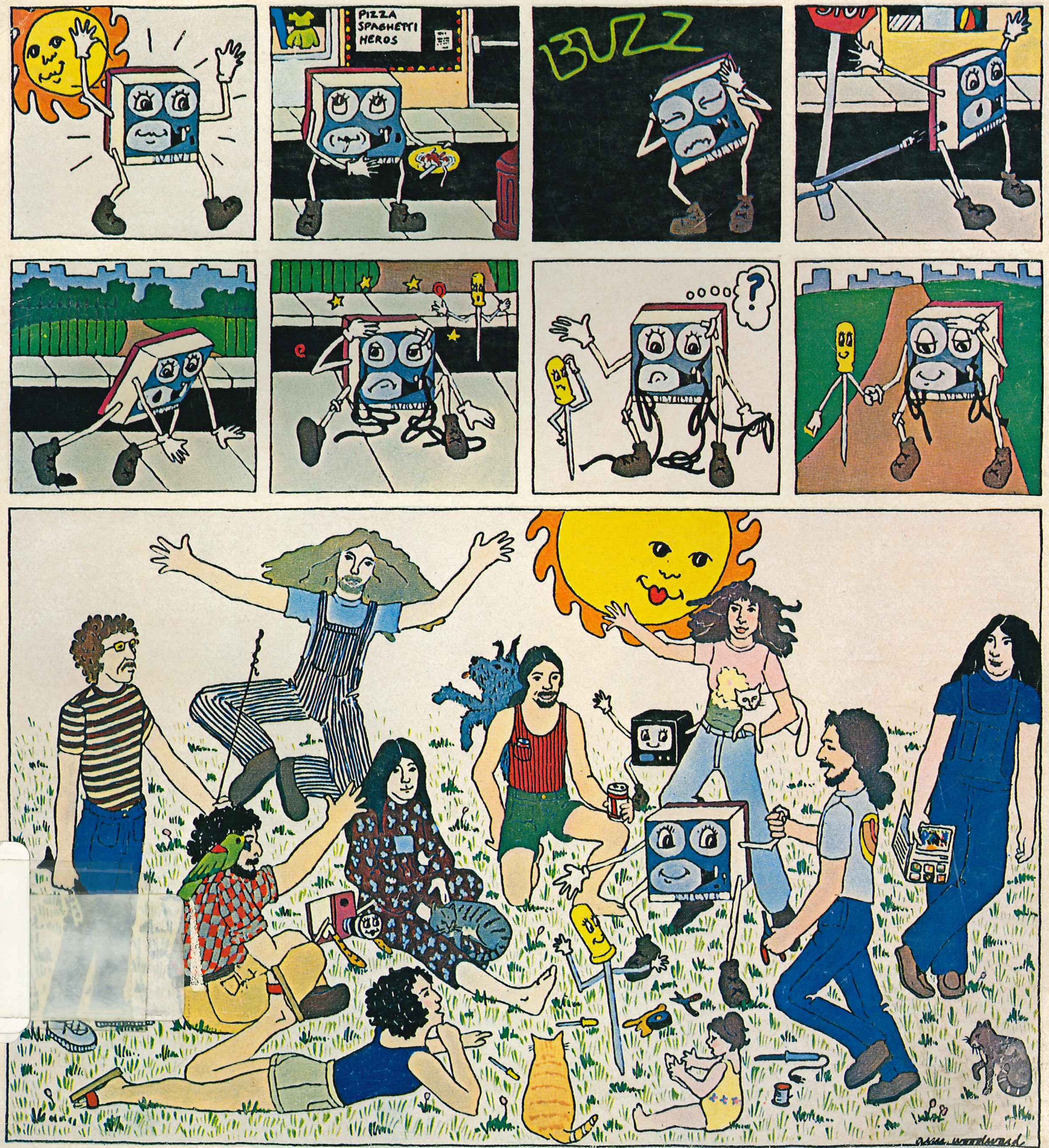
THE SPAGHETTI CITY VIDEO MANUAL

by VIDEOFREEX

a guide to use, repair, and maintenance



HANDBOOKS $4.95

THE SPAGHETTI CITY VIDEO MANUAL

IS A TECHNICAL MANUAL FOR THE NONTECHNICIAN. PORTABLE VIDEO EQUIPMENT IS ON ITS WAY TO BECOMING AS COMMON AS TYPEWRITERS. IT HAS USES FOR ARTISTS, EDUCATORS, BUSINESSMEN, POLITICAL ACTIVISTS, AND OTHERS OF ALL AGES. ATTRACTED BY VIDEO'S IMMEDIACY AND SIMPLICITY OF USE, THEY ARE RARELY TECHNICIANS. THEY ARE CONFRONTED BY A COMPLEX AND FRAGILE SYSTEM THAT IS PRONE TO MANY SIMPLE BREAKDOWNS AND A REPAIR INDUSTRY THAT IS EXPENSIVE, OVERBURDENED, AND VIRTUALLY NONEXISTENT OUTSIDE METROPOLITAN AREAS. "THESE ARE THE GROWING PAINS OF A NEW POPULAR TECHNOLOGY AND AS LONG AS THEY EXIST THERE WILL BE A NEED FOR THE SPAGHETTI CITY VIDEO MANUAL," SAYS JAIME CARO, DIRECTOR OF THE MEDIA EQUIPMENT RESOURCE CENTER (MERC).

THIS MANUAL CAN HELP YOU TO BRIDGE THE GAP BETWEEN THE MANUFACTURER'S PRINTED INSTRUCTIONS AND THE ELECTRONIC REPAIR TECHNICIAN'S EXPERTISE. IT IS A WELL-ORGANIZED, CLEARLY WRITTEN ILLUSTRATED HANDBOOK TO USE, REPAIR, AND MAINTENANCE OF VIDEO SYSTEMS, WITH BIBLIOGRAPHY, INDEX, AND *CATALOGUE RAISONNÉ* OF SOME EXISTING EQUIPMENT.

VIDEOFREEX

IS THE NAME OF AN INNOVATIVE GROUP CONCERNED WITH USES OF VIDEO.

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THE SPAGHETTI CITY VIDEO MANUAL

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TO CHUCK

AND

TO ANN

There are a few who made it possible to get this manual together . . . before it was too late. They deserve at least as much mention as screwdrivers, cables and fuses. So, we want to say a special thank you to Jody Sibert for her "earth" togetherness, and to Elon Soltes and Gael Varsi. Also, thanks to Nancy and the other people at Win Magazine; *and to the New York State Council on the Arts who have helped us to be around.*

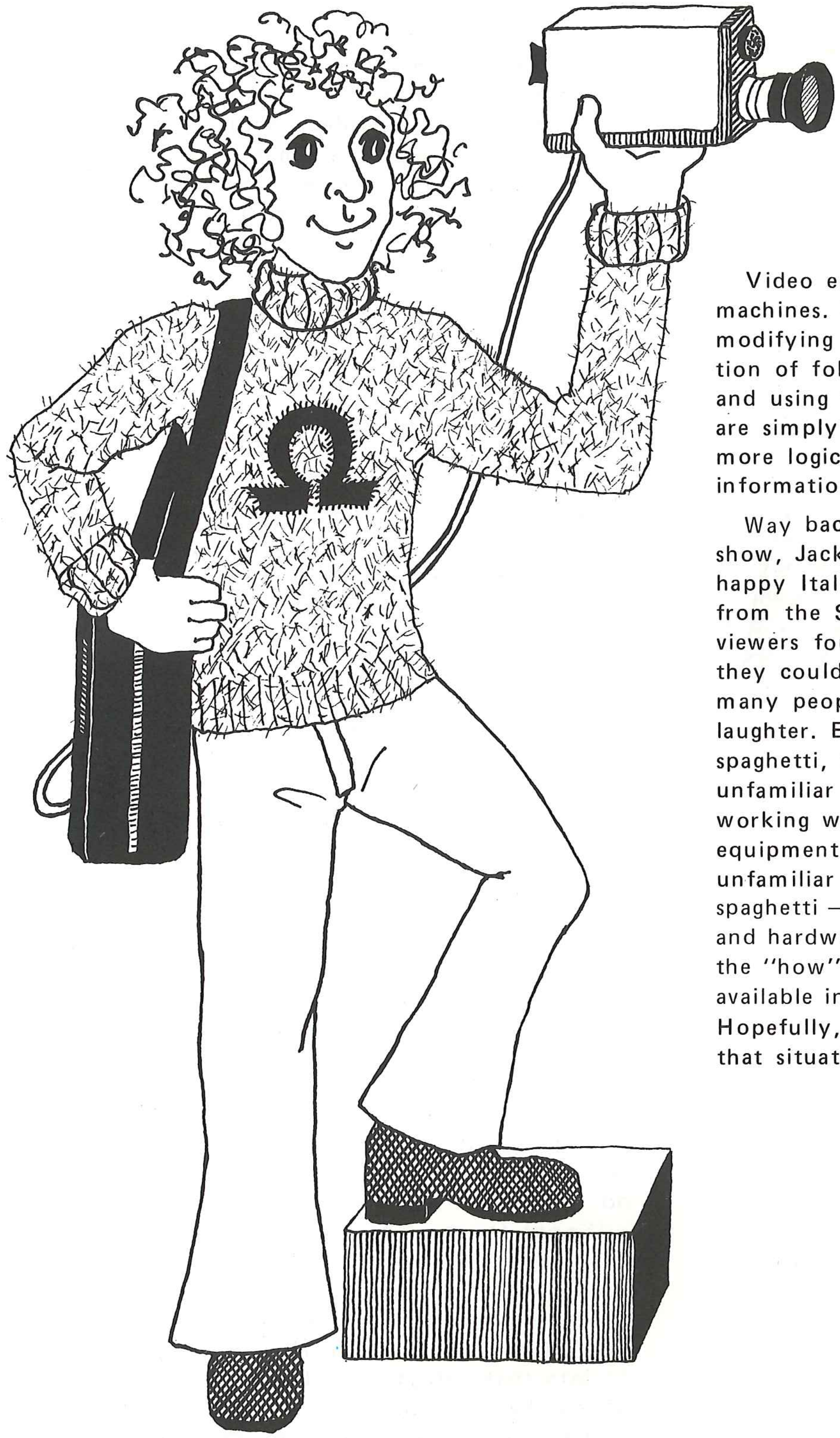
Table Of Contents

Introduction

Og invented the wheel and Sony invented the portable video recorder and something happened in between those two inventions to the way people exchange information that makes this manual necessary. Og had to maintain his wheel in order to use it. And, if Sony technicians were the only people using video, nothing would be different. But what about the rest of us who work with video? Og taught himself how to fix the wheel and passed that information on to other wheel users. Unfortunately, video people can't depend on Sony and the other VTR manufacturers to do the same, at least not in any commonly understandable form. So we're left with Og's original solution — learn to fix it ourselves.

That's what the manual is all about. It's meant to open up some options for people who want to become more self-sufficient with their video hardware. It's divided into four general sections: Theory, Systems, Basic Maintenance and Not So Basic Maintenance. The information in all of those sections is inter-related. The order of the sections is set up so that if you're unfamilar with video equipment you can move gradually from how it works to how to work with it.

Of course if you've never been around anything but a TV set, this manual will seem like gobbledygook and you might be better off spending your time looking for some video equipment to play with. If you've just gotten access to some video equipment, look at the pictures in the manual and see if you can relate them to the equipment around you. Almost every piece of equipment mentioned in the text is pictured. Read the explanations and procedures over more than once and if they don't make sense, don't worry. Two things are true of the answers to "how" and "why" questions about video — first, the longer you work with the equipment, the clearer the answers and explanations become and, second, no few-page explanation is ever entirely sufficient for most of these complex phenomena and processes. A lot of people who have been around video equipment for quite a while still aren't sure how it works. If you feel you fit into that category read the summaries of the theory sections first — you may find you know more than you think.



Video equipment is just so many machines. Using, maintaining and modifying those machines is a combination of following a few simple procedures and using your head. The theory sections are simply included to make it easier and more logical to apply the practical information.

Way back when, on the old Tonite show, Jack Paar showed a film of "the happy Italian peasants harvesting spaghetti from the Spaghetti Tree." Many of the viewers found the film informative but they couldn't figure out what made so many people in the audience crack up with laughter. Even though those viewers ate spaghetti, the technology of spaghetti was unfamiliar to them. Most people now working with portable, low-cost video equipment are also faced with the unfamiliar technology of spaghetti. Video spaghetti – the wires, cables, connectors and hardware – is only unfamiliar because the "how" and "why" of it hasn't been available in any comprehensive form. Hopefully, this manual will help change that situation.

Hardware

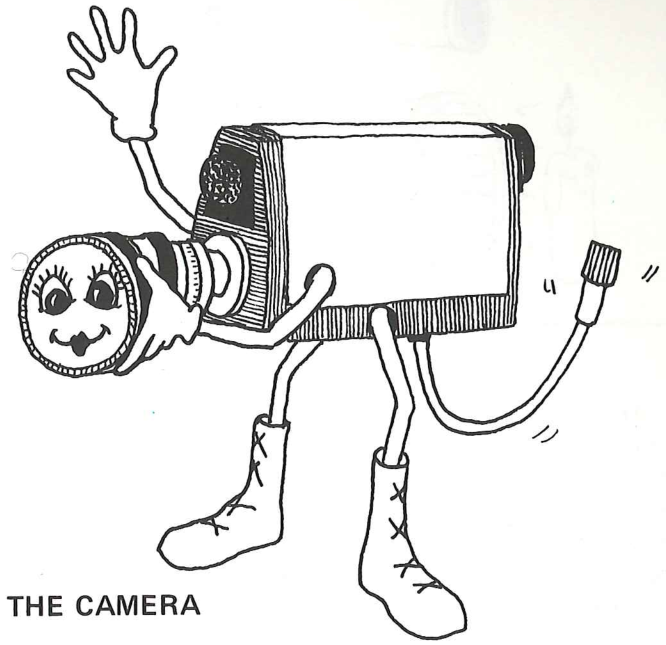
GENERAL NONSENSE

The function of a TV camera is to change the light that strikes it into an electrical signal. This electrical signal is called a *video signal.*

The function of a TV set or monitor is just the reverse – it changes a video signal into light.

The function of a video tape recorder (VTR) is to store or record the video signal. When a VTR receives a video signal from a camera, it converts that electrical signal to magnetism. This magnetism can be transferred onto video tape during the recording process. The process of changing the magnetism on the tape back into a video signal is called *playback*. The full process of making a video tape recording is: light is changed to a video signal in the camera; that signal is sent to the VTR where it is changed to magnetism; the magnetism is stored on the tape.

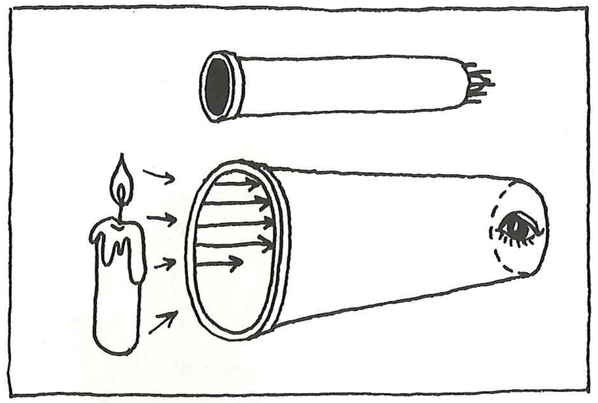
To play back the recording: the magnetism on the tape is reconverted to a video signal in the VTR – this signal is then sent to a TV set or monitor where it is changed back into a representation of the light that struck the camera – so much for process.



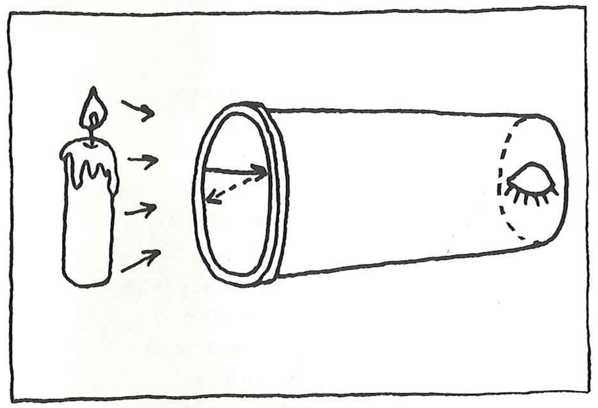
THE CAMERA

The one part of the camera most important to changing light into a video signal is the camera tube. In most low cost equipment it is a *vidicon tube,* although there are other types of tubes. The vidicon tube is a glass cylinder about the size of a fat cigar. One end of it faces the lens opening of the camera in which the tube is housed. That end of the vidicon is responsible for "seeing" the light that is in front of the lens. The surface of this end is coated with a *photoelectrically sensitive material.* When light strikes one side of a photoelectrically sensitive surface, a corresponding electronic reaction is produced on the other side of the surface. Very bright light equals a lot of electrical reaction; dim light equals a little; no light causes no electrical reaction.

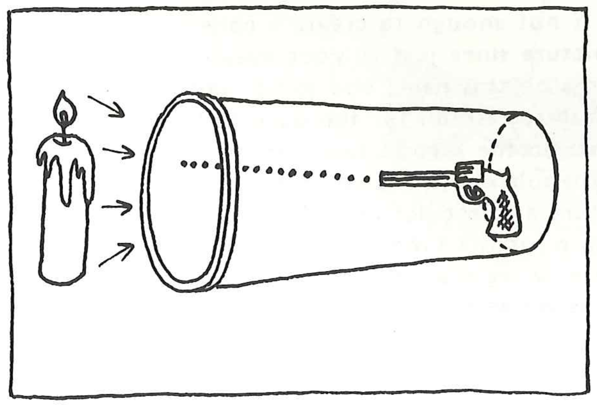
This is not enough to create a coherent video picture since just as your eyes see all the words on this page, you must read them in an orderly fashion for the page to be coherent. So the second function of the tube and the whole camera is to "read" or *scan* the picture at a regular rate. The method of scanning what the tube "sees" is very much like the way we read, for not only is the camera sensitive to one part of the surface of the tube at a time, but the electronics of the camera also cause it to scan the picture in lines from left to right — starting at the top and moving to the bottom.



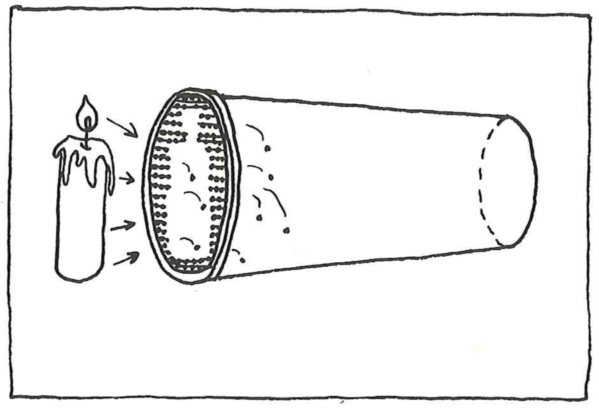
And, just as our eyes "shut off" as we move them from the end of one line of print to the beginning of the next, the sensitivity of the camera shuts off while the camera's scanning mechanism moves back from right to left. This shut-off time is called the *retrace* period.



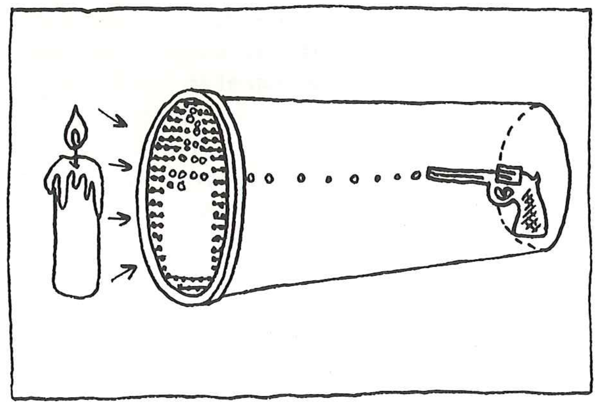
The scanning mechanism works like this. At the end of the tube farthest from the lens there is an *electron gun.* This gun shoots a beam of electrons at the photoelectric surface on the other end of the tube.



