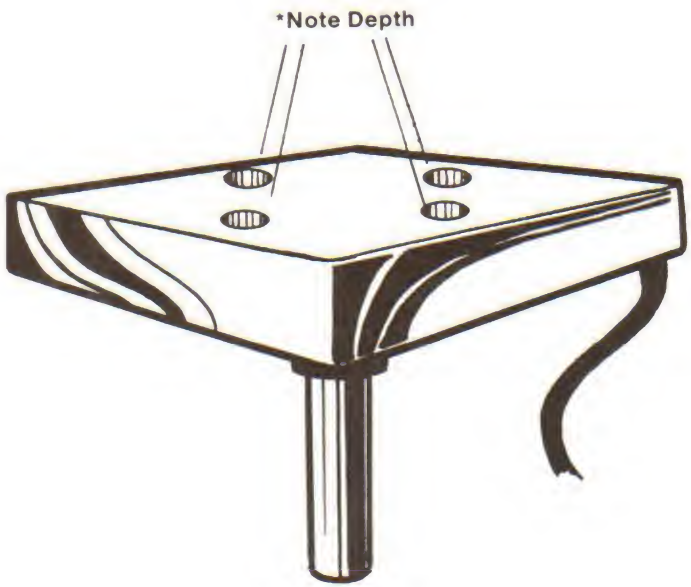
The joysticks are, by far, the most popular hand controller made and used. They consist of a cable, a printed circuit board (called PCB for short), a plastic insert, a fire button and spring, a black plastic cover and a base.

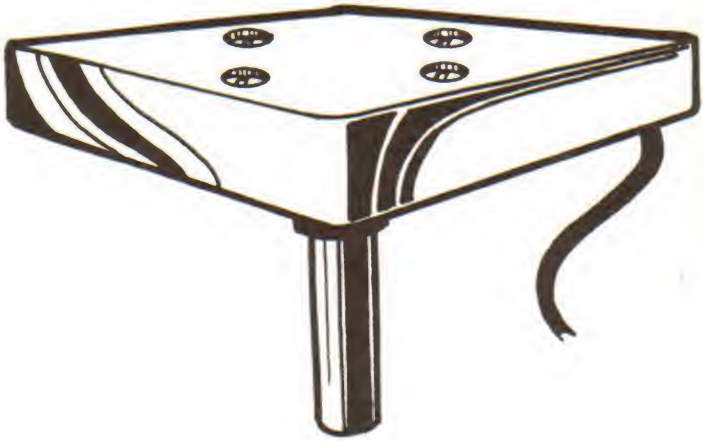


You can tell when the joystick stops functioning properly because the cursor or player usually quits going up, down, right, left and/or firing. If this symptom is present, then chances are your joystick needs to be repaired. However, I need to warn you that there are other problems that can exist within the console that will have the same symptom.

The best way to determine if a joystick is bad or not, is to swap the left and right controllers on a two player game. If the problem follows the joystick, then it is bad. If the problem stays with the port then it is not the joystick.

Two different types of joysticks are still in use on this machine. One can be repaired and one cannot. You can tell if your joystick can be repaired or not by turning it over and looking at the depth of the screws underneath. If the screws are about one half inch deep, then you can repair them. If the screws are just below the surface, you might as well just purchase a new one.





There are three common types of joystick failure.

The most common problem is the plastic insert inside the joystick cracks or breaks. You can see this by taking apart the joystick and inspecting the insert. If it is broken you will need to replace it with a new one. It is impossible to glue or melt the insert, I've tried it.

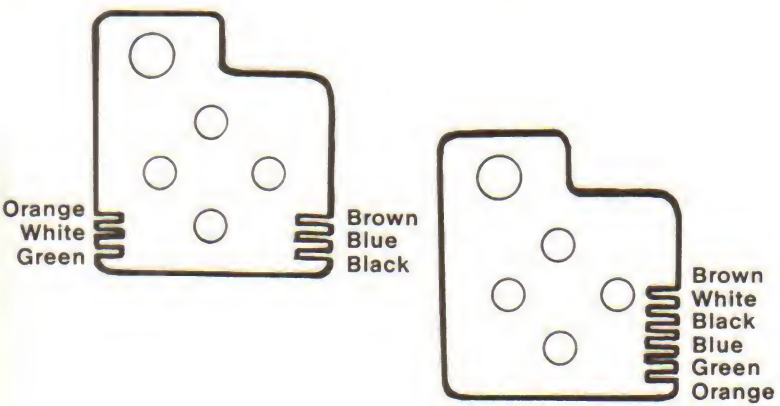
The second most common problem is when the PCB goes bad. As with the plastic insert, this problem can be seen by opening up the joystick. Look at the PCB and push the little, round silver buttons. They should be centered over their individual pads and should return immediately to their arched position uopn release.

If this is not the case then replace the PCB.

The third common problem is when the cable wears out (or gets chewed up by family dog.) Although this problem is a little trickier to detect (unless your dog chewed it in half), there is a way. Disconnect the cable from the PCB. Plug it into the game console, trying not to let any of the wires touch each other. Insert a *Missile Command* cartridge (or any other cartridge that allows you to test up, down, right, left and fire, e.g., *Berzerk*). Turn on your game console and touch the black wire to each of the other wires, one at a time. The chart shows what should happen:

Color	Direction cursor will move
White	Up
Blue	Down
Green	Left
Brown	Right
Orange	Fire

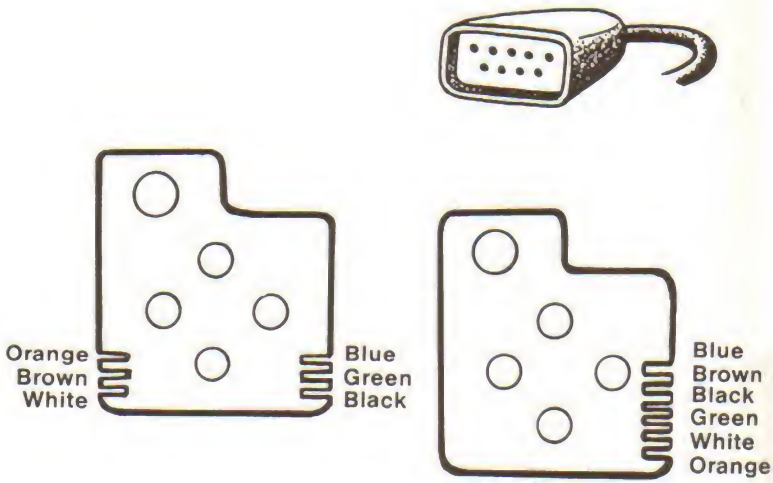
If the cursor does not respond to any or all of these, replace the cable. Below is a diagram to help reconnect the cable to the PCB.



Repair parts for the joystick are available from several suppliers, see Chapter 7 for more information.

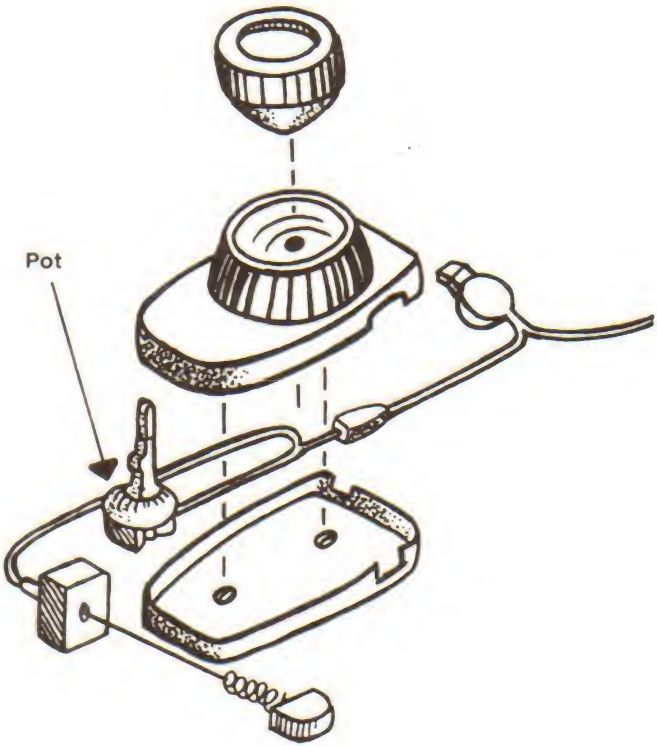
Left-handed joysticks

One night, my cousin and I were fiercely competing against each other. I had never considered myself more coordinated than him, but for some reason, I kept beating him. When I asked him why, he replied, "I'm left-handed and these Atari controllers are built for right-handed people." As I thought about it, he was right. Left-handed, but right. I immediately got my screwdriver and modified his joystick to be a left-handed joystick. So for those of you that are left-handed, here is a diagram to show you how to convert your joystick into a left-handed one.