The camera aims and fires this gun exactly the way that the surface of the tube must be scanned in order to produce a coherent picture — one line at a time, top to bottom. Wherever light strikes the face of the tube, electrons bound to the photoelectric surface are lost.



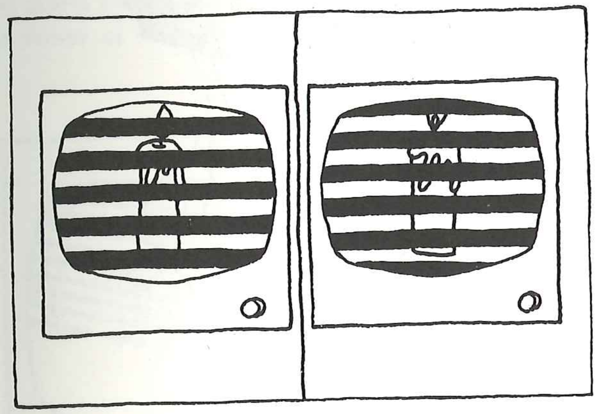
When the beam from the electron gun strikes the photoelectric surface, those beam electrons are able to replace the electrons lost where light is striking the tube.



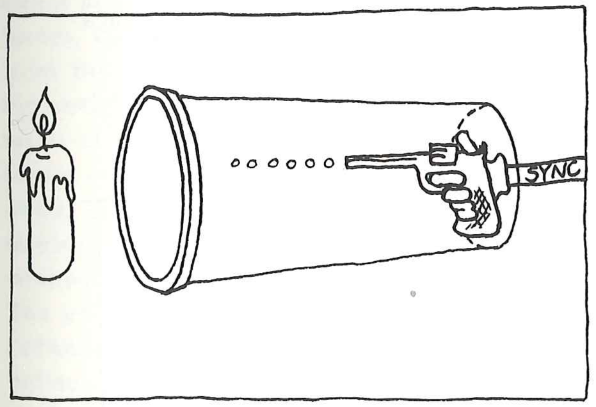
This replacement process can be sensed by the electronics of the camera and translated into a video signal. The electron beam continues to scan the surface of the tube as long as the camera is on. If there is no light striking the surface of the tube, there is no electronic reaction and, consequently, no video signal.

Each page of a book has space for the same number of lines. Similarly, the camera scans the same number of lines each time it "reads" the entire surface of the tube. The camera must scan 525 lines in order to "see" all the light striking the surface of the tube. When the camera has completed the scanning of 525 lines from the top to the bottom, it has scanned a full "frame."

However, the mechanics of video are such that the camera must actually scan the entire surface of the tube twice in order to produce a full frame. The camera scans twice by first starting at the top of the tube and scanning to the bottom — covering 262½ lines during the whole trip. To cover the remaining 262½ lines necessary to complete the frame, the camera scanner returns to one line short of the top of the tube where it begins to scan the remaining lines by filling in the spaces left between the first series of scanned lines. Each of these half-frames, composed of alternate lines, is called a *field.* In North America where the 525 line system is used, there are 30 full frames every second, Since a field is half a frame, there are 60 fields in every second.



That's a lot of scanning. The trick is to keep it all straight so that it happens on time, every time. Keeping the scanning on time, every time, is the job of the *sync,* or *drive pulses.*



The sync pulses are electronic command signals generated either from within the camera or from an external source. They tell the camera when and for how long to scan the tube. There's a lot more to be said about the sync . . . later. For now, it's important to know that the output of any camera must have both a video and a sync signal.

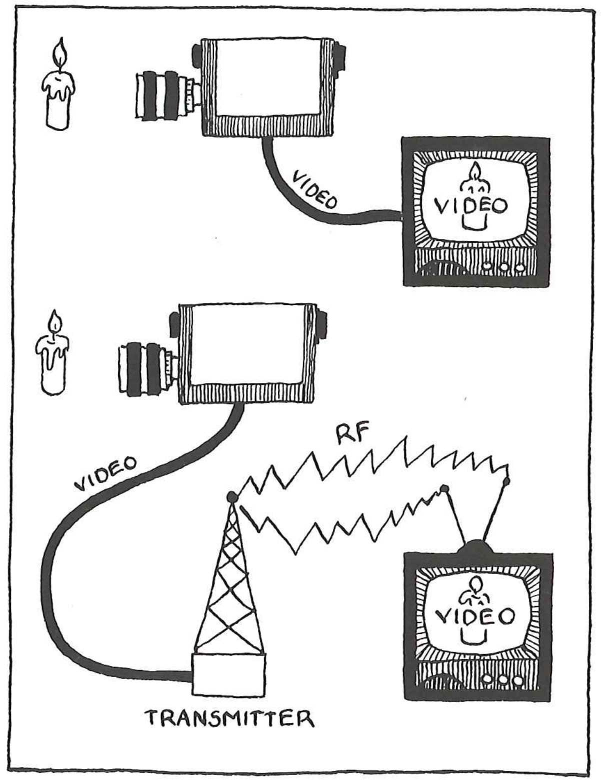
SUMMARY

A TV camera produces an electronic signal generated by the light that hits the photoelectric surface of its tube. The signal that the camera produces contains two types of electronic information. The first, called video, is information about the picture itself. Within certain limits, where the light striking the tube is stronger, the video signal is stronger; where the light is darker, the signal is weaker. The electron beam of the camera tube scans the surface of the tube. The electrons from the beam replace electrons lost where light is striking the photoelectric surface. This process is registered by the circuits of the camera which use it to produce the video signal. The second type of information the camera produces is sync, or the electronic pulses necessary to coordinate the camera's scanning procedure of two fields making up a full frame of 525 lines 30 times every second. Both video and sync are essential to the reproduction of a video signal on a TV or monitor screen and to the video tape recording process.

THE MONITOR/TV SET

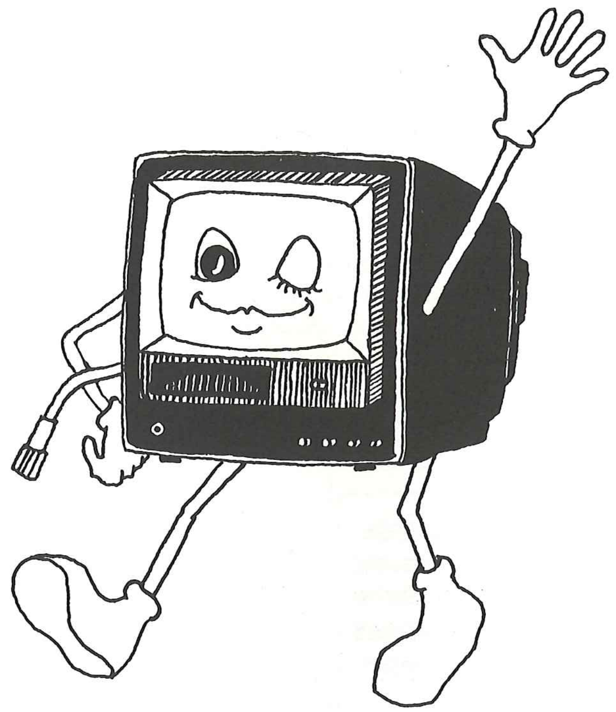
A video monitor and a TV set differ only in the way they receive the video signal. A monitor will accept a direct video signal such as the one generated in a camera. TV sets accept a broadcast or RF signal.

The letters RF stand for radio frequency. Any signal of radio frequency is capable of being radiated or transmitted through the air . . . something which you cannot do with a plain video signal. The source of an RF TV signal is a video signal. The video is changed to RF in order to allow it to be transmitted. Once it reaches the TV set, the RF signal is

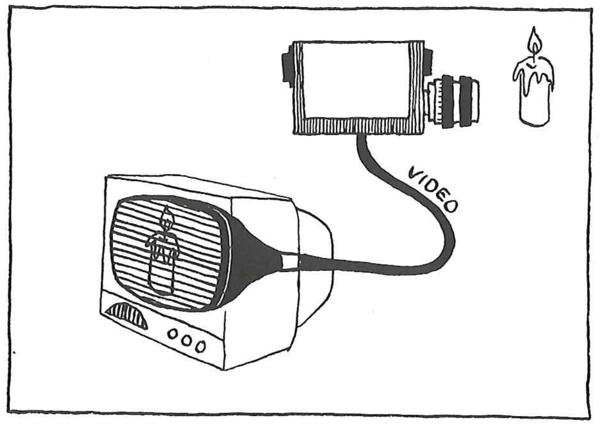


converted back to a video signal. It makes no difference to this explanation whether a monitor or a TV set is discussed since both monitor and TV set work on exactly the same principle.

The picture tube of a monitor is a kind of inverse camera tube. Just as in the camera, the picture tube of the monitor is also coated with a photoelectrically sensitive surface. But when the inside of the picture

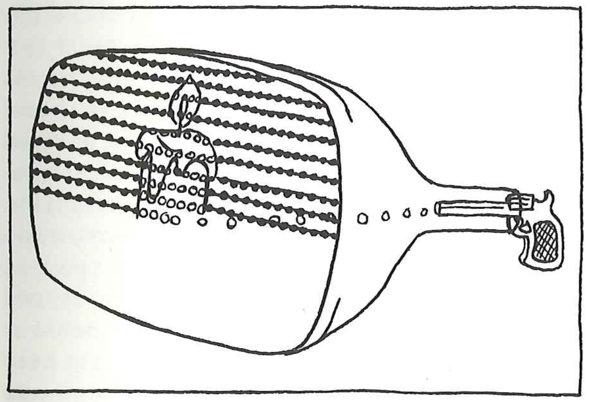


tube screen is struck by an electronic signal, that signal causes light to be given off on the outside of the screen. When a video signal from a camera (or VTR) is fed into the picture tube, the amount of light given off by the screen of the tube is directly proportional to the amount of light that is striking the face of the camera tube. In other words, the monitor "shows" what the camera "sees" . . . almost.

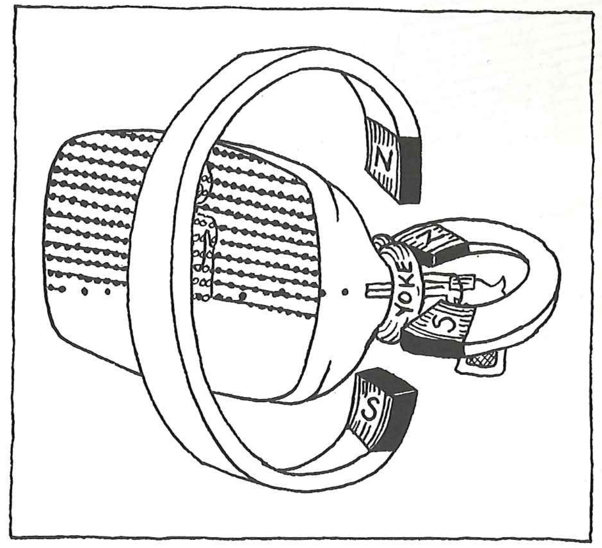


It is the job of the monitor to "write" the picture on the screen. The monitor, like the camera, must work in lines across the surface of the screen. In this process the sync pulse is absolutely essential because it gives the monitor the information necessary to coordinate the lines, fields and frames that the camera has scanned.

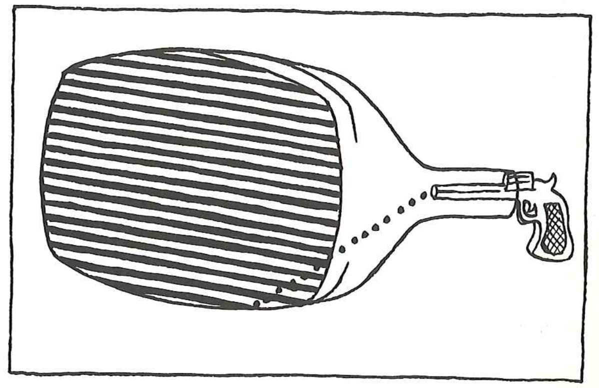
The monitor accomplishes the re-creation of the camera's picture by using an electron gun system similar to the one in the camera to shoot the video signal at the screen — line by line, one field at a time. The electron gun is located at the back of the picture tube (the part farthest away from the screen). It must be directed so that it scans each horizontal line in the same manner as in the camera.



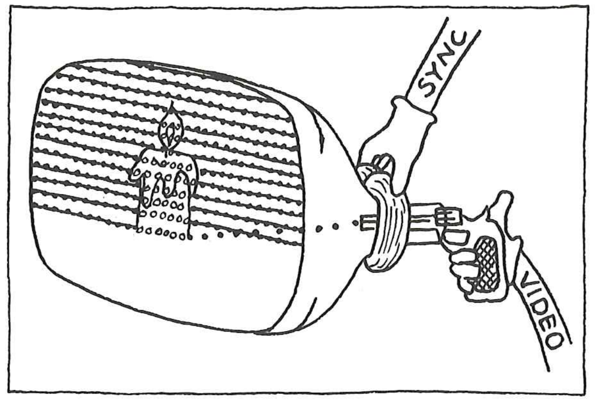
The beam from the electron gun can be either attracted or repelled by magnetic forces. By magnetically controlling the beam from the gun, the beam can be made to scan the entire 525 line surface of the tube in series of 262.5 lines at a time. These magnetic forces are created in the monitor tube by the *yoke*. The yoke is composed of two electromagnets made from thin copper wires wrapped around the neck of the picture tube. The yoke is activated and controlled by the deflection circuits of the monitor. The deflection circuits control the amount and timing of the magnetic forces in the yoke in order to draw the beam from the electron gun across the screen and from top to bottom and back again in the proper fashion. (The camera uses a similar system to direct its electron gun.)



The electron gun and deflection circuits function whether or not there is any video signal being fed to the monitor. The deflected electron beam simply creates 525 blank lines on the screen when there is no video input. These lines are called the *raster* of the monitor.



When a video signal is sent to a monitor two things happen simultaneously. First, the video controls the intensity of the beam from the electron gun. These intensity changes are registered on the screen as the light and dark areas of the picture. Second, the sync signal associated with the video controls the deflection circuits so that the scanning of the monitor happens at the same rate as in the camera.



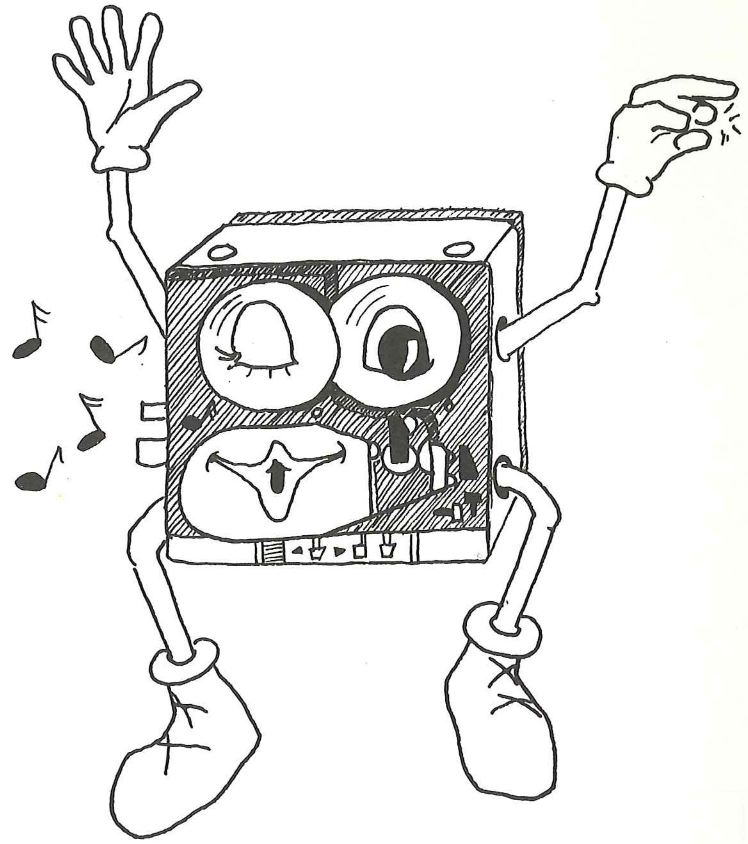
The last important factor necessary to the creation of a TV picture is the human characteristic of persistence of vision. The whole concept of TV depends upon the fact that our eyes retain the image of what they've just seen for a short time after they've just seen it — persistence of vision. It's the same effect you get in an exaggerated form when a flashbulb has just gone off in the immediate foreground or when a match is lit in a dark room and leaves a "streak" in the air. The fact that TV images seem to move realistically and that they don't appear as a series of lines and frames is because persistence of vision adds the necessary continuity to blend the frames together for your eyes.

SUMMARY

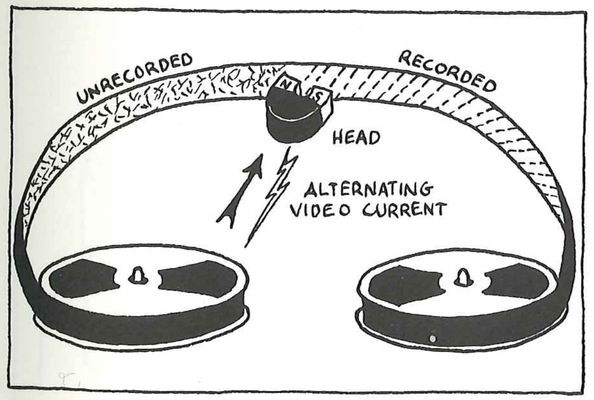
The TV monitor changes the video signal from electricity into light. This change takes place in the picture tube. The electron gun of the picture tube shoots the video signal at the photoelectrically sensitive picture screen. The yoke deflects the video signal across the screen and from top to bottom, creating a 525 line raster. The sync signal controls the deflection circuits so that each of the lines, fields and frames will start and stop at the proper times to fill the monitor screen. Persistence of vision allows us to recognize what we see on the screen as a TV picture rather than as discrete lines and frames.

THE VTR

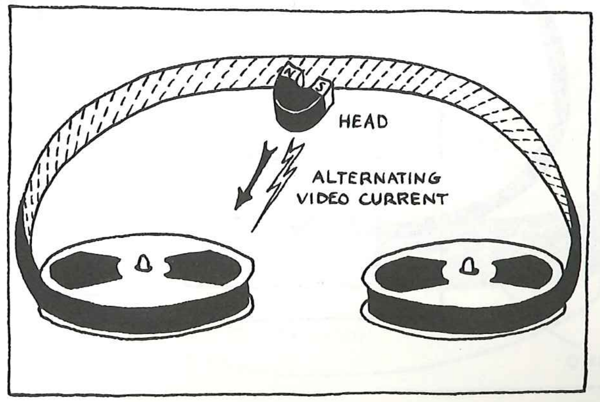
A video signal travels from a camera to a monitor at the speed of light. In fact, anywhere a video signal goes, it does so at the speed of light. Only by changing the signal to magnetism can it be made to "stand still" in order to be recorded. As of this writing, all methods of video recording in common use employ magnetic tape. There are other methods but they have little relation to low-cost VTRs.



Obviously, the basic principle in the making of a magnetic recording depends on the properties of magnetism, especially of electromagnetism. Video tape is made up of a thin strip of polyester plastic, coated on one side by a film of iron oxide particles. When there is nothing recorded on the tape, the oxide particles are magnetically neutral. But when the tape is passed over an electromagnet in which there is an alternating electrical current, the particles on the tape become magnetically oriented. This orientation is directly related to the alternations of the current in the electromagnet. Once oriented, the iron oxide particles on the tape can stay that way almost indefinitely. This orientation process is called *recording* and the electromagnets used are called *heads.* Video can be made to alternate through a head and is recorded in exactly this way.



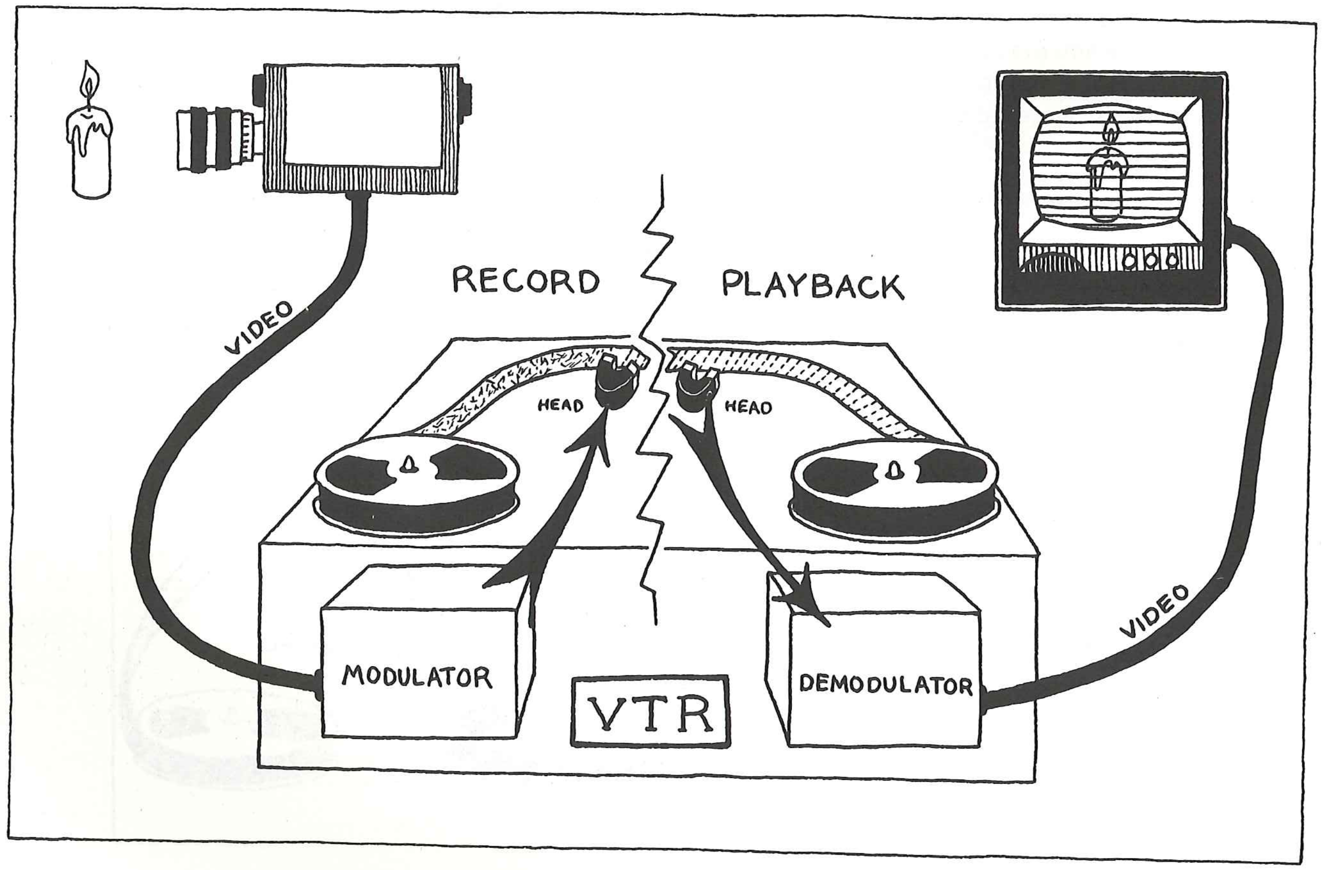
Video playback is based on the fact that magnetism can produce an electric current. When tape that has video recorded on it is passed over the recording head at a time when there is no incoming record current, the magnetically-oriented oxide particles on the tape produce an alternating current in the head. This current is exactly the same as the one which oriented the oxide particles to begin with. This reproduced current can be sent through the electronics of the VTR to a monitor where it appears (almost) exactly the same way the camera originally sensed it.



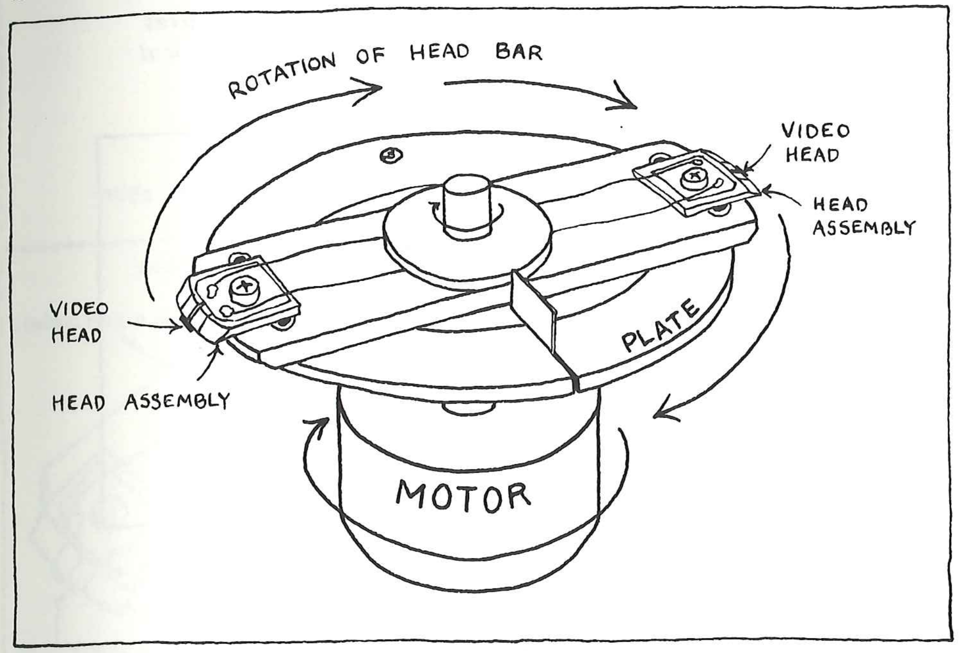
This process of using magnetic tape to reproduce an electronic picture is called *playback.*

The heads used to record and play back video are called the *video heads.* Sync is recorded and played back by the control track head. Audio (sound) is recorded and played back at the audio head which works on the principles described above.

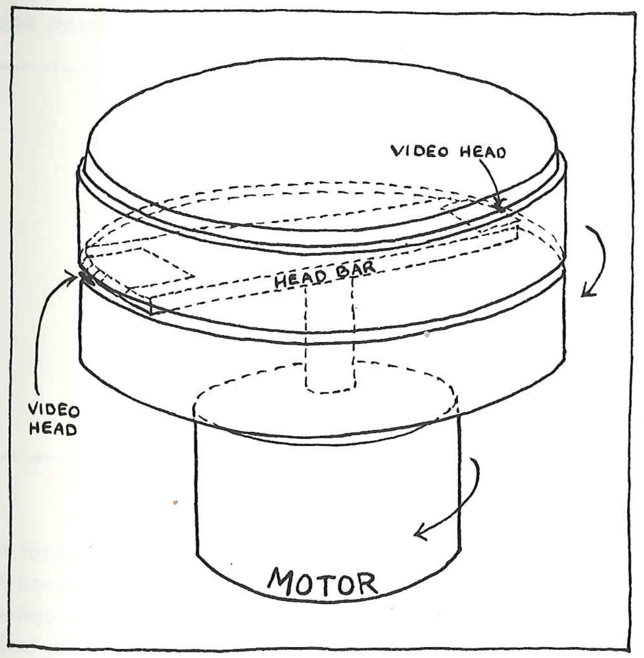
Actually, a video signal from a camera cannot be sent directly to the heads nor can the signal produced in playback be sent directly from the heads to a monitor. An electronic transformation of the video signal has to take place in both record and playback. In order to be recorded, a video signal has to alternate at a frequency which meets the requirements of the heads. The process of changing the frequency of the video signal while keeping the video information intact is called *modulation.* In playback the signal must undergo the reverse transformation — demodulation. Once the signal from the heads has been demodulated, the resultant video signal can be sent to a monitor where it appears the same as it was before modulation in the record process.



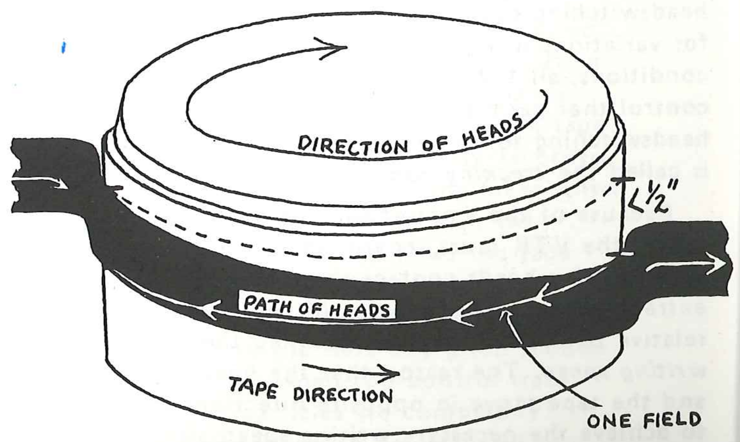
Type 1 standard 1/2" VTRs actually use two video heads — one at either end of a metal bar. This bar rests on a plate which is free to rotate.



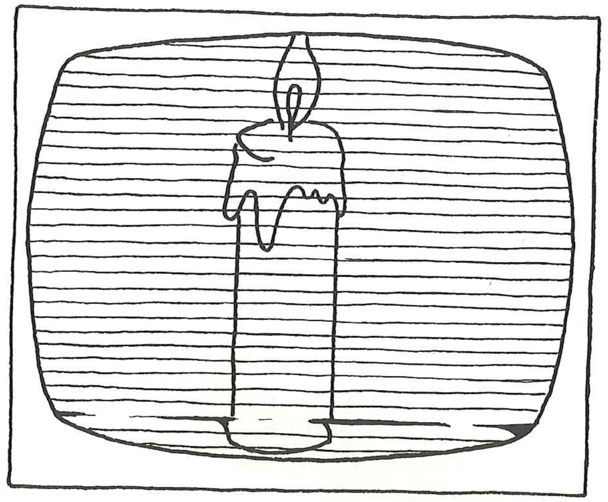
This plate with the head bar connected to it rotates on an axle which is connected to the motor of the VTR. When the motor is turned on, the head bar and plate spin around. This spinning metal bar is sandwiched between the two hollow metal cylinders which make up the drum assembly. The diameter of the drum assembly is just a little bit shorter than the length of the head bar so that the heads (on the ends of the bar) protrude from the rim of the drum.



As the heads spin around the rim of the drum, the tape is passed over them. But the tape moves in the direction opposite that of the heads. The head bar spins clockwise; the tape moves counterclockwise. Also, the tape passes around only a little more than half the circumference of the drum. Not only that, but the tape angles downward as it passes around the drum. When the tape first reaches the drum it is almost 1/2" higher than when it leaves the drum (180° + later). This angular movement allows the video heads to record over most of the width of the tape in what would appear as a long slanted line between the bottom and the top of the tape. The space is left at the top and bottom of the tape to allow the audio and control tracks to be recorded.



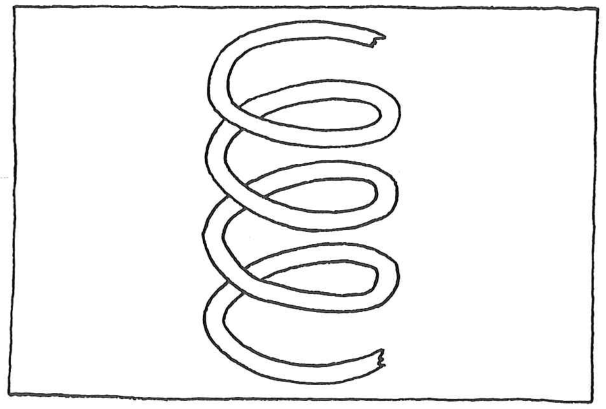
Each video head records (or plays back) one field of video every time it touches the tape. But because the tape passes around a little more than half of the drum, there is an instant when both heads are touching the tape at the same time. This instant when both heads are touching the tape is necessary in order to accomplish the changeover from one head to the other with a minimum of disturbance to the video information being recorded (or played back). This changeover period is called *headswitching* and is recorded on every half-inch tape. There is a certain unavoidable amount of interference associated with headswitching. In order to make this headswitching interference as visually unannoying as possible, it is set up to occur about nine lines before vertical sync. This means that it shows up at the bottom of the screen which, on most monitors, cannot be seen without mis-adjusting the vertical hold control. The headswitching appears as a serration of the picture a few lines wide.

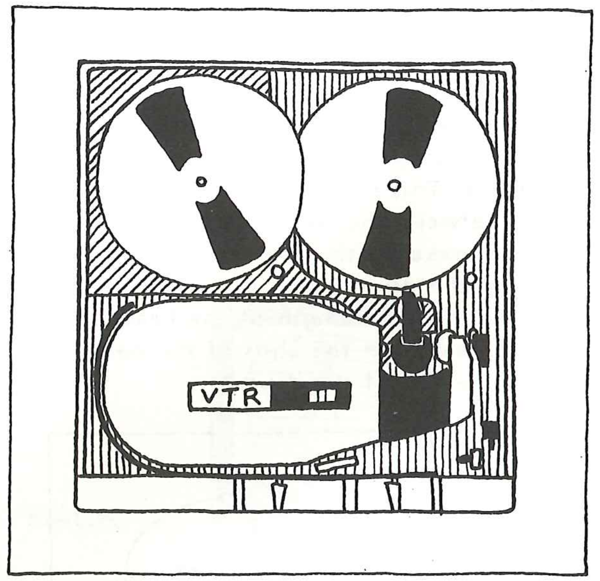


The specifications for any VTR which is 1/2" standard designate exactly where headswitching should occur. But to allow for variations in equipment and recording conditions, all 1/2" standard VTRs have a control that permits the position of the headswitching to be adjusted. This adjustment is called the *tracking control.*

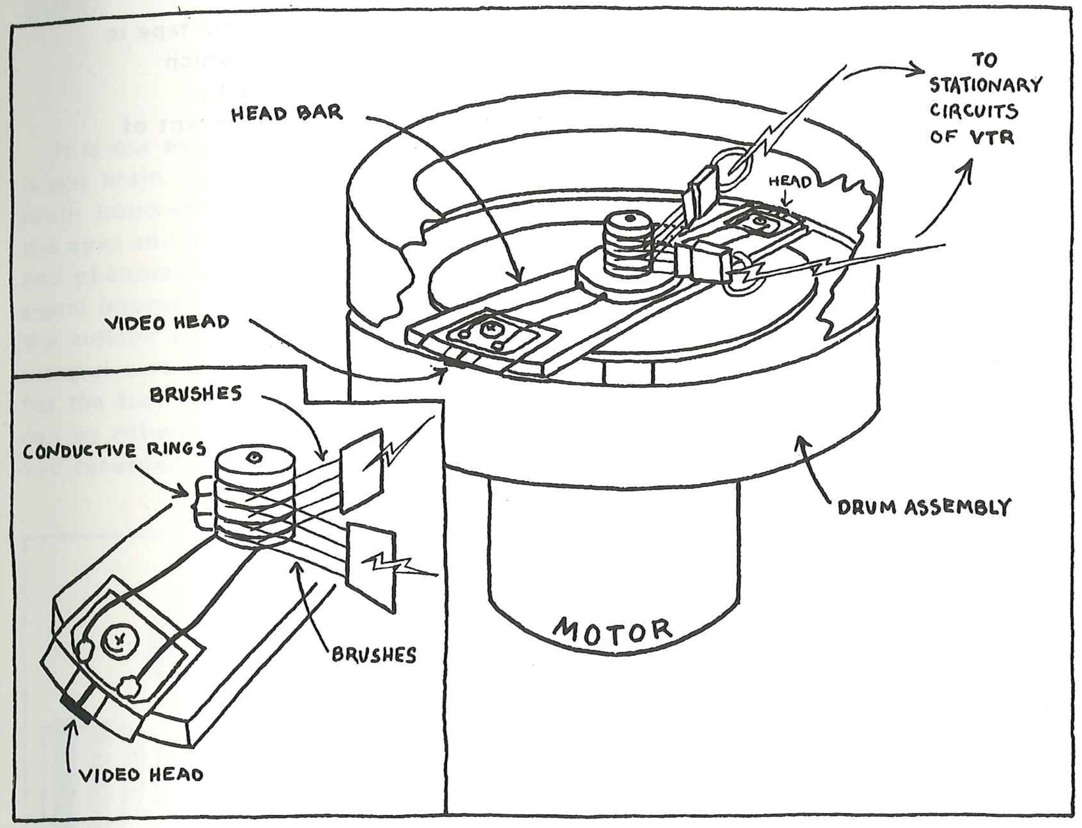
Because of the amount of information which the VTR must record, the velocity at which the heads contact the tape must be extremely high. The velocity of the heads relative to that of the tape is called the *writing speed.* The reason that the head bar and the tape move in opposite directions is to achieve the necessary writing speed and still have the head bar and the tape move at practical speeds.

The path that the tape takes when passing over the drum describes part of the geometrical figure called a helix and gives this method of recording the name *helical scan.*

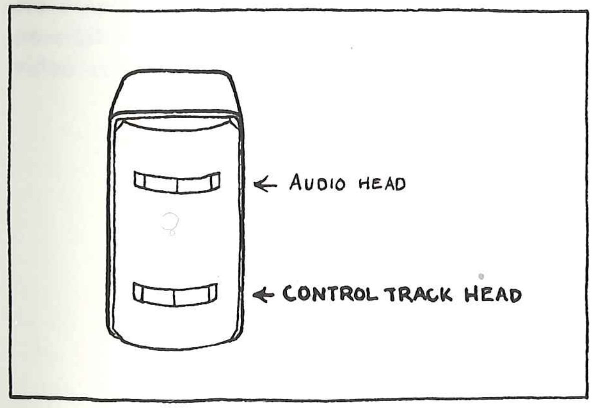




The video current is passed to and from the heads via the brushes. The brushes are contained in the drum assembly. They are small, finger-like wires which are connected to the non-moving circuits of the recorder at one end. At the other end they rest on metal rings mounted on the head bar. These rings are wired directly to the heads. As the head bar spins around, the brushes remain in constant contact with the rings making the transfer of signals possible.

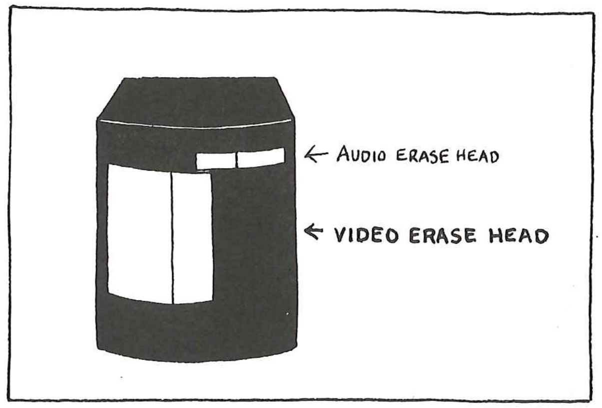


Just like the camera and the monitor, the VTR must have a sync signal in order to function properly. The sync signal affects both the tape and head speed so that fields and frames are recorded and played back exactly as they arrived from the camera. When vertical sync is recorded it is called *the control track* and is recorded and played back by the control track head. The control track head is a stationary electromagnet that receives the incoming sync pulses and records one pulse for every frame.