Paddles

The paddles are not used as much as the joysticks, but they still break down. The most common complaint with the paddles is that the cursor jumps uncontrollably when trying to play games such as *Breakout.*

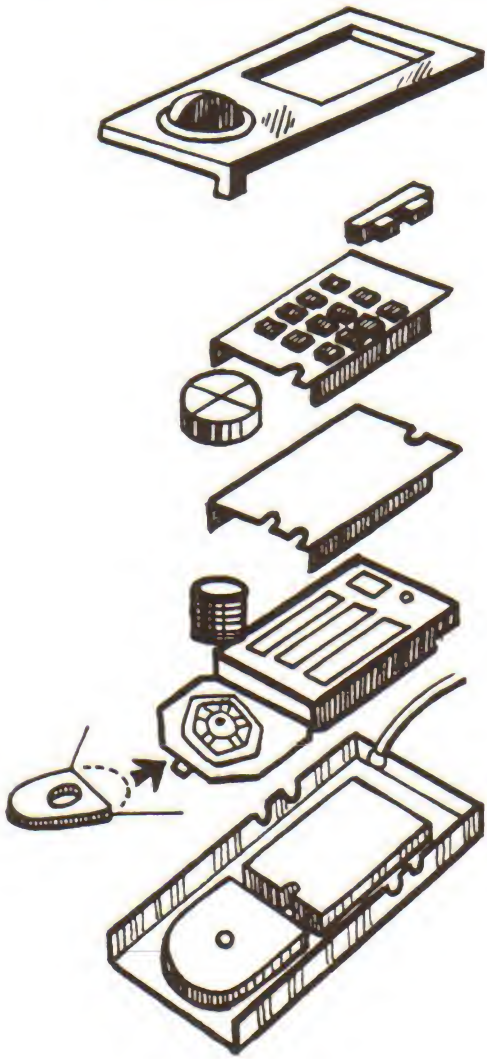


Inside the paddles there is a switch and a device known as a *potentiometer,* or pot for short (see diagram above). With use the pot can become dirty and worn. To repair the paddle, you can either replace it with a 1 meg ohm pot, or you can clean it with an inexpensive can of "circuit or tuner cleaner." Both parts should be available from your local electronics parts store.

Hand controllers

Mattel Intellivision, Tandyvision, and Sears Super Video Arcade

The hand controllers for the Intellivision usually are the first things to go bad. See the troubleshooting chart to detect if yours are bad or not.



Inside the controller is a plastic sheet with a circuit painted, or silk-screened, on it. This is called the *membrane printed circuit board,* or MPCB for short. Often, pieces of the circuit chip off and cause the controller to short out. This can be repaired by opening the controller and cleaning out the MPCB with a soft cloth.

To gain access to the MPCB, loosen and remove the four small screws on the back of the controller. With the controller facing up, lift off the top cover. Remove the round control button and the spring beneath it. There should also be a white plastic spacer, sandwiched between two sections of the MPCB directly beneath the spring.

Note its position. It must be placed back between these two sections when you put the controller back together.

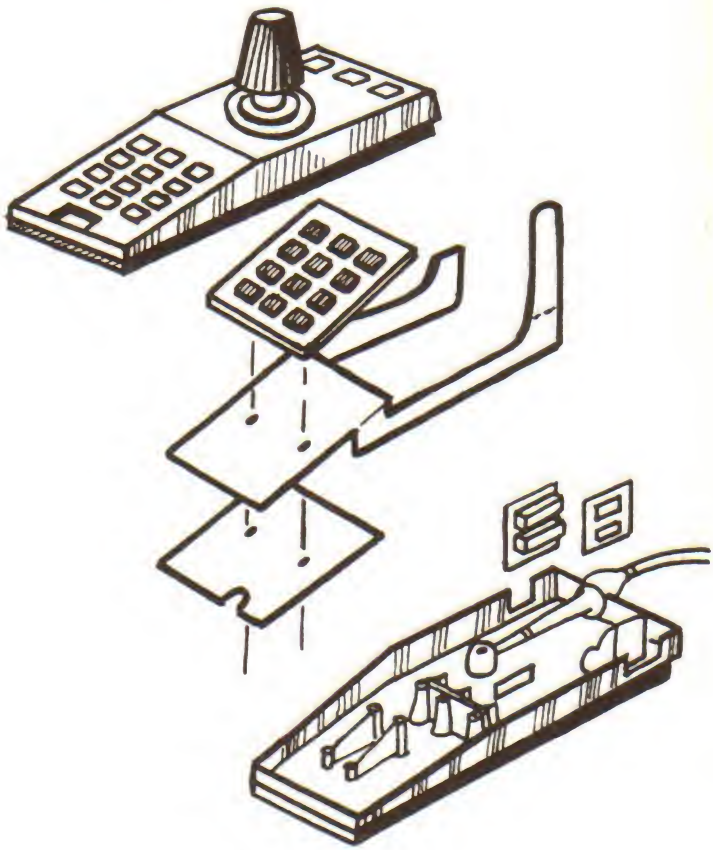
Slide out the black side buttons. (When reassembling the hand controller, these side buttons are useful in holding down the new MPCB, which tends to pop out.) Now, remove the gold, numeric pad and the clear sheet beneath it. This clear sheet is called the static shield.

Remove the MPCB. Visually inspect it to see if it is still in good condition. Hold it up to the light, if you see any holes or breaks in it then it should be replaced. You can purchase new MPCBs from parts suppliers listed in Chapter 7.

After cleaning or replacing, reassemble the hand controller using the hints and drawings from above. Note that MPCB, static shield and numeric pad have two small holes in each of them. These holes interlock with the two pins protruding from the bottom cover of the hand controller, making it easier to align and adjust.

Atari 5200

The design philosophy behind the hand controllers for the Atari 5200 was, I'm sure, to cut down the number of controllers you needed to have to play a variety of games. Now, instead of having joysticks, paddles, keyboard and driving controllers, you only need the new hand controller. Unfortunately, when it breaks, you are completely out of luck. And, since only one controller is used in all games, the chances and probability of it breaking increases drastically. I'm sure that Atari had a good intention, but that doesn't help when you have a bad controller.



The most common complaint about the 5200 controller is with the rubber cover. In most cases, this cover tears just below the handle. If this happens, and it is your only problem, I suggest you leave it alone since this is only a cosmetic problem rather than a functional one. Unfortunately, this is usually not the only problem.

This controller also has a silk screened, plastic circuit, which Atari calls the *flex-circuit*, it can also go bad.

If you suspect something is wrong with it, I recommend that you turn your controller over to an authorized Atari repair center. Not only are the parts a little difficult to find, (and possibly expensive) but the installation is also tricky. For you hardy souls who can find parts, and wish to go ahead and repair the controller, here is how to replace the flex-circuit.

First, remove the small panel that covers the "Start-Pause-Reset" buttons. Simply insert a small screwdriver or knife between the right or left side and pry the panel inward and upward. This is a little delicate and care should be taken not to crack or damage the panel. Set the panel and rubber buttons aside.

Turn the controller over. Loosen and remove the screws on the bottom. Turn the controller back over and remove the top cover. Also remove the main button pad and two side buttons, this will expose the flex-circuit.

Remove the old circuit and replace it with a new one. Note there are alignment holes punched in the flex-circuit which should match with the appropriate posts in the bottom cover.

Bend the new circuit into position. Align the two white pot levers so the top one points left, and the bottom one points straight down.

Replace the side and main button pads. Slide the top cover back into place, being careful to allow the "Start-Pause-Reset" section to slide through its slot.