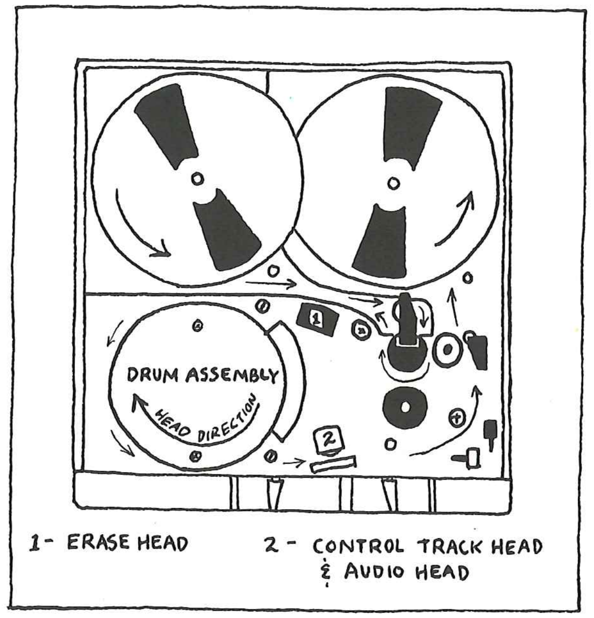


Because the information that the control track head must record is more regular and less frequent than video, the control track can remain stationary and still have a high enough writing speed.

The last essential function of a VTR is erasing the tape. This is done by the stationary erase head.



The erase head magnetically disorients the oxide particles on the tape by subjecting them to an alternating current of extremely high frequency. Once they are disoriented, the particles on the tape carry no trace of what was formerly recorded on them. In the path that the tape takes when moving from supply to take-up reel, the erase head is always the first head the tape passes over. When the VTR is placed in record mode, the erase head is automatically engaged so that by the time any given section of tape reaches the video and control track heads, the oxide particles are completely demagnetized and ready to be recorded on.



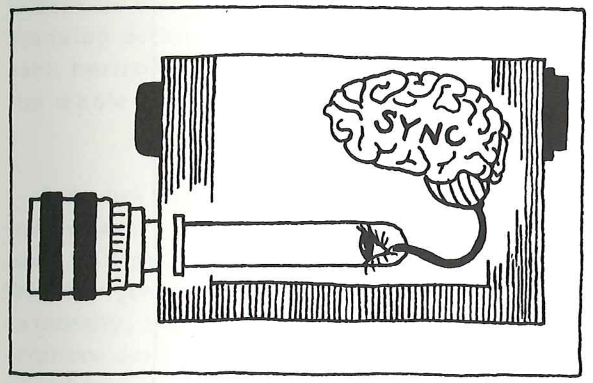
SUMMARY

Electromagnets called the video heads and the control track head magnetically orient iron oxide particles on video tape when the video and sync signals (in the form of alternating current) are fed to them during the record process. When the magnetically oriented tape is played back over the heads at a time when there is no incoming record current, the tape recreates the video and sync signals in the heads. However, in order to be recorded, the video signal must be modulated to the proper frequency. In playback, demodulation must first occur before the signal can be sent from the heads to a monitor.

Video is recorded by two heads mounted on either end of a rotating bar. The bar is mounted in the drum assembly around which the tape is passed. The tape and heads move in opposite directions. The tape passes around just over half the circumference of the drum so that both heads are touching the tape for an instant. Each head records one frame of video every time it touches the tape. The instant in which both heads are touching the tape is the changeover period and is called headswitching. The exact position of headswitching is adjusted at the tracking control. The tape and heads move in opposite directions to allow for the necessary writing speed. The control track records vertical sync in the form of control track pulses. The control track makes recording and playback coherent by supplying the information necessary to coordinate the tape and head bar speeds. Erasing the tape is done by the stationary erase head which disorients the particles on the tape by subjecting them to an alternating current of extremely high frequency.

SYNC

It is our eyes which look at things, yet it is our brain that is responsible for seeing. The brain imposes an order on the light striking the eyes and allows us to recognize objects and phenomena. In the same way the sync signal imposes an order on the light striking the vidicon tube. The sync becomes an integral part of the video signal and accounts for the fact that a picture from the camera can be coherently reproduced on a monitor and recorded on a VTR.



To work with video it is important not only to understand something about sync but also to get a feel for how much sync and video are dependent on each other. And, while sync is no more mystical a subject than video, it seems to be a constant stumbling block for people wanting to use, maintain and modify low-cost video equipment. An understanding of sync systems and how they are employed can tell you a lot about the possibilities for and the limitations of the video equipment you are using.

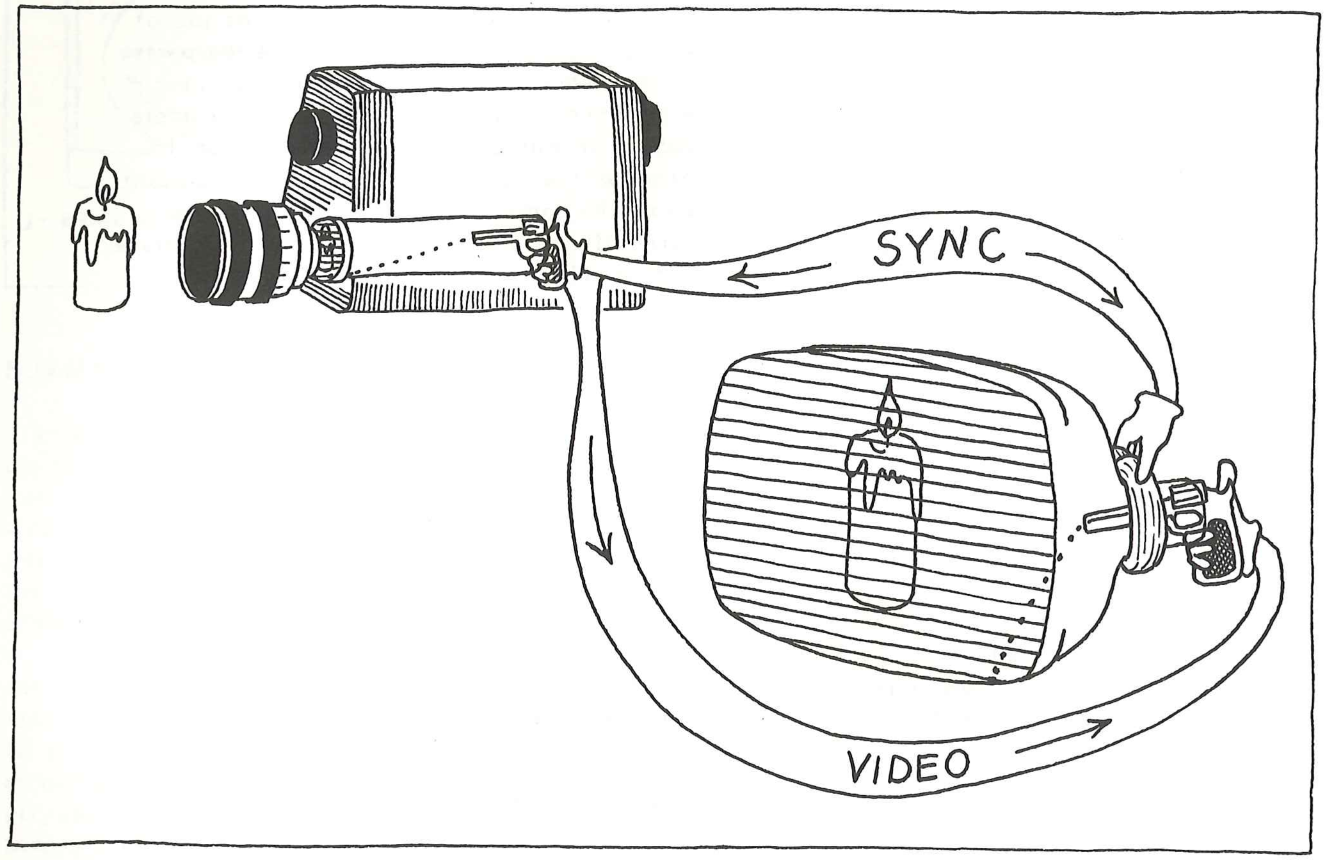
The two essential parts of any sync system are the *horizontal* and *vertical pulses.* To understand how these two signals work, it is important to remember that the electron beam in the camera tube scans from left to right, top to bottom at a rate of 263.5 lines 60 times every second. It is the job of the sync signals to make sure that the parts of the camera which are sensitive to video are turned on when the beam in the camera tube is scanning and off when it is not. In other words, sync turns on the video curcuits when the camera scanner beam is on and turns off the video circuits during the retrace period. There is an "on" and a "retrace" time for each scan line. Horizontal sync is responsible for turning the video on and off for each of those lines.

Vertical sync is responsible for starting each new field. Therefore, in the ideal sync system, there are 525 horizontal sync pulses for every two vertical pulses (if the numbers are getting you confused, go back and read the "Camera" section that talks about fields and frames). When the sync signals are combined with video on one wire, the whole signal is called *composite video.*

At this point it's important to make a subtle but important distinction about sync. The sync signal that is used to operate the camera is not exactly the same as the one which comes from the camera as part of the composite video. The camera actually uses what are called horizontal and vertical *drive pulses.* These drive pulses have an electronic shape and strength that is much better suited to operating (driving) the electron gun circuits of the camera than the actual sync pulses are. These horizontal and vertical drive pulses are used by the camera to create the horizontal and vertical sync pulses that are part of the composite video signal. For the most part, this distinction is ignored when talking about video. Both drive and sync pulses are generally referred to as "sync." This is because the drive pulses occur at exactly the same rate as the sync which they generate and also because it is usually clear when the word "sync" is substituted for "drive."

Because the raster of the monitor is exactly the same as the scan rate of the camera, a monitor receiving video *and* sync from a camera is able to coherently re-create the image produced in the camera. The sync pulses enable the electron gun in the monitor to reproduce the video on the monitor at exactly the same rate as it was generated in the camera.

Thinking of these black and grey areas as "bars" is a bit deceptive. What they actually are is a series of pulses which lasts for a certain time period. The time period represented by the entire grey area, including black area, is called the *vertical blanking period.* The vertical blanking period is the time during which the electron beam in the camera (and the electron gun in the



A VTR records and plays back horizontal sync along with the video at the video heads. A form of vertical sync is recorded at the control track head. That, in its simplest form, is what sync is all about . . . but that ain't the whole story!

Sync is quite visible on a monitor screen. It is a signal that is sensed by the electron gun and displayed on the surface of the picture tube. Vertical sync appears as a black line which runs across the width of the screen. By mis-adjusting the "vertical hold" control on a monitor (a TV set with a broadcast signal will do) you can see the sync line "roll" through the picture. If you look at that bar carefully, you will see that it is made up of two parts. The borders of the bar are grey but there is a thinner, black line contained within the grey areas.

monitor) completes its retrace from the bottom of the picture to the top. The time it takes the beam to accomplish the retrace is about the amount of time it normally takes the beam to scan 15 horizontal lines. The vertical drive pulse shuts off the video circuits of the camera during vertical blanking and there is no video on the screen for this period of 15 lines. This "no-video" or blanking period shows up on the monitor screen as the grey "bar."

Because there is no video during the blanking period, it is an ideal time to insert the sync pulse. The vertical sync pulse shows on the monitor screen as the black bar within the grey one. It too represents a period of time — the period of time necessary for the pulse which starts each field. Since vertical sync is not video information, it

must be "hidden" somewhere within each field where it can't interfere with the video. Obviously, the vertical blanking period is the best, and only, place to do this.

Horizontal sync is not as easy to see as vertical. Many monitors are too sensitive to allow the "horizontal hold" knob to be mis-adjusted to any great degree and still maintain a picture. The reason for this is that by mis-adjusting the horizontal hold, you are mis-adjusting the basic rate at which each line is being scanned by the electron gun. The result of mis-adjustment is a mish-mosh of lines dancing across the screen. But visible or not, horizontal sync also works within its own blanking period — one blanking period and one sync pulse for each horizontal line . . . But that ain't the whole story either!

Sync has to be generated from somewhere — either from within the camera itself or from an external sync generator. Whether generated within the camera or externally, the sync system is called *interlace sync* since the lines of each field of video are spaced between — interlaced with — the lines of the preceding and following fields. Yet there are a number of kinds of interlace sync. And because sync is the determining factor of the stability of any video signal, the types of interlace sync and the means by which they are generated reflect varying degrees of stability.

A sync generator is like a watch — the more sophisticated and well designed it is, the greater its accuracy. And with sync, as with time, accuracy is of paramount importance. The mainspring of a sync generator is an electronic device called an *oscillator.* An oscillator electronically vibrates (oscillates) at a predetermined rate. Many sync generator oscillators oscillate on the rate at which the horizontal scan lines must be generated. That rate is called the *horizontal frequency.* By electronically processing those oscillations, each horizontal sync pulse can be derived.

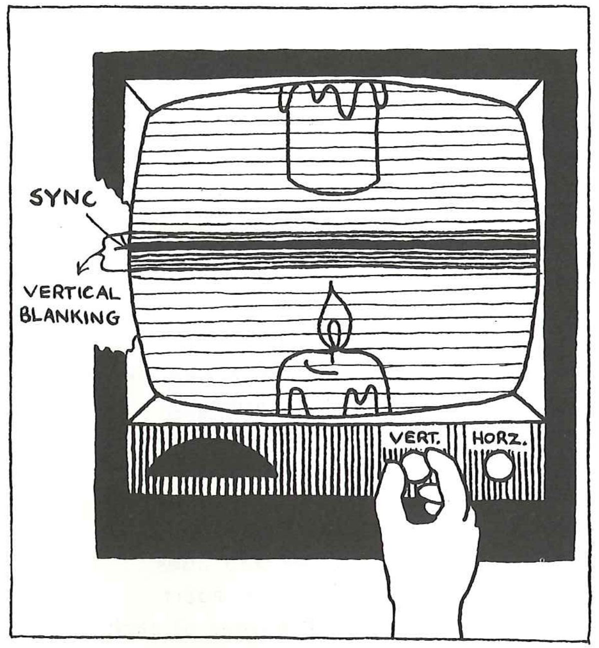
Since the vertical sync rate or vertical frequency is 1/263.5 of the horizontal frequency, vertical sync is produced by an electronic "count down" circuit which senses only every 263.5th oscillation. Thus, vertical sync is actually a component of horizontal sync. Actually, in order to generate the necessary level of stability, vertical sync lasts for a period of time equal to six horizontal lines which accounts for the black "bar" in vertical blanking.

Some sync generators use the exact opposite of this system. That is, they use vertical sync as the basic frequency and multiply or "count up" to get the horizontal. This is generally a less accurate way to produce sync.

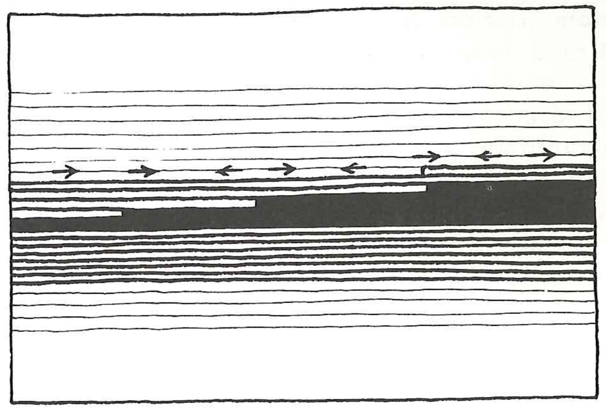
It is the way in which the oscillations are processed that determines the stability of any sync generation system. The "lowest common denominator" system of sync generation is called *random interlace.* The word "random" comes from the fact that no attempt is made to insure that each of the 525 lines in every full frame is spaced evenly apart. Random sync sees to it that the lines of each field fall into their given spaces between the lines of the preceding and following fields, yet those lines may fall *anywhere* within those spaces. The result of this is that the picture often appears to have a wavering quality. It also means that vertical sync is not exact since the lines at the beginning and end of each field are apt to end unevenly in the vertical blanking period.

Random interlace sync is the least stable type of sync. It is also the least expensive means of generating a sync signal. This makes it ideal for surveillance systems in supermarkets and awful for making video recordings. VTRs depend on a fairly exact sync signal because the recorders themselves have a number of mechanical and electronic variables to overcome in record and playback. If the sync signal that is being recorded is inexact, the recording is often a failure. Even when a video signal with random sync can be recorded, transferring that tape to another VTR and/or editing it, are almost always out of the question.

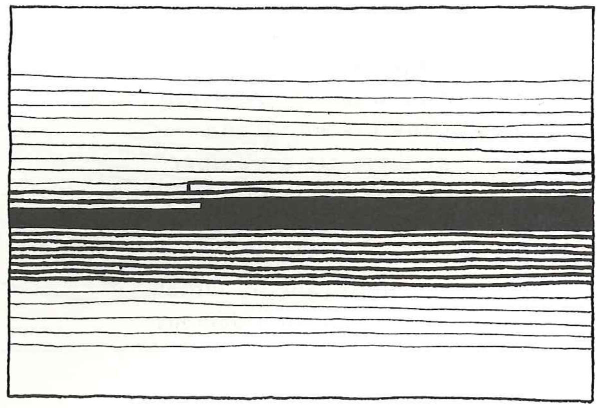
If you ever question whether or not a particular camera is using random interlace sync ("running random"), the best way to tell is to roll the vertical blanking bar to the center of the monitor screen. Use the vertical hold control to keep the bar steady and examine the top of the vertical blanking bar. The top of the blanking bar should be the thin black bar of vertical sync.



If there is a white line dancing rapidly from one side of the screen to the other at the point where vertical sync begins, then the sync signal is random. This white line is actually the cutoff point for the end of each field and it is an indication of the variations which occurs with a random sync system.



The next step up in sync generation is called 2:1 (interlace) sync. 2:1 sync is a general description for all types of sync other than random. On the most basic level, it differs from random sync because each interlaced line is spaced an even distance apart from the lines of the preceding and following fields. This also means that each field starts in the proper place. This provides an infinitely better system for recording video. The way to check for 2:1 sync is to roll the vertical again so that the blanking bar stays where you can observe the top line. If you are looking at a monitor attached to a camera running directly off a 2:1 sync generator, you should see a "stair step" in the middle 1/3 of the screen that begins vertical blanking. The first line of vertical sync will actually take up only 1/3 to 2/3 of the width of the screen. This beginning "stair step" should vary little if at all. However, in watching tape playback, especially of tapes made on portable VTRs, the recorder may tend to alter the beginning of the vertical blanking period so that there will be extra "steps" added to the "stair step" that normally begins vertical blanking. The position of the beginning of blanking may also be offset but the initial "step" or "steps" will be confined to one area of the beginning of sync as opposed to random sync which starts randomly across the initial lines of sync.

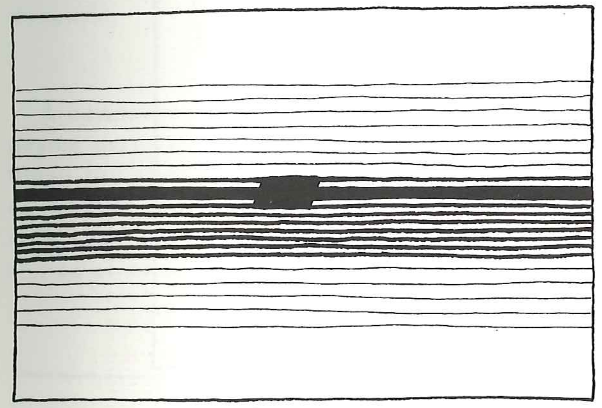


But 2:1 is just a general category of sync. One specific type of 2:1 sync is called industrial 2:1, but is now mostly standardized under the basic technical specifications of EIAJ – Type 1 standard sync. All 1/2" type 1 standard VTR equipment is built to operate on, and/or produce, this type of sync. EIAJ stands for Electronic Industries Association of Japan and it is that organization which has set 1/2" sync standards. The EIAJ feels that any sync signal that can meet their specifications is fully utilizing the capabilities of present 1/2" recorders. They may be correct.

The last category of sync must meet the standards set by the American EIA. The main difference between Industrial EIAJ sync and EIA sync is that EIA sync

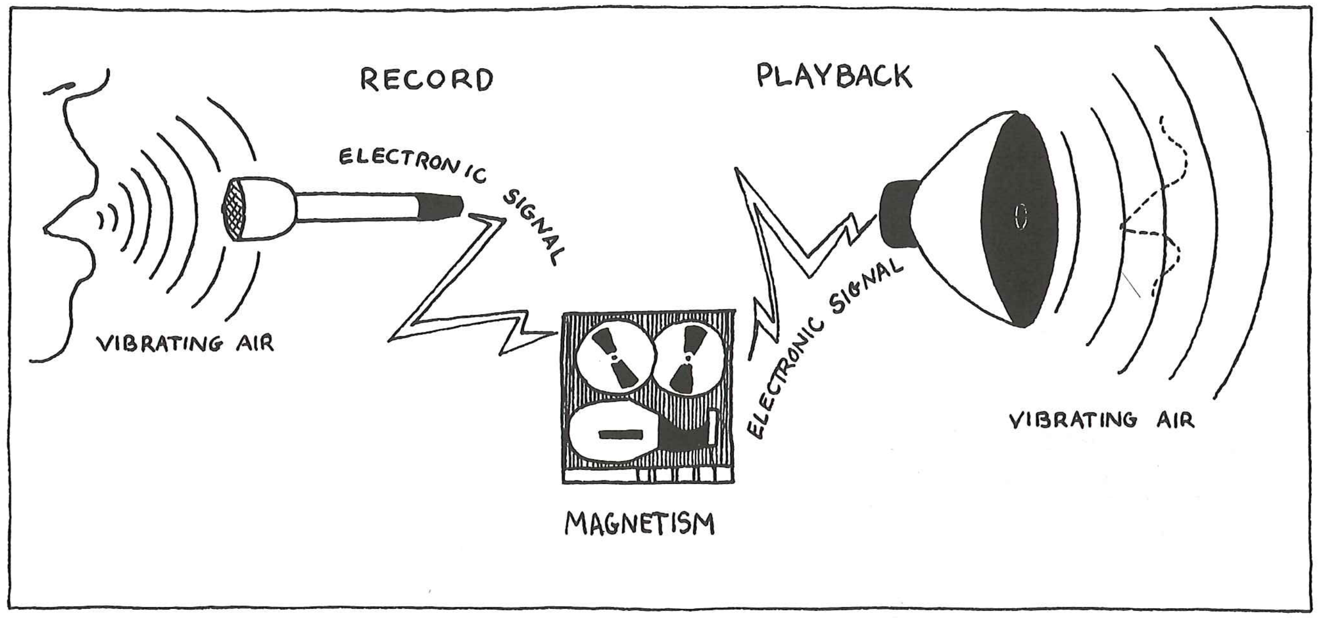
maintains a type of horizontal sync throughout the vertical blanking period. Both 2:1 (EIAJ) and random sync systems actually cut off the horizontal sync pulses that would normally come during the vertical blanking period. EIA sync, however, uses altered horizontal sync in the form of equalization pulses all during the vertical blanking period in order to maintain the most stable picture possible. Of all the types of sync applicable to American (meaning, for the most part, Japanese) standard TV equipment, EIA sync is the most sophisticated and therefore the most stable.

EIA sync is easy to recognize. Roll the vertical blanking on the displaying signal you want to check on (or on a TV set receiving any regular broadcast signal). The black sync bar of EIA sync has a black box in the middle.



This box is a visual representation of the equalization pulses. Only EIA sync has this kind of sync configuration.

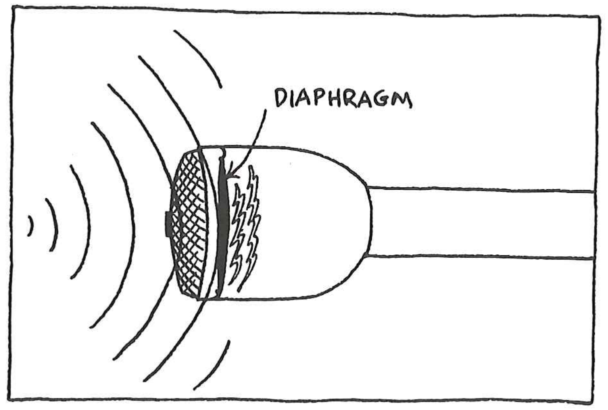
Sound is produced by vibrating waves in the air. These waves vibrate at different frequencies and at different strengths. Frequency differences are heard as different pitches — high or low. Strength is heard as volume — loud or soft. These loose explanations are the basis for an understanding of how sound — audio — is recorded and played back and how the the equipment to do this functions.



In the process of recording audio on magnetic tape, the sound waves must first be changed from vibrating waves into an electronic signal. The electronic signal is then converted to magnetism and stored in magnetic form on the tape. When the tape is played back, the magnetism is changed back into an electronic signal which can then be transformed into vibrating waves in the air that closely resemble the waves of the original sound.

The principles of magnetic recording have already been covered in the VTR section. An audio signal needs no sync pulse to control its coherency. The fact that the audio is always "synched" to the visuals (e.g., no lag between lip movement and the voice that goes with it) is because the audio is recorded simultaneously with the video, and the audio head on every 1/2" type 1 VTR is exactly the same distance from the video heads. Thus, in playback on another standard VTR the audio and video portions of the tape reach their respective heads at the same time and are played back simultaneously. In all standard 1/2" VTRs the audio and control track heads are contained in the same housing.

The instrument responsible for changing sound into an electrical signal is called a *microphone* (mic). Most mics are directly responsive to the vibrations in the air by means of a thin membrane called a diaphragm. The diaphragm is stretched like a drum skin across the part of the mic facing the incoming sound. The diaphragm vibrates as sound strikes it.

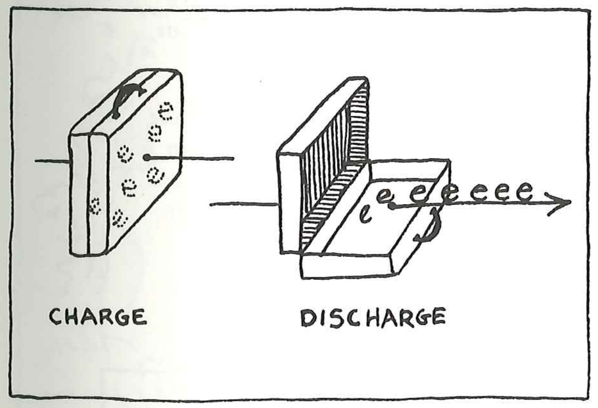


In turn, the diaphragm is connected to one of a number of systems that change its vibrations into an audio signal. It is those systems which determine the quality and sensitivity of the microphone and also give each mic its generic name.

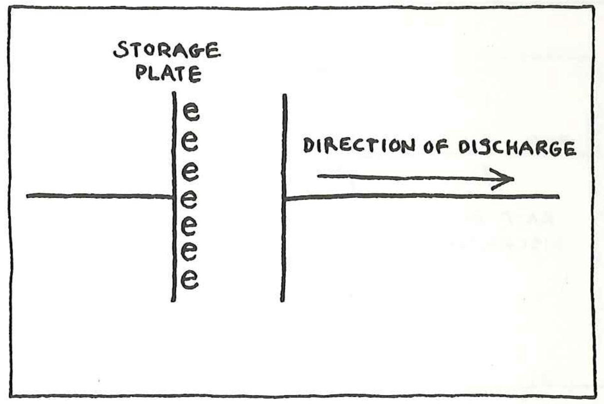
There are three types of microphones in common use with VTR equipment: condensor, dynamic, and crystal microphones. Even though mics can be generally classified by these names, there are also other ways to refer to mics and these other ways describe more specific characteristics of each mic. However, it is first necessary to know how the three general categories of mics work.

Of those three general categories, the two types of mics most often used in video work are the condensor and the dynamic. The mic attached to the front of the Sony AVC 3400 portable video camera is a condensor mic. Many hand-held mics are dynamic.

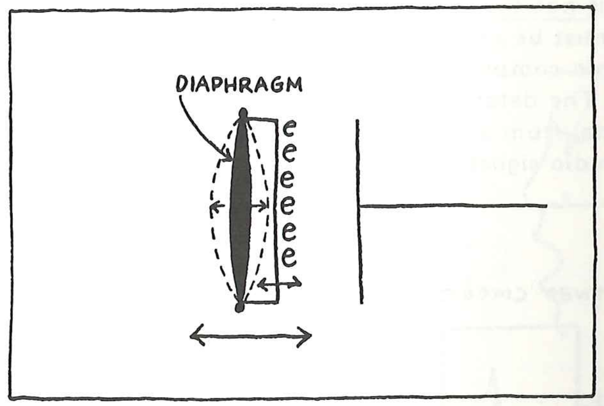
A condensor or capacitor is an electronic device that can store an electrical charge. When the electrical charge stored in the condensor reaches a certain amount, the condensor releases, or discharges the entire charge at once.



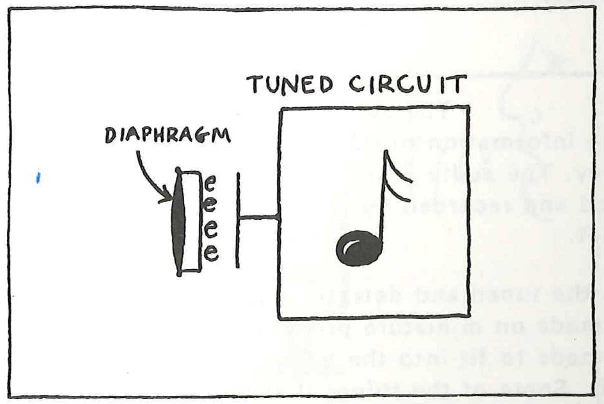
This charge and discharge procedure can be repeated many times without impairing the effectiveness of the condensor. A condensor is composed of two plates, one of which stores the charge and one through which the condensor discharges. The amount of charge necessary to cause the condensor to discharge is directly related to the distance between these two plates.



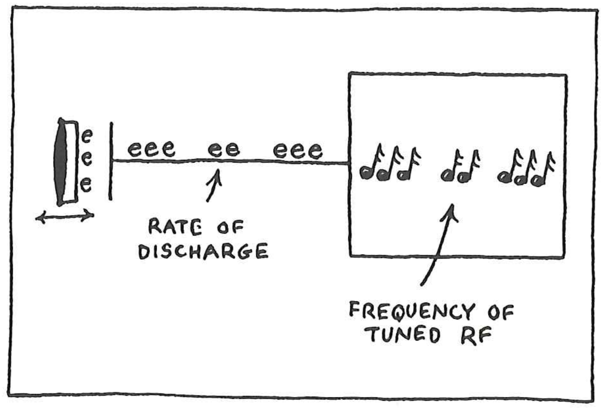
In a condensor mic, the diaphragm is directly connected to one plate of a condensor. A charge is supplied, usually by batteries, to one plate of this condensor. As sound strikes the diaphragm, it vibrates and the distance between the two plates changes accordingly. These changes in the relative positions of the two plates causes the rate of charge and discharge of the condensor to change.



The entire diaphragm condensor is part of a system of electronic components called a *tuned circuit.*

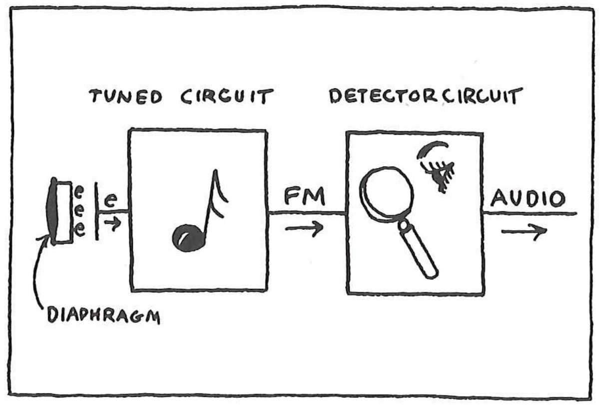


The tuned circuit is designed to produce a regular RF signal. When sound strikes the diaphragm causing the condensor to charge and discharge, the regularity of the RF signal is interrupted.



The condensor then controls the regularity or frequency of the RF signal. This process of controlling the frequency of an RF signal is called *modulation* and, since it is the rate or frequency of discharge of the condensor that modulates the RF signal, the entire name for the process is *Frequency Modulation — FM.*

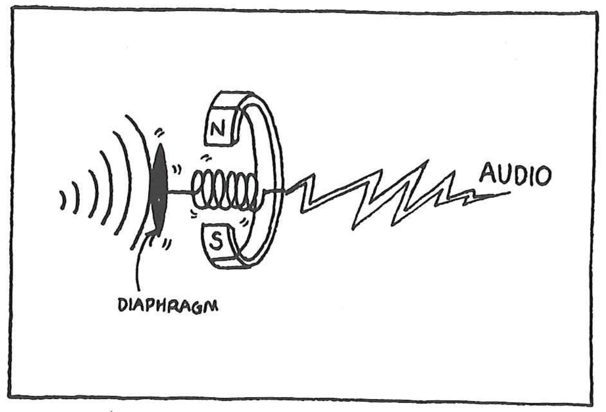
The FM signal produced in the tuned circuit is not the end of the process. The FM signal must be sent to another system of electronic components called a *detector circuit.* The detector circuit changes the FM signal from a radio frequency signal to an audio signal.



The audio signal contains the same information but at a much lower frequency. The audio signal can then be processed and recorded by the electronics of a VTR.

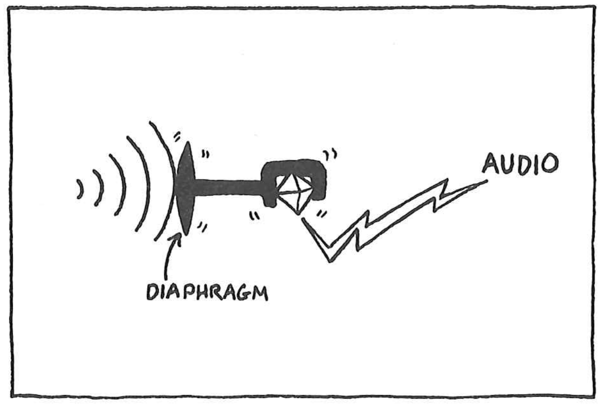
Both the tuned and detector circuits can be made on miniature proportions and can be made to fit into the body of a hand-held mic. Some of the things that make condensor mics so attractive for use with video equipment are their sensitivity to a range of sounds including both pitch and volume and the fact that they add very little interference of their own to the actual audio signal. Some disadvantages of condensor-type mics are their fragility and the problems that come with any battery-operated piece of equipment.

Dynamic mics are a little simpler in operation. Dynamic mics utilize the principle of electromagnetism to produce an audio output. The diaphragm of a dynamic mic is connected to a coil of wire. This coil sits between the poles of a magnet. When the diaphragm vibrates, it moves the coil through the magnetic field and produces an electric current. This current is an audio signal that can be recorded by a VTR.



While dynamic mics do not have the fidelity of condensor mics, they are still quite good for VTR work. Since they have essentially no electronic circuitry, there is very little to go wrong and for that reason, dynamic mics are generally more rugged and less expensive than condensor mics.

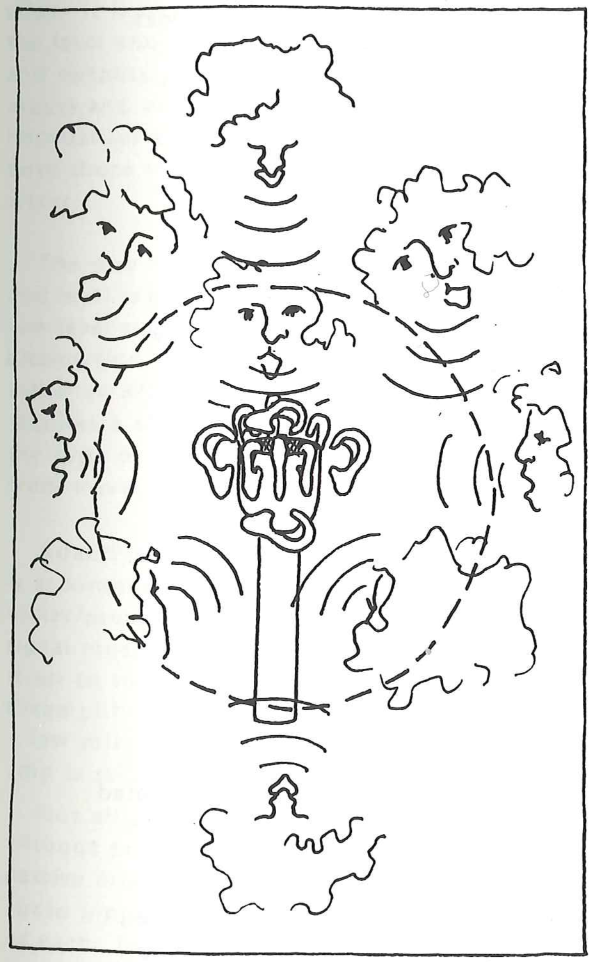
Crystal mics work on the principle that a quartz crystal, when slightly twisted in a certain way, produces an electrical current. Therefore, in crystal mics, the diaphragm is connected to a quartz crystal. When the diaphragm is vibrated, the crystal is twisted. In this way the audio signal is produced.



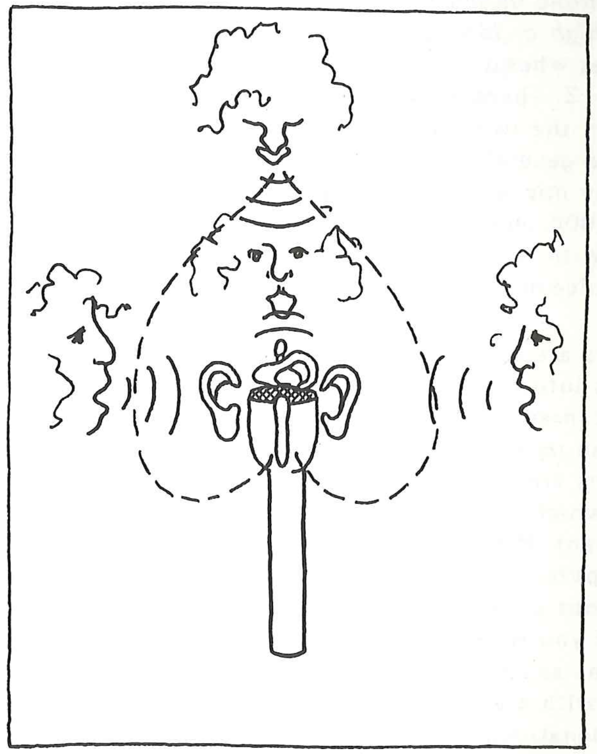
This type of microphone is cheap and relatively easy to produce, but it is also limited. The sensitivity of a crystal mic is noticeably less than that of either a dynamic or a condensor mic and the crystal tends to break easily.