Hold the handle straight up as you replace the top cover. The handle should match the levers mentioned above. Make sure that they match and the handle has seated properly into its base. Test the controller before you replace and tighten the screws. Hold it together with one hand while you move the handle around with the other. You might even want to plug the controller in and play a game with it to make sure it works properly. Don't be discouraged if it doesn't go back together easily for you, it takes me several tries too.

Bend the remaining flex-circuit and replace Start-Pause-Reset" buttons and cover panel to finish.

When you are sure that the handle has matched with the levers, replace the screws and tighten.

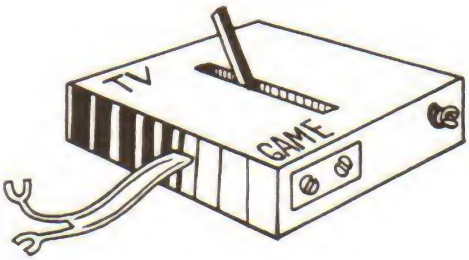
Bend remaining flex-circuit over and replace the "Start-Pause-Reset" buttons and cover panel. Now you are finished.

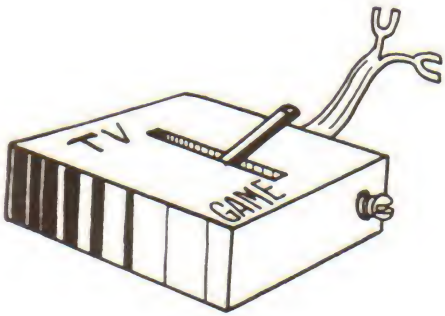
TV/Game switches

The TV/Game switch is a real time saver. It turns out that the video signal from the game console can be directly connected to the television VHF input leads, if you disconnect your television antenna and/or cable. If you don't disconnect your antenna leads, then you become a miniature television broadcasting station every time you turn on your game, sending your game signal up the antenna and out over the entire neighborhood. The FCC (Federal Communications Council) has ruled this illegal, not to mention what your neighbors would think of it.

It therefore becomes necessary to disconnect your antenna and connect your game everytime you want to play. The TV/Game switch accomplishes this with the flick of a switch. It does get used a lot and therefore it also breaks down a lot.

There are two popular types of TV/Game switches. Each is pictured below:

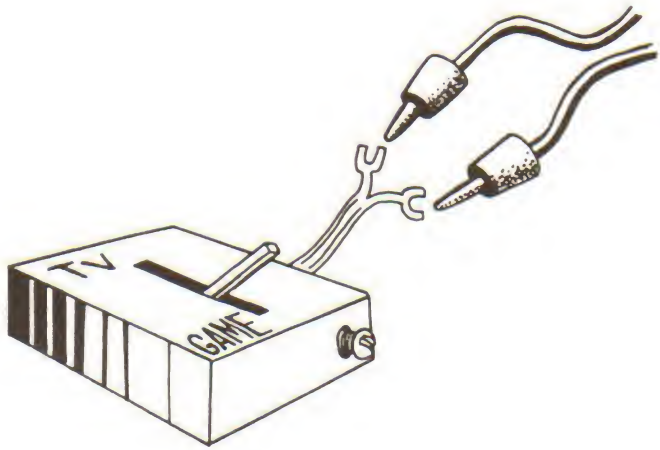




The most common problem with the TV/Game switch is in the twin lead cable which connects to the television. One of two things usually happens, either the lugs come off the end, or the wire inside breaks.

To find out if your TV/Game switch is bad or not, you need to do the following:

Get your VOM and set it for the smallest ohms setting. Set your switch to the "game" or "computer" position. Touch the two leads from the VOM to the two leads coming out of the switch box. Thus:



You should get a reading of zero to 10 ohms. If there is no reading at all, (make sure you have followed these instructions completely) then you probably have a bad switch box. Here's how to fix it.

If the two lugs have come off, or the wire has broken off at the end, simply strip back the insulation on the wires and apply a little solder to them. (Solder strengthens them considerably.) Bend them into a J-shape so they will form around the television's screws.

Sometimes the twin lead breaks off at the point where it comes out of the metal box. This is not obvious, because it is still encased in the insulation. In this case, replace the wire with a new twin lead wire, available at most corner electronics parts stores. Ask for twin lead antenna wire. You will need less than a foot.

If replacing the wire doesn't solve the problem, then the switch is beyond repair and a new one should be bought. This is also available at most electronics parts stores.

Game cartridges

The game cartridges are basically electronic chips that contain game instructions. You can tell if your cartridge is bad if after you plug it in and turn it on, you get strange lines on your screen or your cartridge reacts differently than it ever has before. Transfer the cartridge to your friend's machine and if the problems follows the cartridge, and shows up on his machine too, then it's bad.

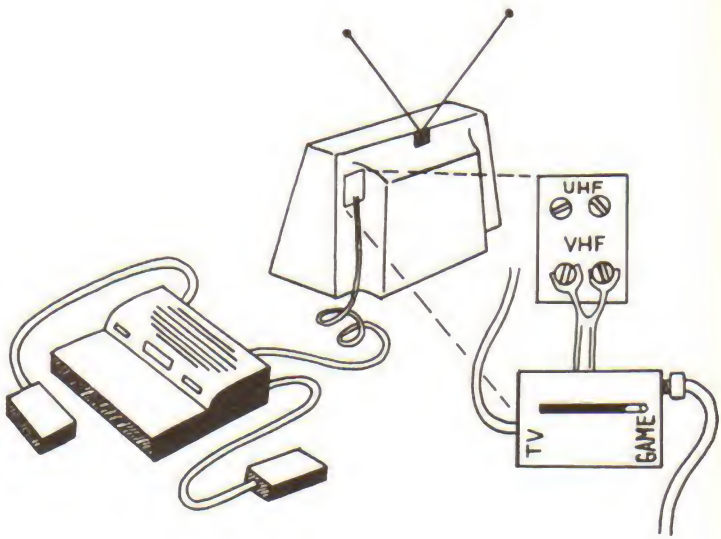
Usually there is nothing that can be done when the cartridge goes bad. Most manufacturers will exchange it for a nominal fee. I suggest you write or call them for their exchange fees and procedures.

Console or main unit

This is usually the last piece to check when looking for a problem, since it cannot work properly until all the other pieces work properly.

I have devoted a chapter for each of the major video games on the market today. I suggest that you read through the entire chapter, before attempting any repairs on your console.

For general information, I have shown a video game and how it should be properly connected. Please note circled areas.



Chapter 3 notes

Chapter 3 notes

Chapter 3 notes

Chapter 3 notes

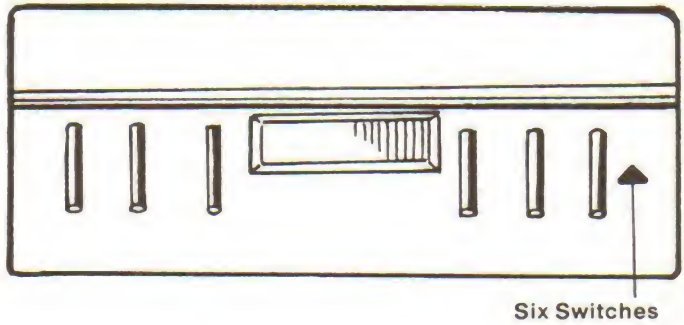
Chapter 4

Atari CX-2600, Atari CX-2600A, Sears Tele Games, and Sears Video Arcade

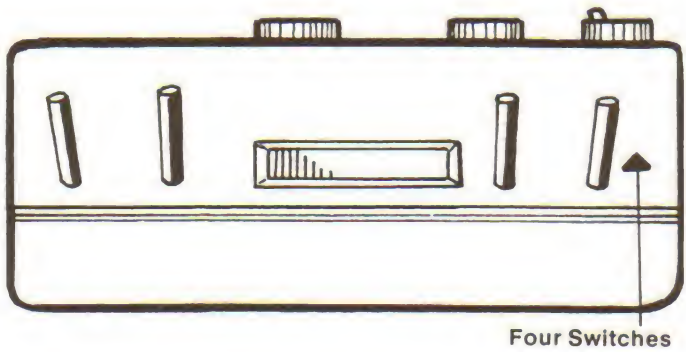
Differences and diagrams

The cartridges, power adapter, TV/Game switch, joysticks, and paddles are all interchangable with any of these models. But, there are some very important differences in the main console.