Microphones, no matter what type they are, are also classified by their *pick-up patterns.* The pick-up pattern of a microphone is the direction in which the mic is most sensitive to incoming sound. The terms used to describe the pick-up patterns of mics indicate the space in which a mic is most sensitive to sounds. In other words, a mic with a cardiod pick-up pattern is most sensitive to sounds produced within a "heart-shaped" space in front of and immediately to the sides of the mic. That cardiod pattern is not a flat, two-dimensional plane as shown on the polar graph of the pattern, but a three-dimensional space. Some of the most common mic pick-up patterns are:

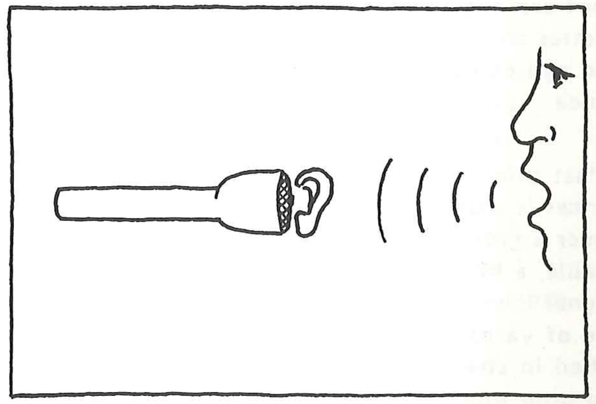
1. Omni-directional — all directions (within the limits prescribed by the graph)



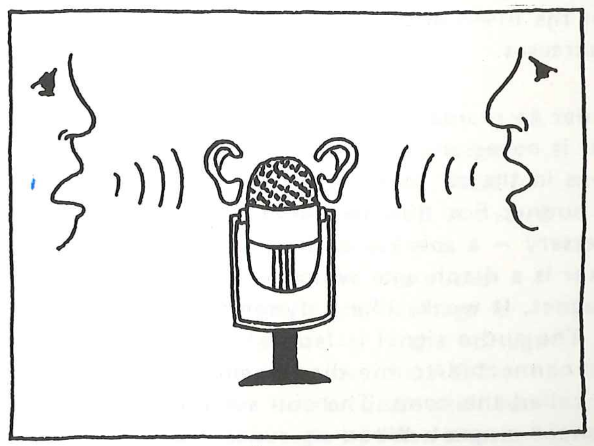
2. Cardiod — heart-shaped



3. Directional or Uni-directional



4. Bi-directional — two directions

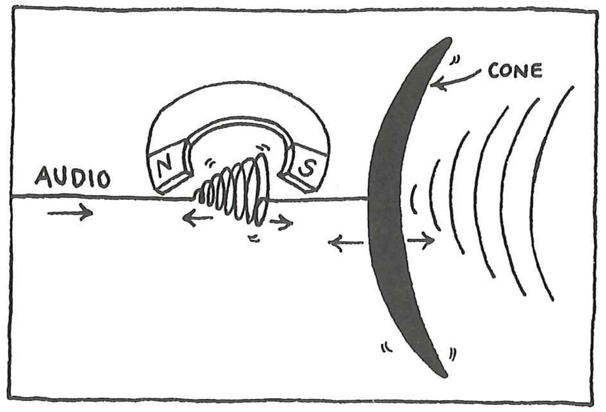


Another way to classify mics is by their *impedance.* The impedance of a mic is a characteristic of its output signal. Impedance is symbolized by the letter Z and is expressed in units of electrical resistence — ohms. Microphone impedances are classified as either *high* or *low* and the manufacturer specifies whether a mic is "Hi" — or "Lo" — Z. There is no exact cut-off point between the two impedance ratings for mics but as a general guideline, it is safe to assume that any mic with an impedance greater than 1,000 ohms (sometimes written as 1K ohms, with the K standing for kilo—) is a high impedance mic.

There are a few practical applications for this information. Hi— and lo—Z mics are not interchangeable without a device called an *Impedance matcher.* Mic impedance matchers are usually available at electronics stores which sell ham radio and TV equipment. Most VTRs accept only lo—Z mic imputs. It is important to keep the impedance of the mic you want to use in mind if you want to avoid such common problems as an audio signal with a hum or one with a very weak or a very overblown audio signal. All of these problems can arise if the proper impedance of the mic and input are not observed. Almost all crystal mics are high impedance and most dynamic and condensor mics are low impedance.

One last thing to remember about mic impedances is that a lo—Z mic signal can travel over a great distance of normal audio cable; a hi—Z signal cannot. If a hi—Z signal is sent over a cable longer than a couple of yards, the signal is severely diminished in strength and a hum or buzz starts to crop up. The signal gets weaker and the hum gets stronger as the distance between the hi—Z mic and the end of the cable increases.

In order to recreate sound from an audio signal, it is necessary to re-create the vibrations in the air that produced the original sound. For this, two components are necessary — a *speaker* and an *amplifier.* A speaker is a diaphragm which is controlled by a magnet. It works like a dynamic mic in reverse. The audio signal is fed to a coil which is connected to the diaphragm of the speaker called the *cone.* The coil surrounds a permanent magnet. When an audio signal is fed to the coil, the coil reacts by setting up its own magnetic field in opposition to that of the permanent magnet. These two opposing magnetic fields cause the coil to move and with it, the cone. The moving cone vibrates the air around it reproducing (approximately) the sound around the mic that put out the original audio signal.



This is not the only type of speaker system, but it is currently the most widely used.

The cone of the speaker is larger and more bulky than the diaphragm of the mic. It takes a boost in power for an audio signal to be strong enough to cause vibrations in the speaker cone. It is the job of an audio amplifier to add this boost to the audio signal at the same time keeping the signal as free from distortion as possible.

Many amplifiers do more than just amplify an audio signal and make it powerful enough to vibrate or "drive" a speaker. Many amplifiers have tone controls. Since most sounds are composed of various frequencies of vibrations in the air, by emphasizing certain of those frequencies, it is possible to control the tone of a sound. High frequencies, for instance, produce high pitched sounds; low frequencies produce low pitched sounds. If you want more bass or low frequencies in a particular sound, you can get them by emphasizing those low frequencies with the tone control. The tone control on an amplifier effects only the output of the amplifier to the speaker and not the original audio signal itself.

In many senses, audio is not as complicated as video. Since there is no sync to deal with, audio can be mixed, altered and recorded with much greater ease than video. The hardware for audio is also less expensive and more readily available than the comparable

pieces of video hardware. By keeping a few things in mind, it is possible to have extremely flexible audio systems for use in production and editing/transfer video systems.

The most basic of auxiliary audio hardware is an audio *mixer/preamp.* An audio mixer does what its name implies. It allows for a certain number of audio inputs (dependent on the capabilities of the mixer) to be combined into one output. The mixing of the audio signals can be controlled by a separate volume adjustment for each input and there is usually a master control which controls the output of the mixer.

Most audio mixer/preamps have two kinds of inputs and outputs: mic and line. Those terms refer to the voltage levels of the signals involved. The signal from a mic is a very low voltage and is measured in thousandths of a volt, called millivolts. A line level signal such as the line or auxiliary output of a VTR is much higher — approximately 1 volt. Line level signals have an impedance associated with them just as mic signals do. Therefore, when using a mixer it is important to be aware of both the level and the impedance of the inputs and outputs. Many mixers have switched inputs and outputs that allow you to choose impedances and levels. Be sure to keep both those things in mind when using a mixer.

The way to adapt line level signal to a mic level is to diminish the voltage of the line level signal. This process is called *attenuation* and the device to do it is called an *attenuator.* Since each mixer requires a slightly different signal level, the type of attenuator necessary varies from mixer to mixer.

Adapting a mic level signal to a line level is accomplished by the preamp section of a mixer/preamp. Obviously, the mic level signal must be amplified in order to bring it up to the voltage of a line level signal. Preamplification boosts the signal from a few millivolts to about a volt. A power amp is still necessary to drive a speaker.

Not all mixers have preamps. Mixers without preamplification circuits are called *passive mixers.* Passive mixers combine audio inputs by diminishing the strength of each. The output of a passive mixer therefore, can never be greater than the strongest of the inputs. This type of mixer is extremely inexpensive and requires no external power supply such as a battery or wall current. It also has some extreme disadvantages if you are working with weak signals or with signals which are different strengths or levels.

Most half-inch VTRs have both mic and line level inputs. The line input is often marked as an auxiliary (aux.) input. All half-inch VTRs have a line level output marked "Line" or "Aux" out (or "earphone" on the portable). Almost always these *line level* inputs and outputs are high impedance. The 8-pin connector also carries audio. The audio in the 8-pin is always at a line level.

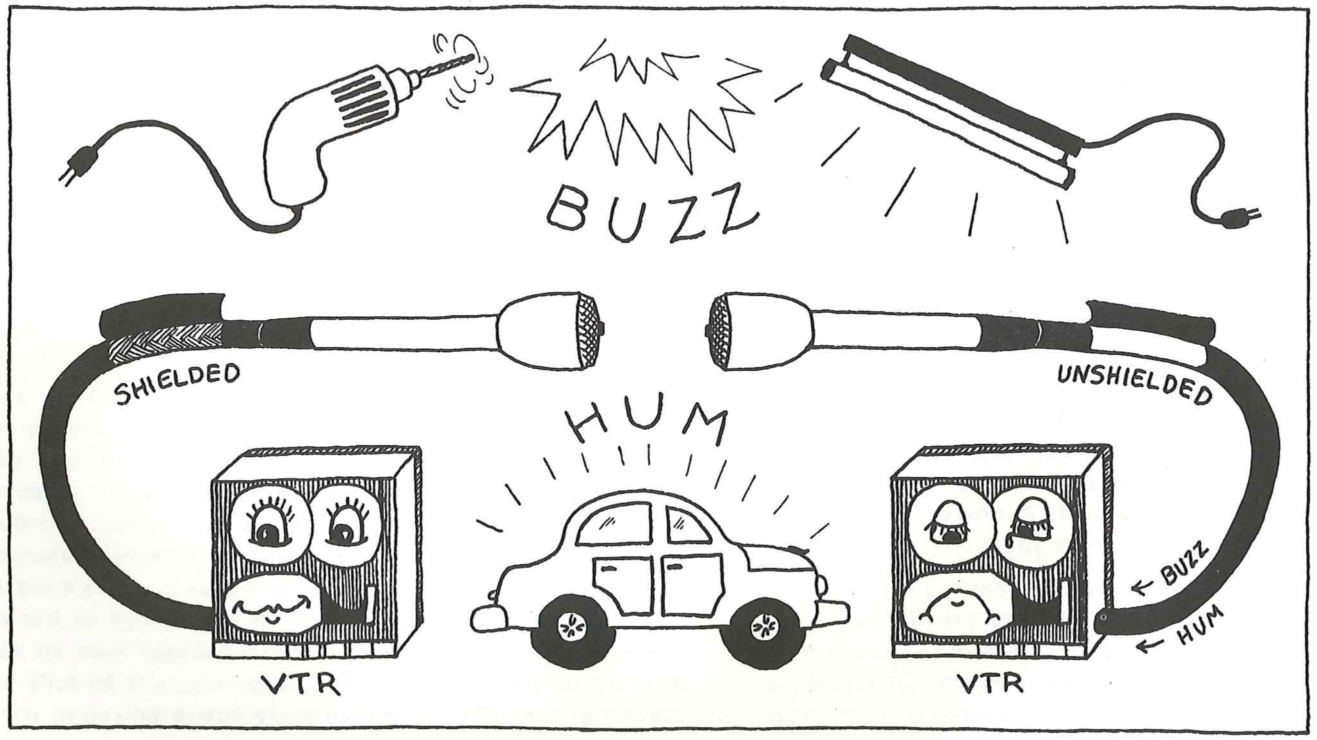
All VTRs have a peak input voltage after which the audio circuits become insensitive to further changes in voltage. Since an audio signal is comprised of changing voltages, it is essential to keep the audio signal between the limits of the peak and minimum sensitivity of the VTR. If the audio signal is too high, the signal is said to be *overblown* and is characterized by fuzziness or a blurry sound when the signal is played back. There are two ways to avoid overblowing the audio. The first way is to constantly monitor the audio level (for mic or line input) on a meter — either at a mixer or at the VTR. Audio meters are called *VU meters.* The VU stands for *volume unit.* Most VU meters have a red zone which indicates that the peak audio voltage has been reached. But metering the audio is not always practical nor indeed possible, especially with portable VTRs.

The second way to keep the audio from overblowing is to use the *AGC* function provided on most half-inch VTRs. AGC stands for *automatic gain control.* An AGC system is a circuit which senses the incoming signal and controls the audio level accordingly. If the signal voltage is too high, the AGC lowers it. If the voltage level of the input is too low, the AGC raises it. This system works quite well for signals which are too high but can cause some headaches for low signals. If, for example, someone who has been speaking directly into a mic suddenly stops speaking, the AGC is immediately activated in order to compensate for the drop in audio level. This compensation by the AGC tends to produce a swelling effect that sounds like an incoming electronic tide. There are three alternatives to this situation: 1) don't use the AGC . . . and you're back to monitoring the audio level all the time; 2) if you have a VTR which has an AGC and nothing else, you can have it modified to bypass the AGC . . . and then you're back to monitoring the audio level all the time . . . or; 3) try to keep as regular a level as possible on the input to the VTR.

Even though sound is composed of various frequencies, not all of those frequencies are desirable to listen to or to record. Controlling the frequencies of sounds coming from an amplifier is simply a matter of adjusting the tone control. Recording tone changes is another matter. It is always possible to play back a tape through an amplifier with the tone controls adjusted to your liking and record that audio by placing a mic in front of the speaker. This method is often less than satisfactory for two reasons. The first is that the tone controls on most amplifiers have a limited effect on the frequency make-up of the sounds they are amplifying. The second reason is that there are a lot of external factors (people sneezing, etc.) that contribute to an overall loss of quality when an audio signal is re-recorded by first changing that audio signal back into sound.

The piece of electronic equipment that allows you to control the frequencies of a given sound and record what you have done without first changing the audio signal back into sound, is called a *graphic equalizer.* Most low-cost graphic equalizers divide the range of audible frequencies into about five categories: high treble, mid-treble, mid-range, mid-bass, and bass (sometimes designated numerically by their frequency ranges). Different sounds fall into one or more of these frequency ranges. By emphasizing or de-emphasizing the appropriate frequency (s), it is possible to control the tone of an audio signal and record that result. By breaking down audible sound into separate frequency ranges, it is possible to have a great deal of control over the audio signal, even after it has been recorded.

Most background rumble, including that caused by wind and traffic, falls in the bass and mid-bass ranges. By de-emphasizing those frequencies, most of the rumble will disappear or be severely diminished. By de-emphasizing the high treble and emphasizing the mid-treble, it is often possible to salvage the voice of a speaker which has been drowned out by a hum or buzz in the original audio.

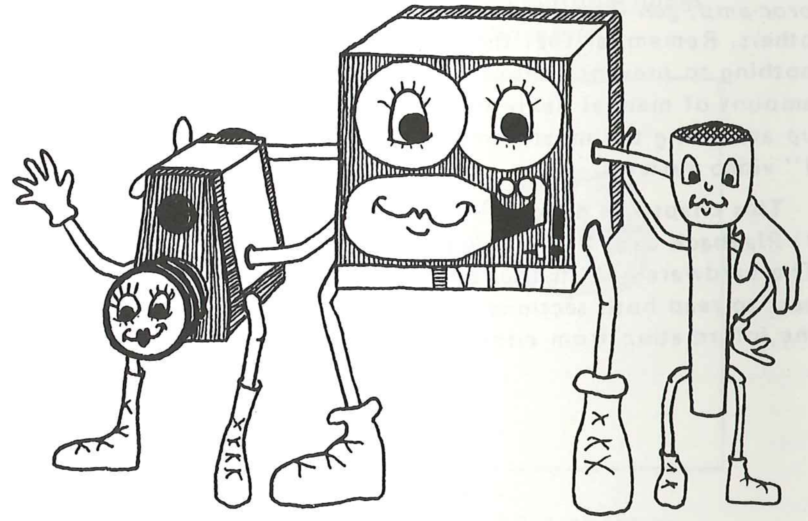


Hums and buzzes are a drag. Taking the following two precautions will reduce the chance of audio hum ruining otherwise good video tapes:

1) make sure that all audio cables are shielded and properly grounded. Audio is highly susceptible to outside interference, particularly from any nearby electronic gear. Audio problems can arise from being near such things as running car engines (spark plugs), fluorescent lights and heavy power tools. All of these things and many others produce their own types of electrical signals and those signals can wreak havoc with your audio if you're not careful. The only way to keep out this unwanted interference is to intercept it before it gets to the audio signal. The shield or outer wrapping on audio cable serves the purpose of intercepting this interference. Once this interference is intercepted, it must be channeled to ground, i.e. an electronically neutral area where it can't cause any problems with the regular signal. The shield wire that surrounds each audio cable should be firmly attached to the grounded part of each connector on the cable. If the shield comes loose it becomes either an inefficient ground or it may come in contact with the audio wire causing a short circuit in the audio cable. In either case, the result is usually a hum or a buzz or even the total loss of the audio signal.

2) The cases of all audio equipment should be connected to one another by wire. This wire acts as a shield for the whole system. Each piece of audio equipment (mixers, VTRs, etc.) tends to build up a small voltage on its case causing the grounds of the various pieces of equipment to be slightly different. This situation is referred to as a *floating ground* . A floating ground is a major cause of hum in any audio system and it can be avoided by making sure that every audio device is properly grounded to every other.

The preceding information touches on only a few of the things you need to know when dealing with audio systems. There's a lot more information available. Much of that information can be found on the book shelves of electronics and Hi-Fi stores and in the countless journals published each month that address themselves to the problems of audio freaks. There is a great potential for TV audio and yet, for some reason, it has become a second place technology in VTR work. But, even with tiny monitor speakers, AGC problems and all the other audio headaches, good quality audio is possible with the existing half-inch hardware – if you take as much care with the mic as you do with the camera.



Introduction To Systems

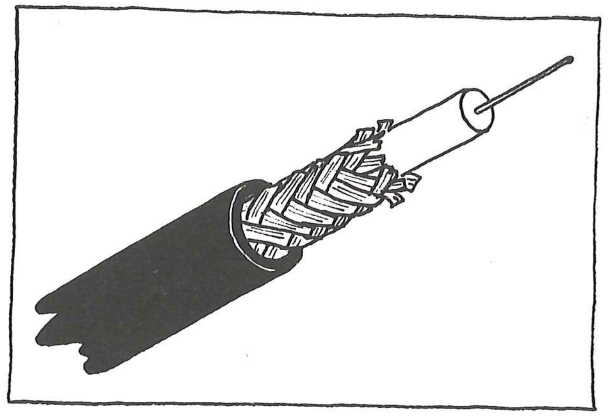
If you want to do more than record and play back with a one camera, one monitor, one VTR set-up, this section presents some of the possibilities and some rules to follow for setting up and using expanded systems. It may also increase your working video vocabulary to include such terms as: *proc-amp, gen-lock, distribution amp,* and others. Remember that there is absolutely nothing to prevent anyone with a minimal amount of manual dexterity from setting up and using the most complex of 1/2'' and 1'' video systems.

This chapter is divided into two parts: 1) Playback and 2) Editing/transfer systems. The hardware and its uses overlap, so it is best to read both sections before applying the information from either.