I will split these video games into two distinct groups, the CX-2600 and the CX-2600A. The CX-2600 group has six chrome switches on the front and if a channel select switch exists, commonly called the 2-3 select switch, it is usually on the bottom right side. The left and right difficulty switches have been moved to the back of the machine along with the 2-3 select switch. Below are diagrams of each group.



CX-2600 Group



CX-2600A Group

Once inside each machine, you will find that the CX-2600 group is comprised of two printed circuit boards, while the 2600A only has one.

Disassembly

In order to do repairs the console must be disassembled. I should mention here that static electricity can be harmful to your unit. To avoid this, I try to do all my work on a wooden table. Also taking off your shoes, especially if they are leather soled, cuts down on the static and lessens the chance of damage, or you can spray the carpet in your work area with a fabric softner, which usually contains a static suppressor.

Here's how to disassemble the CX-2600 group

Remove any game cartridges and disconnect the power cord and the cord to the television. Place a towel on a table or work bench. Set the game unit upside-down on the towel. Loosen the six Phillips-head screws securing the top cover, leaving the two screws in the center intact.

Turn unit back over, being careful not to misplace any of the six screws, which should now fall out onto the towel. Lift off the top cover. There should be a round, black dust cover on each of the six switches. Pull them off and set aside. Unplug the black cable, called the coax cable, from the silver box the cable is plugged into.

Turn the unit over again, and now remove the two center screws. With one hand underneath, lift the unit off the towel and carefully remove the inside electronics.

At this point I usually wash off the top and bottom covers with soap and water and set them aside to dry while I proceed with the repair.

Several of the more common problems can be fixed at this point. Check the bottom of all the switches carefully, sometimes they simply come unsoldered, especially, the RESET switch. Other problems that can be fixed at this time are a bad or chewed-up coax cable, a bad AC power jack (the tiny black

and silver box the wall transformer plugs into), and a broken 9-pin connector (where the joysticks plug in). Check the trouble-shooting/repair chart to find out what you need to do.

If it is necessary to go inside the metal case, proceed as follows:

Remove the six screws (four in some units) holding on the bottom plate. Set the screws and plate aside. Remove the two remaining screws.

The little board that the six switches are located on is called the *upper printed circuit board,* or UPCB. The board you have just exposed is called the *lower printed circuit board,* or LPCB. Disconnect the cable that joins the two PCB's.

Remove the lower PCB. It must be pulled out at an angle, because the socket where the cartridges plug in, (called J200) has been inserted at an angle. You have now broken the CX-2600 down into its most workable components.

Disassembly of the CX-2600A

Remove any game cartridges, unplug the power cord, TV cable and game controllers. Place a towel on a table or workbench. Turn the unit upside-down on the towel and loosen the four Phillips-head screws that hold the top cover on. Turn the unit back over, be careful not to lose the screws, which should now fall out onto the towel. Set the four screws aside.

The design of the 2600A is such that the inside circuit board is loosely attached to the top cover. Lift the top cover up a few inches and disengage it from the circuit board. Unplug the coax cable from the circuit board.

Now, I usually wash the top and bottom cover with soap and water and set them aside to dry, while I continue repairing the circuit board.

Several of the more common problems can be fixed at this point. Check the bottom of all the switches carefully, sometimes they simply come unsoldered, especially the RESET switch. Other problems that can be fixed at this time are: a bad or chewed-up coax cable, a bad AC power jack (the little black and silver box the wall transformer plugs into), and a broken 9-pin connector (where the joysticks plug in). Check the troubleshooting/repair chart to see what you need to do.

If it is necessary to go inside the metal case, proceed as follows.

Note that the top of the metal case is held down by four tabs that have been twisted. Using a pair of needle-nose pliers, carefully twist these tabs back, so they are straight. Sometimes, even with the greatest of care, these tabs break off. While it is not critical that all the tabs be intact, you will need one or two of them when you reassemble the unit.

The CX-2600A is now completely apart, and ready for your repair.

Reassembly

To reassemble, simply reverse the above processes. A couple of things to note. Be sure on the CX-2600 that the socket where the cartridges plug in, called J200, is properly inserted and seated in its slot. If it is not it will bend forward when the bottom plate is screwed in and you will not be able to insert any cartridges. Be sure to replace the round, black dust covers and plug the coax cable back in.

Troubleshooting steps

If during any of these steps a problem is encountered refer to the symptom/repair chart on the next few pages.

- Connect system to color television.
- Plug joysticks in.
- Insert *Missile Command* cartridge.
- Turn system on. Wiggle switch from side to side. Pull up on the switch. If the television screen pops on and off then the ON/OFF switch is worn and should be replaced.
- Turn COLOR/BW switch on and off. Screen should go from color to black and white.
- Select game number 18, this tests the GAME SELECT switch. (Switch should return to upper position automatically.)
- Push the RESET button to start game. This tests the reset switch. (Switch should return to the upper position automatically.)
- RIGHT and LEFT DIFFICULTY switches should be in B, or novice position.
- Make sure the volume on your television set is turned up.
- Push the RESET button to start the game. This tests the reset switch. (Button should automatically return to the upper position.)
- As the game starts, a pulsating high-pitched noise should be heard.

- When cursor appears test up, down, right, left and fire on the first player. Bullets should move rapidly. Finish playing first wave, then test the same functions on the second, or right player.

- After the first wave of missiles, place RIGHT and LEFT DIFFICULTY switches in the A, or EXPERT positions and repeat previous step. Bullets should move slowly.

If system tests out properly then proceed.

- Turn system OFF, and insert *Breakout* cartridge and paddles.

- Turn system ON, and select two player game.

- Play both right and left player. Cursor should move evenly and smoothly. If it jumps around, pot should be cleaned or replaced.

- Turn system OFF, and insert *Blackjack* cartridge.

- Turn system ON. The screen should be a bright green color.

- Allow system to "burn-in" for 30 minutes to an hour. This tests for any problems that may show up as a result of the game heating up.

- This completes the test. You have tested all major functions of the system.

Symptom/Repair Chart

Note: I will first cover the problems that can be handled without going inside the console.

Symptom:
Game will not turn on.

Repair:
You probably have a bad AC adapter/transformer.

Symptom:
Very snowy or distorted picture on your television. No picture at all, and you know the transformer is good.

Repair:
Check to make sure that the game is hooked up correctly, see your owners manual. If all is correct then you probably have a bad TV/Game switch.

Symptom:
When playing a game the cursor will not do one or all of these functions: Up, down, right or left.

Repair:
Probably a bad joystick. Swap the left and right joysticks. If problem "follows" joystick, then it is the joystick. If problem stays, then it is most likely a broken 9-pin connector.

Symptom:
When playing *Breakout* the cursor jumps erratically.

Repair:
Clean or replace the 1 megohm pot in the paddle which is acting up.

Note: All of the problems mentioned below necessitate going inside the main console. Proceed ONLY if you feel comfortable.

Symptom:
No sound.

Repair:
You must take the unit apart and replace two capacitors. Their values are 820 pfd (pico farad) and their numbers are C206 and C207. They are small, cylindrical and silver in color.

Symptom:
Player fires automatically on *Space Invaders,* even without joysticks plugged in. On *Missile Command* the player will not fire at all when the joystick fire button is pushed.

Repair:
For the CX-2600 replace the littlest IC on the lower printed circuit board (LPCB). It is called the *hex buffer* and it's the smallest IC on the LPCB with only 14 pins. Several companies make replacement chips, National Semiconductor makes the CD4050 and Motorola makes the 14050. Either one of these chips will work as a replacement.

To replace the chip, you must unsolder the 14 pins and then replace it. I usually put in a socket and then I insert the replacement chip. This way if it goes bad again, I can just pop out the old chip, no soldering involved, and slide in the new chip.

The CX-2600A group does not have a hex buffer chip in it. This symptom usually means you have to replace the chip called the *television interface adapter,* TIA. It's one of the big ones, its number is Atari C010444. No generic is made.

Symptom:
The game will not respond when the panel switches are changed. For example, color will not come on, right or left difficulty levels do not change, regardless of switch position.

Repair:
Check to make sure the switch is in proper working order. You can do this by using your DVM and measuring the ohms of the switch. In the down position your meter should read a very high value, close to infinity. If the switch does does not follow this pattern then replace it.

If the switch is all right you need to replace the capacitor, called a filter capacitor that is associated with the problem. Below is a list of the various symptoms and the name and value for each capacitor that needs to be replaced. (In all cases the voltage of the capacitor should be around 12-24 volts.)

Symptom	CX-2600		CX-2600A	
	Cap No.	Value	Cap No.	Value
Can't change				
right difficulty.	C223	.01ufd	C232	.001ufd
left difficulty.	C224	.01ufd	C231	.001ufd
No Color	C225	.01ufd	C233	.001ufd
Automatically				
game selects.	C226	.01ufd	C235	.001ufd
resets.	C227	.01ufd	C234	.001ufd
1st Player/Left 9-pin				
Cursor continually				
goes UP.	C232	.001ufd	C227	.001ufd
DOWN.	C233	.001ufd	C228	.001ufd
LEFT.	C234	.001ufd	C229	.001ufd
RIGHT.	C235	.001ufd	C230	.001ufd
fires.	C236	220 pfd	C217	470 pfd

2nd Player/Right 9-pin				
Cursor continually				
goes UP.	C228	.001ufd	C223	.001ufd
DOWN.	C229	.001ufd	C224	.001ufd
LEFT.	C230	.001ufd	C225	.001ufd
RIGHT.	C231	.001ufd	C226	.001ufd
fires.	C237	220 pfd	C216	470 pfd

If, after replacing the filter capacitor, the problem still exists then you should try replacing one of the larger chips, called the *RAM chip.* It should have "Atari C010750" written on it somewhere. It can also be replaced by the generic 6532 chip.

Remove it by alternately placing a small screw driver at each end, between it and the socket, and gently pry it up on the end. Note its orientation.

Symptom:
When you turn on the game you get vertical lines (usually white or yellow) on the television screen.

Repair:
Replace either the RAM chip or the TIA chip using the same procedures as above.

Symptom:
When game is reset, screen blanks out and goes back to game number one.

Repair:
Replace the RAM chip.

Symptom:
Wiggling the power plug at the power adapter causes the game to turn on and off.

Repair:
It could be a loose or broken wire inside the power cord, but chances are it's a bad AC power jack. The jack is located on the back of the main PCB. It's the little black plastic box that the AC transformer plugs into.

Symptom:
After playing a game for several minutes the television screen blanks out.

Repair:
Find the voltage regulator. It is the little square black device with three legs coming out of the bottom. It's located in the lower left-hand corner of both the upper PCB for the CX-2600 and the CX-2600A PCB.

We need to test it to see if it is bad. Plug in the AC power adapter and switch the ON/OFF switch into the ON position. Using your DVM or VOM, place the black lead on the center leg and the red lead on the right lead. You should read 5 VDC. If it's less than about 4.8 VDC, then replace it with a new generic 7805 regulator.

If it's OK then you probably have a bad RAM chip and it should be replaced.

Symptom:
Games appears jumbled on the screen, but normal sound can be heard.

Repair:
This problem is sometimes caused by not having your television on the right channel. Try channels 2, 3 and 4. Try adjusting the fine tuning on your TV. (See section on proper TV hook-up.)

Symptom:
Screen becomes snowy and/or no color after several minutes of play. Reset cures problem but only for a while.

Repair:
CX-2600 owners, try replacing the .22 ufd capacitors, (they look like green Chicklets) on the upper PCB near the ON/OFF switch. (Replace with .22 ufd 100 volt cap.)

CX-2600A owners, should replace the .1 ufd capacitor, C241 (it also looks like a green Chicklet) in the lower left hand corner of the PCB. (Replace with .1 ufd 24 volt cap.)

Chapter 4 notes

Chapter 4 notes

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Chapter 5

Mattel Intellivision I, Tandyvision, and Sears Super Video Arcade

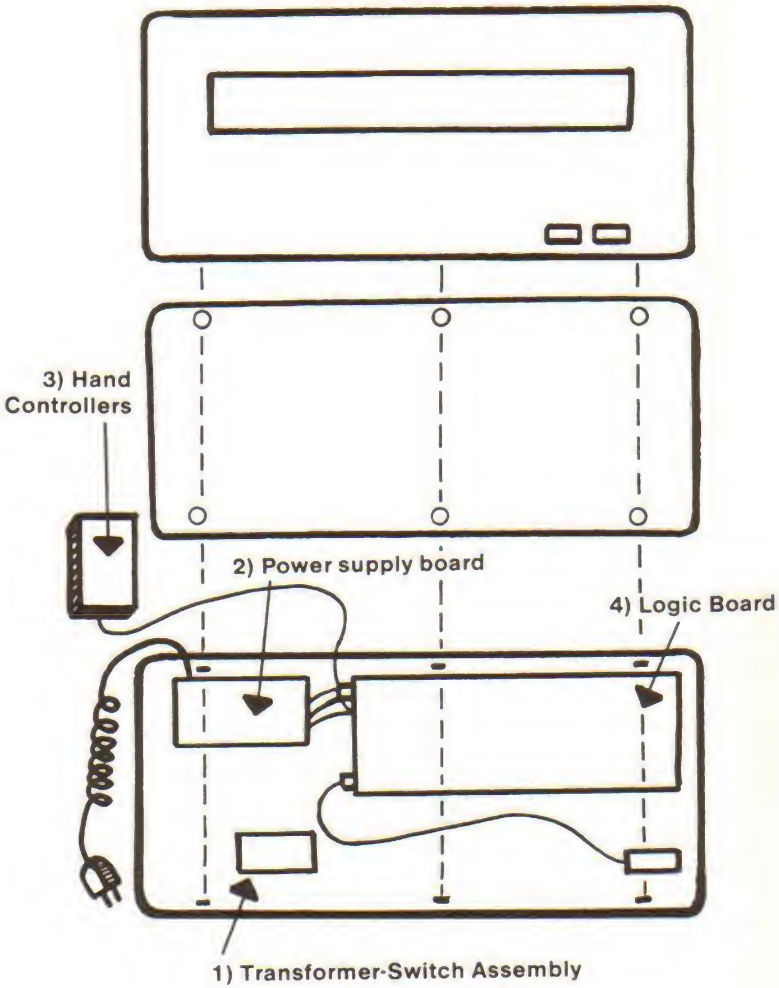
Overview and diagrams

This group of video arcade games, although comprised of more complicated circuitry, is actually easier to repair.

As you can see from the diagram on the next page, this system console is only comprised of four major components. I have listed them in their superposition order.

First, is the *transformer assembly.* The assembly is, itself, made up of smaller components, the AC power cord, the ON/OFF switch, the transformer and a small plastic connector. The AC power cord brings in the power from the wall outlet. The ON/OFF switch allows you to turn this power on and off. The transformer converts normal house current, usually 117 VAC, into two smaller voltages (listed in the troubleshooting section below). The plastic connector allows easy removal and replacement of the transformer assembly.

The next major component is the *power supply board.* It receives AC power from the transformer assembly mentioned above, and transforms it into several different DC values. Not


3) Hand
Controllers
2) Power supply board
4) Logic Board
1) Transformer-Switch Assembly

only does it convert the voltages, but it also stabilizes them for the logic board.

The third unit is the *hand controllers.* They are very important. The Intellivision will not work properly if the hand controllers are not finctioning properly. You can determine if the hand controllers are bad by using the troubleshooting section found later in this chapter. When you have determined that they are bad, you can repair them per the instructions given in Chapter 3, in the section on hand controllers.

The final unit is called the *logic board.* This board is the brains of the Intellivision. It is also very important, but it cannot work properly without all of the above working properly.

Note: Be sure NOT to overlook the coax cable, TV/Game switch and game cartridge as possible problem areas.