VIDEO PLAYBACK SYSTEMS

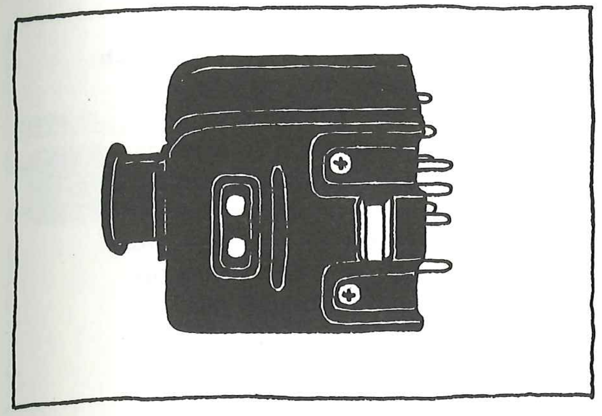
The essential components for any playback system are a VTR and a monitor. Two essential considerations for any playback system are: 1) In what form does the signal get from the VTR to the monitor — video and audio or RF?, and 2) What goes in between the VTR and the monitor — cable or air space, auxiliary hardware or nothing? These questions have to be answered for each individual playback system.

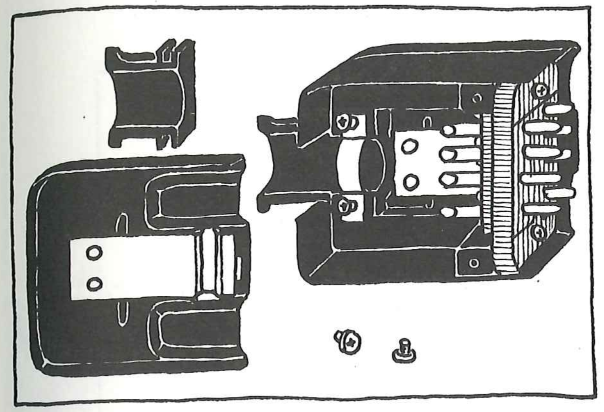
The two criteria for a good playback are the quality of the image and the ease of operation. The more complex the system, the harder those criteria are to meet. The simplest playback video system is one in which the video signal is fed directly from a VTR into a monitor. In this system, the video signal travels through a *co-axial cable.* Co-axial cable (co-ax) is so named because there are two axes within the cable. The inner axis is a solid core of wire surrounded by a relatively thick plastic casing; the outer axis is usually a group of thin braided wires (some co-ax cables use a thin layer of foil rather than braided wire) surrounding the plastic casing. These braided wires are surrounded by a thin plastic or rubber jacket. The inner wire is called the *center conductor.* The outer braiding is called the *shield.*



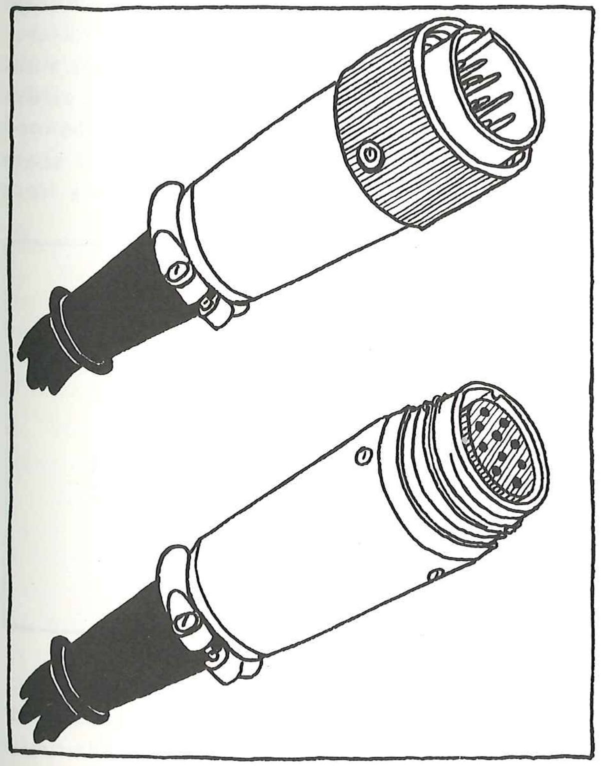
Any video signal that travels more than a few inches on a wire must travel on co-ax cable in order to avoid extreme deterioration of the signal. The actual video signal travels on the center conductor. It is the job of the shield to insure that no outside interference enters the video signal. Just as the video signal must eventually go to the picture tube via the center of the co-ax cable, the outside interference, stopped by the shield, must eventually be sent to ground where it cannot interfere with the video.

The cable over which video travels should not be confused with the type of connector that is attached to the ends of the cable. Most 1/2'' equipment uses the Japanese 8-pin connector.

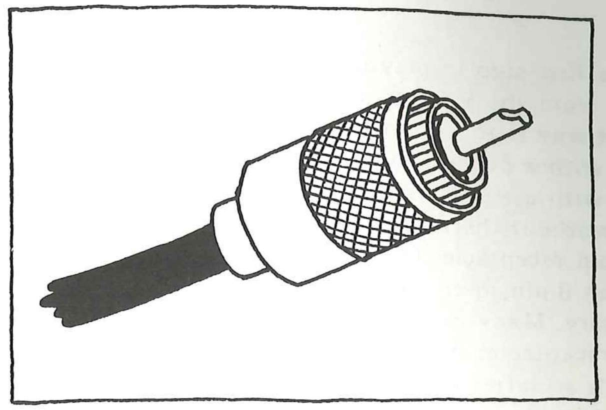




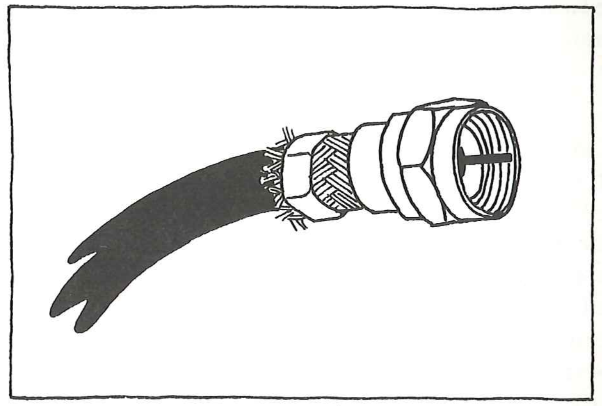
Yet, within the cable that is attached to the 8-pin connectors there are 2 co-axial cables — an input and an output for video. Within the 10-pin connector that connects the portable VTR to the camera there are a number of co-ax cables.



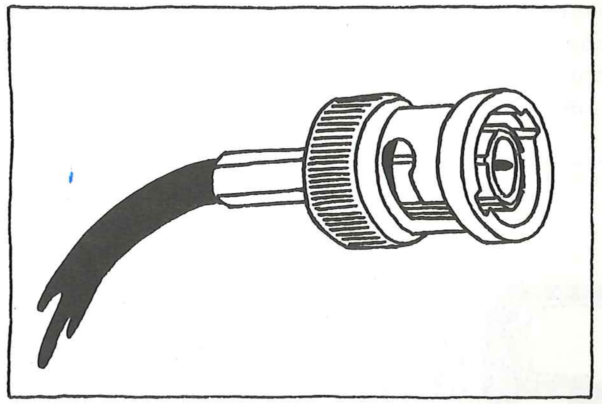
Besides the 8-pin and 10-pin connectors, the most common type of connector found on co-ax cable used in half-inch video is the *UHF* connector.



Many monitors and VTRs have UHF receptacles on them as well as receptacles for 8-pin connectors. A lot of video people refer to UHF connectors as "co-ax connectors." That can confuse things because there are also *F* connectors



and *BNC* connectors



and various other esoteric types that are constantly popping up on the ends of co-ax cable. It is important to remember that a video cable is usually defined by its *connector* and not simply that it's co-axial.

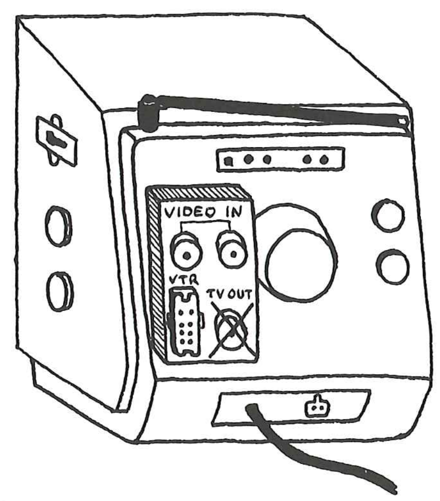
If this seems a bit off the track in defining the needs of a playback system, it's only because it's necessary to speak the same language in order to continue.

The first step in playback is to get the signal from the VTR to the monitor. The easiest way is to use an 8-pin to 10-pin cable with a portable VTR, or an 8-pin to 8-pin with a studio (AC operated) deck. This works if the monitor you are using has an 8-pin receptacle. If the monitor doesn't have an 8-pin, then some adaptations are necessary. Many monitors have only UHF or BNC receptacles on them, so getting video to them is a matter of matching up the connectors.

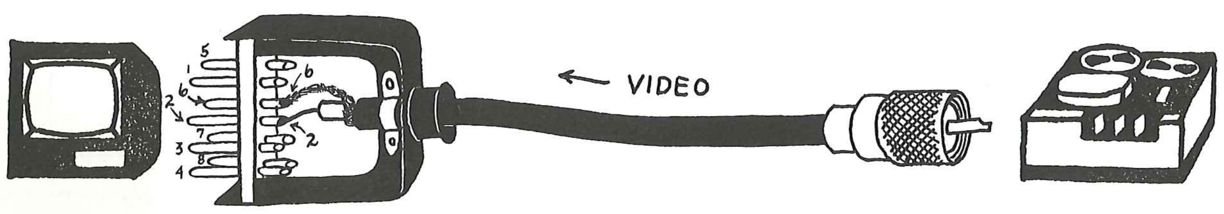
The 8-pin and 10-pin cables are not some sort of special electronic components, but a bundle of discrete cables, each of which serves an individual purpose. Each of the pins is numbered on the connector. In the 8-pin connector, for example, pin 2 carries the video from the VTR to the monitor, pin 6 is the shield.

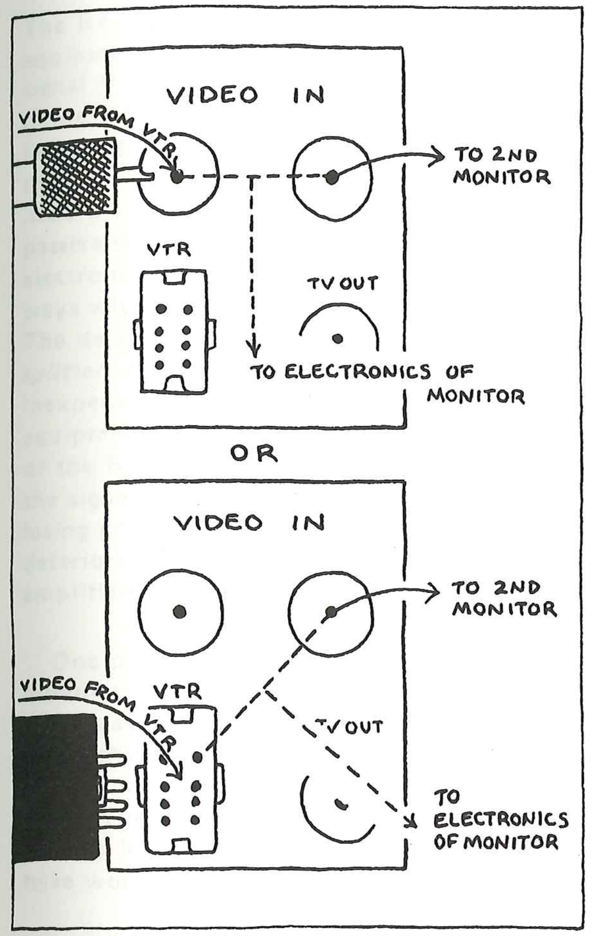
So, for instance, if you want to connect a VTR with an 8-pin connector to a monitor with a UHF receptacle, all you have to do is get an 8-pin connector, a UHF connector (which can be purchased unwired), and a piece of co-ax cable. Attach the UHF connector to one end of the co-ax cable (see "Attaching a UHF Connector to a Co-ax Cable"). To the other end attach the 8-pin with the center conductor of the co-ax cable going to pin 2 and the shield going to pin 6. Connect the 8-pin connector to the VTR and the UHF connector to the monitor. Now video can be sent from the VTR to the monitor.

What about more than one monitor? Depending on the type of connector on each monitor, it is usually easy to connect 2 or 3 monitors to one VTR. Simply connect the VTR to the first monitor, the second monitor to the first and the third monitor to the second. Most monitors provide for just such a "loop through" set-up by having two video receptacles (UHF or BNC) which are interchangeable as video *inputs* to the monitor. Both these inputs are usually marked "Video In." Some monitors/TV sets also have a UHF receptacle marked "Video Out," but this is a video output for the broadcast TV signal only.

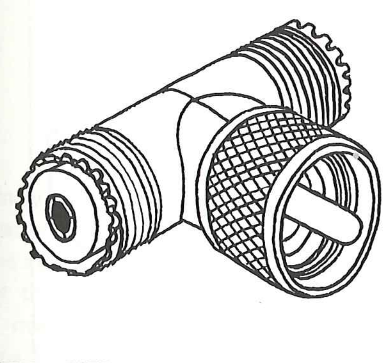


The two receptacles are wired in a "T" configuration. Each receptacle is connected to one end of the crossbar of the "T" and the base of "T" goes to the electronics of the monitor. This allows a video signal to be connected to one side of the "T," leaving the other side of the "T" free to go to another monitor. In many Japanese monitors the 8-pin receptacle acts as one end of the crossbar of the "T."

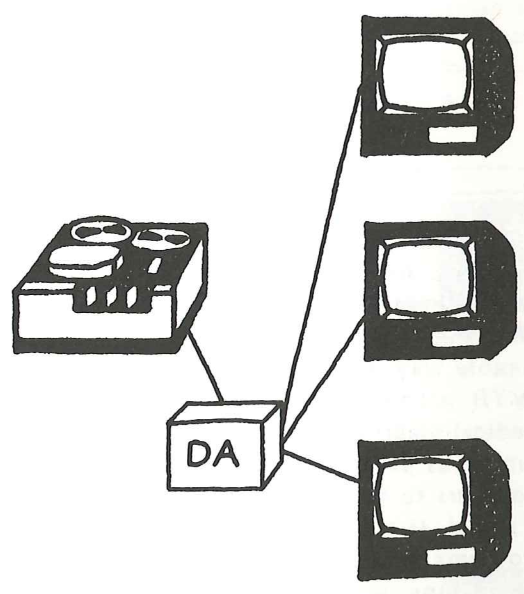




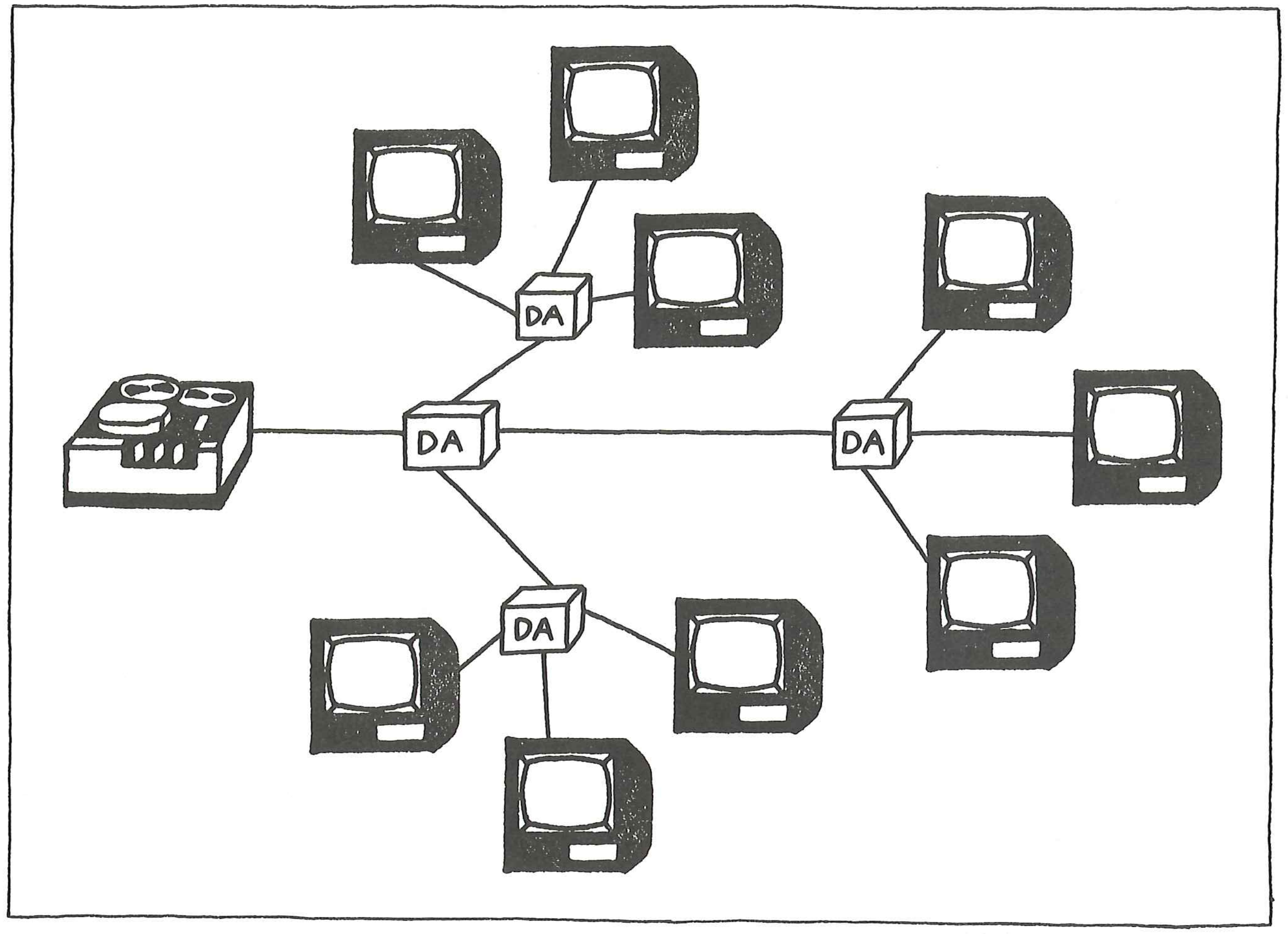
The procedure is the same for an 8-pin or a UHF connector. The only snag comes with monitors which have only an 8-pin or only one UHF (or BNC) receptacle on them. In this case, the only solution is to make your own "T" on the cable itself by connecting two co-axial cables to pins 2 and 6 on the 8-pin connector. There are also commercially made UHF "T" connectors available at most electronics stores.



A video signal cannot be mechanically looped an infinite number of times. Even when the signal from one VTR is sent to three different monitors, there may be noticeable loss in picture quality in all of the monitors because the video signal is being spread too thin. Also, the number of cables connecting each monitor to the next quickly becomes a nightmare of co-axial spaghetti. To avoid these problems an electronic device called a *distribution amplifier (DA)* is necessary. A DA amplifies or boosts the video signal so that each output of the DA produces the same strength and quality video signal as the VTR is producing. This is necessary when many monitors are hooked up to the same source because the signal is weakened whenever it is mechanically split. A DA also insulates each of its outputs electronically so that interference in any one of the monitors will not affect any of the others (a situation which can occur with the loop-through system).