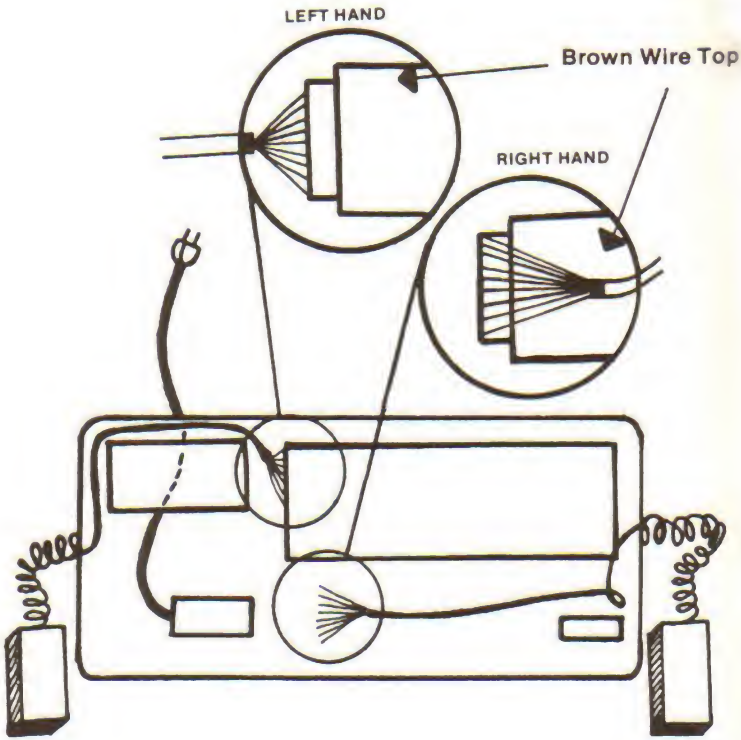
Disassembly

I should mention here, as I did in the previous chapter, that static electricity can be harmful to your unit. To avoid this, I try to do all my work in an area free of static, such as a wooden table. Sometimes taking off my shoes or spraying the area with a fabric softner (which usually contains a fabric suppressor), helps cut down on static build up. Do not attempt to repair your unit if static electricity is present.

Unplug the unit from the wall and from the television. Remove any cartridge from the machine. Turn the power switch to the ON position to drain any stored up voltage. Place a soft cloth on a table or workbench. Turn the console upside down and place it on the cloth. Using a Phillips screwdriver (some units may need a nutdriver), remove the six cover retaining screws. It's a good idea to put them in a small cup so they don't get lost.

Turn unit back over and gently lift off the top cover. The small brown cover for the ON/OFF switch will come off at this point. Weave the hand controllers through the holes in the top cover. I usually stop right here and wash off the top cover with soap and warm water, then set it aside to dry, before I proceed with the repair.

The insides of the Intellivision are now exposed. You should be able to identify the four major component groups. There is a brown plastic plate covering and scuring the logic board, transformer and power supply board. Remove the six screws holding down the plate, and place them aside. Unplug and remove the TV coax cable.



Note here how the hand controller cables are positioned. They must be positioned as not to interfere with seating of the top cover.

You have now broken the unit down into its most workable components.

Reassembly

To reassemble the unit, simply reverse the above process. Don't forget to replace the hand controllers and plug in the television coax cable.

Troubleshooting steps

The major problem with this category of video games is the hand controllers. Since this has already been covered in a previous chapter, we will not go into it here. (See Chapter 3.)

If during any of the following steps the unit fails to operate as described, refer to symptom/repair chart next page.

- Plug unit into wall and connect to television.
- Insert *Skiing* cartridge. Turn unit on.
- Game title should appear on screen.
- Push disk to start game. If game will not start, see symptom/repair chart at the end of this chapter.
- When prompted for "player" push "1," then push "enter."

- Game will now ask you to enter course number. We will use this to test the numbers on our hand controllers. We do this by pressing "1." The number "1" should appear on the screen. Hit "clear." The number should disappear. Cycle through all the numbers on both controllers. If any number doesn't work, then the hand controller is bad. See Chapter 3.

- Next, enter a slope number by pressing "5" and then "enter." Do the same for course number, press "5" and "enter." The game should now allow you to start the game by pressing the round disk on the controller.

- Make a run down the ski slope. Exercise the disk by trying to rotate the skier through several 360 degree rotations. Also try pushing the side buttons. The player should jump.

- Turn the unit off and insert the *Baseball* cartridge. Turn unit on.

- Press the reset button. The game will reset and the *Baseball* title will appear on the screen. Play a couple of innings, testing both side buttons. The top button allows you to bunt the ball, while the bottom button is a full swing, or bat. Be sure to test the left side and the right side buttons separately.

If after playing a couple of innings, everything checks out OK, clean and reassemble the unit.

Symptom/Repair Chart

Symptom:
When you turn game on screen clears, title comes on, but game will not play when hand controllers are pushed.

Repair:
Normally means one or both of the MPCBs must be cleaned or replaced. Sometimes you can simply open up the hand controller, clean it off, put it back together and it will work. (See Chapter 3.) If you have cleaned or replaced both MPCBs and the problem still exists, then you may need a couple of new hand controllers cables or a new logic board.

One good way of telling if your controllers are good or not is to try them on your friend's machine. If they work on his then there is a good chance you need a new logic board.

Symptom:
When you turn game on screen clears (turns dark), but game title does not appear on screen.

Repair:
With the power switch in the OFF position, take the cover off the unit. Unplug the transformer assembly from the power supply board. Place the power switch in the ON position. Using your VOM, test the following voltages.

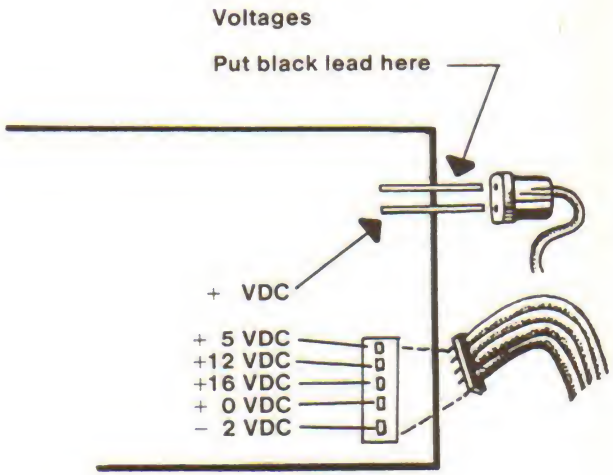
The first readings you'll need to take are the on the plastic connector of the transformer assembly. They are AC voltage readings. If the voltages do not read as follows, then replace the transformer assembly, it cannot be repaired.

Yellow
Blue
Green/Yellow
Green
Green

Yellow-Blue	18 VAC
Green/yellow - Any Green	9.25 VAC
Green to Green	18.5 VAC

Turn the unit OFF. Reconnect the transformer assembly to the power supply board.

Turn the unit ON. The next set of voltages are DC voltages and should be read from the other end of the power supply board. They can be taken right off the cables leading to the logic board.



If any of the voltages are not present, then the power supply board should be replaced. Some of you may want to attempt a repair on this board, go right ahead. I have found that most of the problems associated with the two voltage regulators, one is a 7805 and the other a 7812 regulator, or the two larger capacitors.

Symptom:
The small connector that the TV coax cable plugs into, called the RCA connector, is loose or broken. This usually causes the television picture to be very bad or snowy. Sometimes there isn't any picture at all.

Repair:

Replacing the logic board is usually the easiest thing to do. Unfortunately, it's the most complicated repair procedure you can do on the Intellivision. I will briefly describe how this is done. You will need a large soldering iron, 100-150 watts, to attempt this repair.

First, unplug all cables leading to the logic board, including the hand controllers, and remove it from the bottom plastic cover. Note that the silver side of the logic board is facing up and the black side is facing down.

Next, you will need to remove the silver and black covers from the logic board. This is done by unsoldering the 12 solder joints securing the top, silver cover, and the 12 solder joints securing the bottom black cover. I normally heat the joint with my soldering gun, while I pry the joint open. Once the joint is loose, I remove the gun and let it cool. This is easier than trying to remove the solder from each joint.

Once the covers are removed, you will be able to see another small silver box inside the logic board. This is called the RF modulator, a fancy name for a box that allows your game to talk to your television. Remove the top to the RF modulator and look down inside. You should be able to see a small resistor that should be soldered to the little tab protruding from the RCA jack.

Most of the time, what happens is the RCA jack becomes loose and begins to turn and spin. This twists the resistor loose from the RCA jack, 90 percent of the time. Unfortunately, 10 percent of the time the resistor remains fastened to the RCA jack and pulls out the circuit board beneath it.

If the resistor has come loose from the RCA jack, you should be able to run a bead of solder around the base of the RCA jack on the outside of the RF modulator. This will keep the jack from spinning any more. Then, resolder the resistor to the RCA plug.

If the resistor has come loose from the circuit board, you must turn the logic board over, unsolder the four remaining legs holding the RF modulator, and then remove the modulator from the circuit board. Then remove the bottom cover of the RF modulator. This will expose the circuit board and should allow you to resolder the resistor.

To reassemble, reverse the above complicated process. Now you see why I suggested purchasing a new logic board.

This should take care of most of the major problems concerning this model.

Chapter 5 notes

Chapter 5 notes

Chapter 5 notes

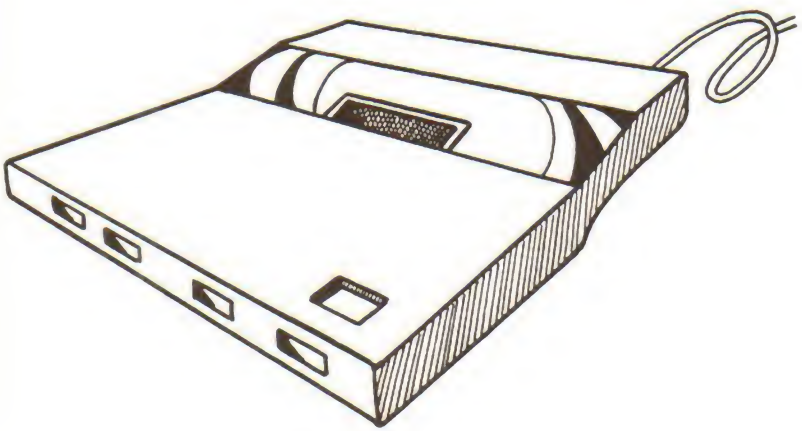
Chapter 5 notes

Chapter 6

Atari 5200

Overview and diagrams

The 5200 system is comprised of the following devices: the main console, two hand controllers, a power adapter, a deluxe TV/Game switch box (has a input for cable television), the switch box adapter, and of course, the game cartridges.



When Atari came out with the 5200, they tried to avoid some of the problems and inconveniences which existed with their CX-2600 and CX-2600A models. For one, using several different types of controllers. As already mentioned, Atari replaced these various controllers with one hand controller. (See Chapter 3 for more deatils.) Unfortunately, because of its increased use, it is more prone to breakage, a shortcoming of the 5200 system.

Also, as you may be aware, the 2600-series video games required a TV cord and a cord for the power adapter. These two cords were always getting knotted or tangled up around something, usually your feet. Atari simplified this by having only one cord run from the 5200 to the television.

It did, however, necessitate the addition of a device known as the *switch box adapter.* That's the small, black box that goes behind the television, which the cord from the 5200 console and the power adapter plug into. The addition of this box has its advantages and disadvantages. The advantage, as I've already mentioned, is it eliminates the need for multiple wires. The disadvantage is it complicates hooking up the system to the television and adds one more piece that can break down and cause problems.

Another obivious engineering change that was made on the 5200, was the elimination of most of the mechanical switches that were on the 2600-series. The switches broke often, and were a continual source of trouble. This was, in my opinion, a very good move.

Inside the 5200 is a completely different video game. The amount of RAM inside the 5200 was enlarged, allowing for better graphics and more sophisticated gaming. It basically is an Atari 400 computer without a keyboard. Unfortunately, the game cartridge format for the 5200 is completely different from that of the 400 computer, as well as the 2600-series.

Troubleshooting steps

Because the 5200 is a lot more complicated than any of the video games we have covered, I suggest that you scan the list of problems I feel are easy enough for us to repair, and if your problem is not on the list, refer your machine to a qualified service technician. In some cases, repair parts are only available through Atari authorized repair centers.

Symptom
Hand controller doesn't act properly.

Repair:
Check the connectors on the front of the machine to see if the pins inside them have been bent or broken. There should be 15 pins for each connector.

If they have been bent, carefully bend them back into place.

If they have been push inside the console, you can usually open the console up, and once inside the machine push them back into their proper position.

If the pins are broken off, then you must replace the 15 pin-connector. This part can be ordered from any of the parts suppliers listed in Chapter 7 of this book.

If the pins are OK, refer to Chapter 3, the section on hand controllers.

Symtom
When machine is turned on, you get nothing on the television screen at all.

Repair:
Make sure the system is connected properly (see your owner's manual).

Test the AC power adapter, by plugging it into a friend's machine or testing it with your VOM. Output should be around 9 to 9.5 VDC.

Test the TV/Game switch box to make sure it is in good condition. (See Chapter 3.)

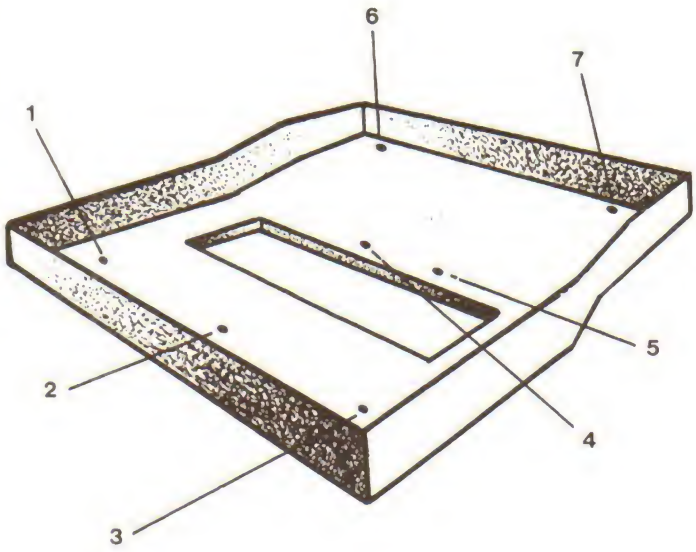
Make sure the switch in the switch box adapter is in normal position, rather than the standby position. While listening to the switch box adapter, push the ON/OFF button on the 5200 console, a clicking sound should be heard, if there is no clicking sound then adapter could be bad. Again, make sure that you have the switch on the box set to normal rather than standby.

If the problem still exists, refer your machine to a service technician.

Disassembly and reassembly

I should mention here, as I have several times before, that static electricity can be harmful to your unit. To avoid this, I try to do all my work in an area free of static, such as on a wooden table. Sometimes taking off my shoes or spraying the area with a fabric softner (which usually contains a static suppressor), helps cut down on static build up. Do not attempt to repair your unit if static electricity is present.

Disconnect all cables to/from unit. The cable that runs from to/from the 5200 console to the television *cannot* be removed. Turn the unit upside-down on a table, I recommend that you work over a towel or soft cloth to prevent any scratches. Remove the seven remaining screws and put them in a small cup.



Now, turn the unit back over and pull the top off. Set it aside. To remove the circuit board, gently pull it straight up and out of the bottom cover. Sometimes the front of the circuit board is a little stubborn and needs a little extra attention because of the two posts that the 5200 rests on, and they tend to hold it in place.

Note: The television coax cable cannot be removed! When you turn the circuit board over, to remove or replace the 15 pin connectors, be careful not to bend or crimp the cable.

To reassemble, simply reverse the above process.

Chapter 6 notes

Chapter 6 notes

Chapter 6 notes

Chapter 7

Parts

A supply of proper parts is essential to make any kind of repair. Some parts are more susceptible to breakage than others. Some parts can be repaired, while others can't. Certain parts are commonly available throughout the country at electronics parts stores, while others must be special ordered. And, of course, some parts are quite expensive, while others are cheap.

You are probably asking yourself several questions right now.

"OK, so this guy taught me *how* to repair my unit, but *where* am I supposed to get the parts?"

"What parts will I need?"

"How much will parts cost?"

"Which parts are easy to find, and which parts are not?"

"Are there any equivalent parts I can substitute, in case I can't find the orginal?"

"Should I keep an extra part on hand, just in case?"

"How can I get my boss to give me a raise?"

Well, with the exception of the last question, I'll try to answer all these questions for you.

Intellivision group

With the exception of the TV/Game switch, the coax cable and a few other parts found on the power supply board, all replacement parts needed for the Intellivision group are specially ordered. Below is a listing of the Mattel part number and a description of the replacement part.

Mattel Part No.	Description
2609-9629	Transformer/switch assembly
2609-9539	Power supply board
2609-9379	Logic board
2609-9059	Complete hand controller
2609-9589	Circuit matrix
2609-9579	Hand controller cable
2609-2079	Side buttons

A couple of note on ordering the above parts. When you order a new logic board (2609-9379), the price normally charged includes exchanging your old logic board. You should ask the supplier, when ordering, if you need to return the old board. Most parts suppliers will not exchange boards of the old logic board has been tampered with.

The side buttons for the hand controllers usually come in sets of two buttons. This is enough to repair one hand controller. Don't be afraid to ask your parts supplier to clarify questions you may have when ordering parts.

Atari CX-2600 and CX-2600A groups

Atari Part No.	Description	Notes
Miscellaneous		
CA014120	Regular TV/Game switch box	
CA010112	Deluxe TV/Game switch box	
A003647	TV coax cable	
CA014034	AC adapter	
C010806	J-200 socket (CX-2600)	Socket where game cartridge plugs in.
C015902	J-200 socket (CC-2600A)	Socket where game cartridge plugs in.
C010314	J-200 cover (CX-2600)	Black plastic cover for J-200.
C015573	J-200 cover (CX-2600A)	Black plastic cover for J-200

Atari Part No.	Description	Notes
Joystick		
C012116	Plastic insert	
C010726	Cable	
CA015396	PCB	
C012114	Fire button	
C012951	Fire button spring	
C012109	Rubber boot cover	

Atari Part No.	Description	Notes
IC Chips		
C010444	TIA chip	Seldom goes bad. Custom made.
C010745	CPU chip	Generic 6507 CPU.
C010750	RAM chip	Generic 6532 RAM.
C010816	Hex buffer	Can also use Nat. CD4050 or Mot. 14050.
none	LP IC socket	Replace bad hex buffer with LP IC socket and new hex buffer (14 pin).

Atari Part No.	Description	Notes
Console		
C010373	Slide switch	ON/OFF, color and difficulty (CX-2600) switches.
C010388	Momentary spring switch	Reset and game switch select switches.
C012241	Channel select switch	Channel 2-3 select switch and difficulty (CX-2600A) switches.
C010448	9-pin connector	Joystick ports
C010819	Voltage regulator	Can also use, generic 7805.
79-5918	AC power jack	
C010821	820 pfd caps	Replaced when sound is bad.

Atari Part No.	Description	Notes
Paddles		
C010464	1 meg ohm pot	
C010457	Paddle knob	
C010810	Cable	
C010739	Fire button	

Atari 5200 parts

Atari Part No.	Description	Notes
Miscellaneous		
C018187	AC adapter	Output is 9-9.5 VDC 2A.
CA018266	Switch box adapter	
CA010112	Deluxe TV/Game switch box	
C018013	15 pin connector	Joystick port.

Atari Part No.	Description	Notes
Hand Controller		
C018124	Flex circuit	
C018115	Rubber boot	
CA018145	Cable assembly	
C018127	Fire button	
C018126	12 key pad	
C018128	Pause-reset pad	

Suppliers

Below is a listing of the parts suppliers. I have tried to include address and telephone numbers where possible. I have also noted what type of parts each of them supply. Some suppliers are exclusively Atari, others are exclusively Mattel, one supplier carries both.

Supplier	Parts supplied		
	General	Atari	Intellivision
Best Electronics 4440 E. Sheena Phoenix, AZ 85032 (602) 992-3042	YES	YES	YES
Boyd Distributing 1400 West Third Ave. Denver, CO 80223 (303) 629-7701	NO	YES	NO
Jameco Electronics 1355 Shoreway Rd. Belmont, CA 94002 (415) 592-8097	YES	PARTIAL	NO
Ora Electronics 18215 Parthenia St. Northridge, CA 91325	YES	YES	NO
Mattel Electronics 13040 East Temple Ave. City of Industry, CA 91746 (800) 421-2826 Outside CA (213) 978-5847 CA	NO	NO	YES

Chapter 7 notes

Glossary of Terms

AMP Short for amperage. The unit of electricity that measures the volume of electron flow.

CAP Short for capacitor. (See section on device descriptions.)

Coax Cable The cable that connects the video game to the television set. It is a specially designed cable that cuts down on picture interference.

CPU Central Processing Unit. This is the brains of any computer or home video game.

Cursor The little dot on the screen that shows where you are. It can be shaped in different forms: tanks, balls, men, cars, etc.

DVM Digital Voltmeter also known as Digital Multi-Meter. Same purpose as the VOM, except it has a digital or numeric read out.

Filter Cap A capacitor that filters or allows glitches that might affect or harm a certain device to pass harmlessly out of the circuit. Sometimes they go bad and effectively cancel out the device they are intended to filter.

Flex-Circuit The plastic sheet which an electrical circuit is printed, which comprises the main element in the Atari 5200 hand controllers.

Hex Buffer A 14-pin integrated circuit on the Atari CX-2600 video game board. Also known as National CD4050 or Motorola 14050.

Logic Board The main circuit board in the Intellivision circuitry.

LP IC socket Low Profile Integrated Circuit socket. When IC chips have been soldered onto a circuit board and they go bad, it's difficult to replace them. The socket was designed to solve this problem. The socket is soldered to the board and a chip inserted into it. This way, if a chip goes bad all you have to do is pop it out of the socket and pop in a new one.

MILLI Stands for 1/1000th. One millimeter is one one-thousandth of a meter.

MPCB Membrane Printed Circuit Board. The plastic sheet inside the Mattel Intellivision hand controller.

OHM The unit of resistance. Symbolized by the Greek letter omega.

PCB Printed Circuit Board. A general term used in electronics to denote the board that all other components are mounted on.

PFD Pico Farad. Pico means 1/1000000000000. 1 pico farad would then be written .000000000001 farad or 1 pfd.

POT Abbreviation for Potentiometer. Also known as variable resistor. The volume control on television is a good example. It allows you to vary the level of sound from zero to as loud as you like.

RAM Literally means Random Access Memory. RAM is the part of a video game that remembers what game it's playing and the instructions. The RAM goes blank when the power is turned off.

RCA Plug The name for the plug on the end of the coax cable.

Regulator A small electronic device that regulates voltages. For example the 7805 is a +5 VDC regulator, 7812 is a +12 VDC regulator. The 7805 takes any voltage from +5 VDC to

about +24 VDC on its input and only allows +5 VDC to be output, the rest is turned into heat.

RF Modulator Radio Frequency Modulator. It is an electronic circuit that converts, or changes, signals to a level that your television can see and understand. In the video game context, it's usually a small silver box that the coax cable plugs into.

ROM Stands for Read Only Memory. It is also part of the video game memory. Unlike the RAM, it doesn't go blank when power is removed. It's better known as the game cartridge.

75 Ohm Lead Also known as coax cable. A round cable assembly consisting of a central wire surrounded by an insulator, which is enclosed in a braided wired sleeve. A final insulator is used to encase the other three components, acting as a protective covering.

Short A term often misused in the English language to mean a breakage or intermittent circuitry, e.g., "I have a short in my TV." More correctly defined as zero resistance between two points.

300 Ohm Lead Also known as "twin-lead" wire. A flat cable assembly consisting of two parallel wires encased in a plastic insulator.

TIA A specialized "chip" inside the Atari CX-2600 and CX-2600A. It stands for Television Interface Adapter.

TV Fine Tuning The adjusting knob on your television that allows you to fine tune your set.

UFD Stands for micro farad. Farad is the unit of measurement for capacitance, and micro means 1/1000000. One micro farad would be written like this: .000001 farad or 1 ufd.

UHF Ultra High Frequency. Denotes television channels 14-83.

VHF Very High Frequency. Denotes television channels 2-13.

VOM Volt Ohmmeter. A meter, device tool which allows you to accurately measure voltages (AC and DC) and resistance or ohms.

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