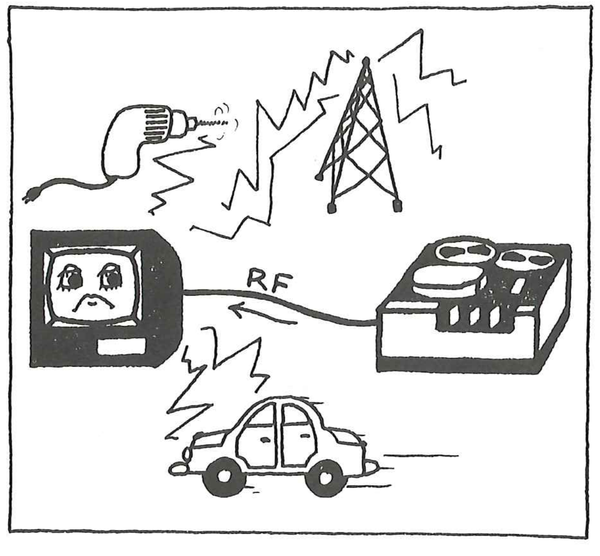


A DA is usually classified by the number of outputs for each input. Thus, for the system of one VTR and three monitors, the proper DA would be a "one in, three out" distribution amplifier. In this case the VTR is plugged directly into the DA input and each of the outputs of the DA goes directly to one of the monitors. DAs can also be connected together (i.e., one output of a DA can be fed to the input of another in order to increase the number of final outputs). This procedure is called *"stacking"* or *"cascading"*.



Using an RF signal for playback presents different problems. Any time an electronic signal is altered, there is always the risk that the signal will also be distorted in some undesirable way. When the video signal of a VTR is converted to an RF signal — a radical electronic alteration — there are numerous problems to be avoided. The first problems to be avoided come with the original signal. If there are noticeable technical problems with a tape (eg., tracking errors, wrinkled tape, etc.), then when the signal from that tape undergoes the change from video to RF, those errors are usually multiplied. Other problems may arise at the TV set. Most regular broadcast TV signals have a high degree of electronic stability. TV sets are critically aligned to receive that quality of signal so that when 1/2" tapes with their relatively less stable signal are fed into a set, the TV may have a hard time stabilizing on the 1/2" signal. This is especially true of older, tube type TV sets.

RF signals are also a great deal more susceptible to outside interference. It is extremely important to be aware of this when trying to play back RF signals around electrical equipment (saws, drills, etc.), in or very near to car traffic, anywhere near a broadcast TV or FM station, or in any number of other interference-causing situations, not all of which you can be prepared for.

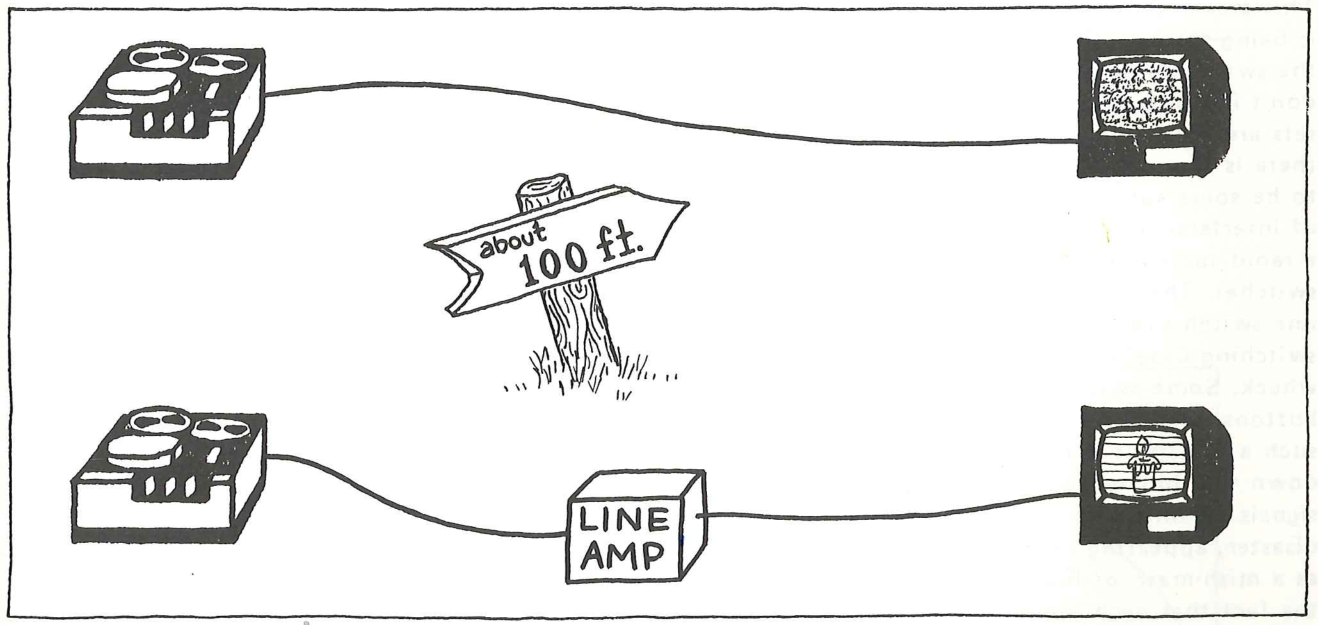


The quality of RF signals also depends a lot on the type of RF modulator used.

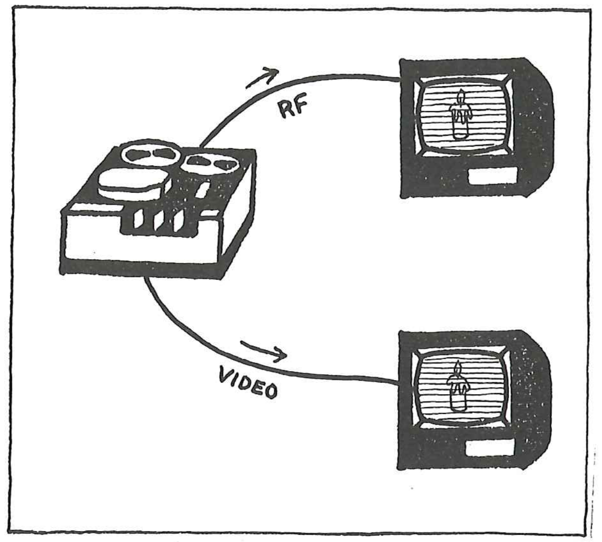
The RF units that come with 1/2" equipment are quite sufficient to send a signal from a VTR to one or two TV sets if the VTR, the tape, and the TV sets are all in reasonably good shape. Reaching more than a couple of TV sets can present a little more of a problem. It is possible to passively (i.e., without power-consuming electronics) split an RF signal a number of ways without too much loss of signal quality. The device to do this is called an *antenna splitter.* An antenna splitter can be bought inexpensively at any store which sells TV equipment. It is hooked up to the output of the RF modulator and serves to distribute the signal. Cascading antenna splitters is a losing proposition since the signal rapidly deteriorates, but there are RF distribution amplifiers . . . unfortunately they are costly.

One problem with the small portable RF modulators of 1/2" equipment is that there is no way to control their output levels. When the original video signal is extremely weak, the RF signal will be correspondingly weak. There is also no way to adjust the relative levels of video and audio. If you have worked much with 1/2" RF adaptors, you may have noticed that on some TV sets the audio sometimes affects the video. The only way to compensate for that is to adjust the fine tune on the TV set, which often means compromising between good picture and good audio. Cable stations, for instance, when they originate programming, use much more sophisticated RF modulation and distribution equipment. Better RF equipment allows for much more control over both the video and audio signals and also puts out much stronger signals. However, there is also a problem with this more sophisticated equipment — it is neither highly portable nor inexpensive.

All of the preceding systems have presupposed that the distances between the VTR and the monitor(s) have been no more than a few yards at the most. There are other considerations if there is a greater distance between the video source and the monitor. "Distance" is an arbitrary term. The needs of the system and the budget involved will determine when distance becomes a factor. If a video or RF signal has to be sent for more than, say, 50 feet, then the addition of a *line amplifier* is advisable Both video and RF signals meet electronic resistance as they pass over a cable. Putting an amplifier in the middle of the length of cable boosts the signal and overcomes the cumulative results of that resistance. The indication that a line amplifier is necessary is a weak, noisy signal. *Noise* is the technical term that, when applied to video, indicates a grainy quality in the video.



When an RF signal is sent out of a VTR via an RF unit, there is still a video signal that is quite usable. In other words, if you have one monitor and one TV set, you can play back on both simultaneously by sending video to the monitor and RF to the TV set.

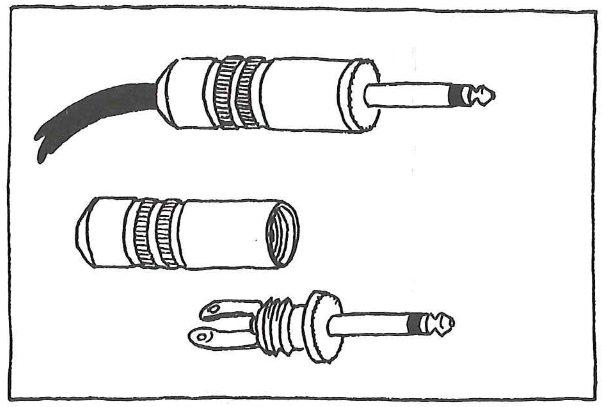


Another playback system that might arise is a system in which there are two video sources (two VTRs, a VTR and a camera, etc.) going to one or more monitors through some sort of switch. The only new consideration in this circumstance is the quality of the switch. Unless this system is in a broadcast-type TV studio where everything is done electronically, the switch is likely to be a mechanical one. This means that for the instant the switch is being thrown, there is no signal leaving the switch going to the monitors. Monitors don't like the absence of signal and TV sets are even worse about it. Every time there is a switch, therefore, there is bound to be some sort of roll-over or "glitch" of interference. This tends to preclude a rapid succession of stable good quality switches. The monitor is able to handle one switch every now and then, but rapid switching usually throws everything out of whack. Some switching systems employ buttons, one button for each input. With such a system it is physically possible to hold down two buttons at once, combining two signals on one output. This is a visual disaster, appearing on the monitor screen as a mish-mash of lines. This results from the fact that each input (if you are dealing with 1/2" and 1" equipment) has a slightly different horizontal and vertical frequency. When the frequencies conflict, the monitor has no way to cope with both of them. The best mechanical switching results are obtained with efficent switches whose contacts are free from dust and dirt and which often as not, produce insignificant interference on the screen during most switches.

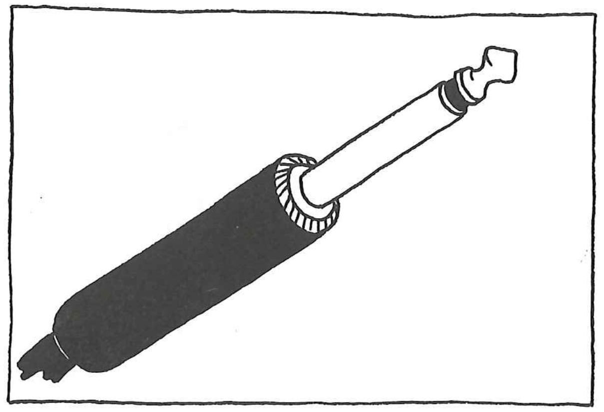
AUDIO PLAYBACK SYSTEMS

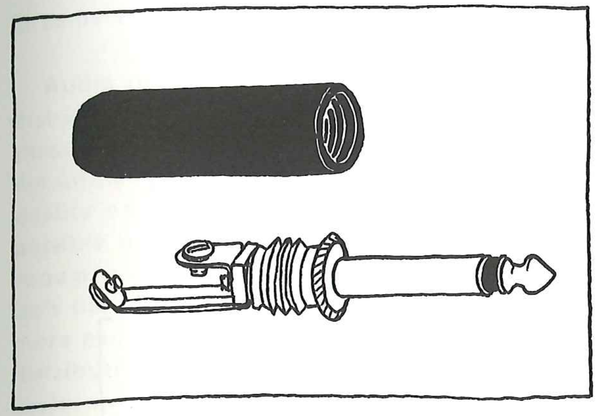
Audio playback systems are more straightforward than their video counterparts. Audio signals are of much lower frequencies and are not as complex as composite video. Consequently, the cabling and distribution requirements are not quite so great. The essential components of any audio playback system are an amplifier and a speaker. The function of auxiliary equipment has been covered in the "Audio" section.

Most video monitors have built-in amplifiers and speakers. Using this built-in system is simply a matter of getting the audio to the monitor on the proper cable with the appropriate connector. The audio signal should always travel on shielded cable. Four of the most commonly found audio connectors (with 1/2" VTRs anyway) are the mini plug,

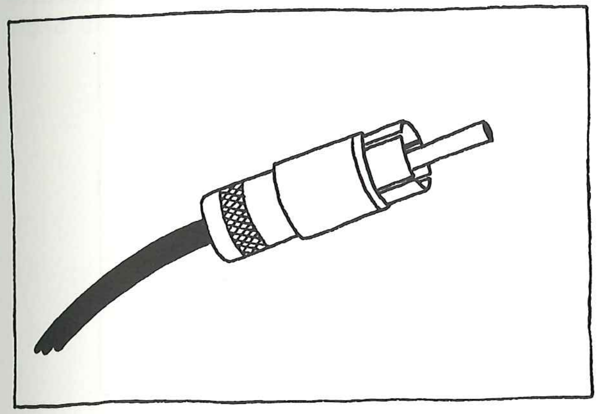


the phone plug,

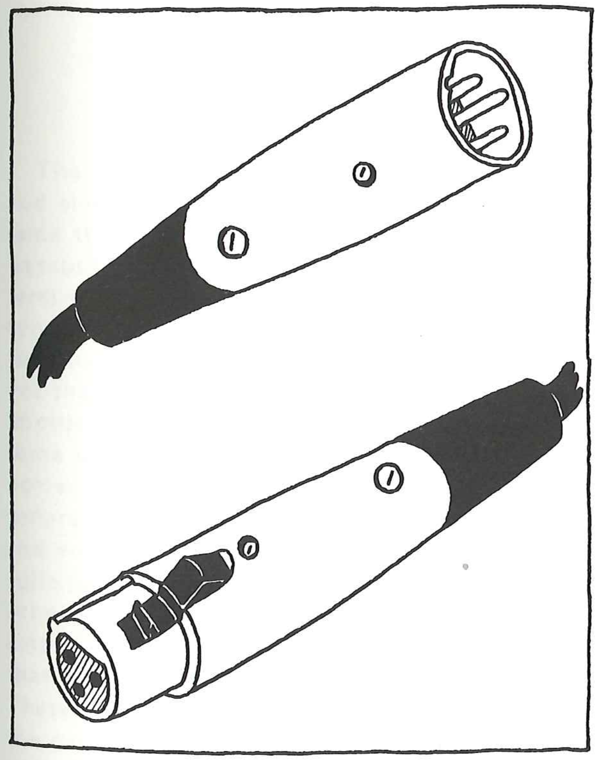




the RCA phono plug

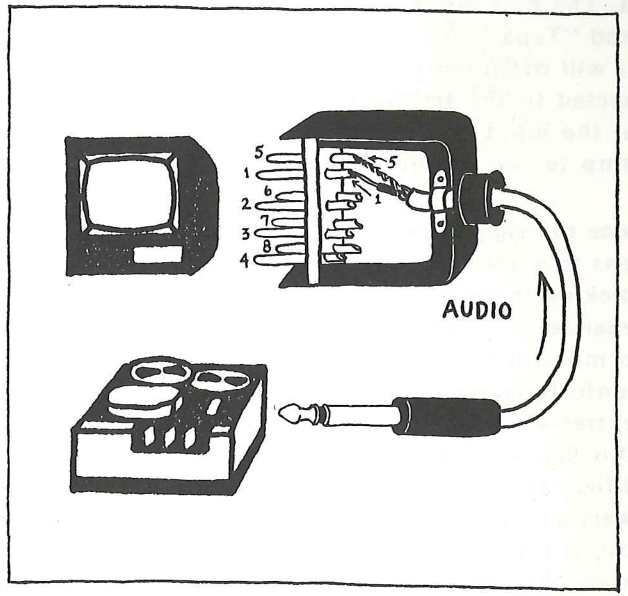


and the XLR plug (often referred to as a cannon plug).

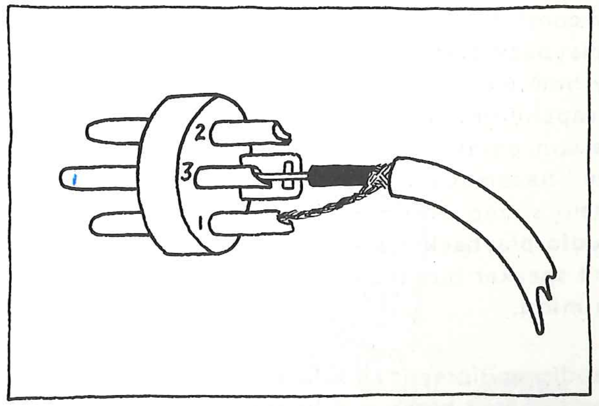


One of these connectors — or the 8-pin — serve as the audio input to all but the most esoteric of monitors.

Most often you are faced with the problem of having to adapt the output of a VTR to the input of a monitor where one of the connectors is an 8-pin. The procedure for this is exactly the same as the procedure for making up a UHF to 8-pin cable except that the center conductor of the wire goes to pin 1 of the 8-pin and the shield goes to pin 5.



The XLR connector has three solder points (the other plugs have only a center and a shield). Each solder point is connected to a prong of the connector and is clearly numbered. The general convention for wiring these connectors is that the center conductor of the audio cable is wired to pin 3 of the XLR and the shield is wired to pin 1.



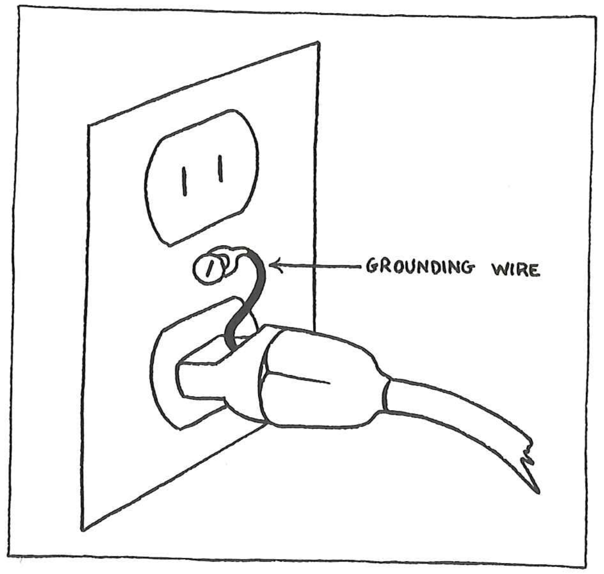
It is unnecessary to use the third pin when working with 1/2" VTR equipment. Unfortunately, this wiring configuration is not entirely standardized. Because of this, it's wise to make some tests when working with unfamilar audio equipment requiring XLR connectors.

Most 1/2" VTRs have auxiliary audio outputs. These outputs are line level and can be connected to the tape input on most amplifiers. The earphone output of the portable VTR is also a line level output. Many stereo-HiFi amps have a series of input receptacles in the back. These receptacles are almost always for RCA plugs. The best input is usually the one marked "Tape," but the auxiliary ("Aux") input will often work as well. Once connected to the amplifier, don't forget to set the input selector on the front of the amp to the appropriate setting.

Once the signal has been amplified it must be sent to a speaker. The three considerations for picking the proper speaker are its impedance, size and quality. When using the video monitor for sound you have no choice, and unfortunately most monitor speakers are extremely small. There are two reasons for this limited size: 1) the monitor amplifiers are extremely low power and the speakers are selected to be just strong enough to absorb that power; 2) the speaker must fit inside the cabinet of the monitor and there isn't much space left for it. Small speakers are a drawback because of their limited volume range and because they over-emphasize the treble sounds at the expense of the bass. The overall effect is a "tinny" sound quality.

Most 1/2" VTRs are relatively good audio recorders. The only way their full range can be heard is through a high quality amp/speaker combination. The quality of an audio playback system is determined in part by how well the speaker is matched to the capabilities and power of the amplifier. At a certain point, however, the word "quality" becomes a matter of taste. Any competent stereo-HiFi person can design a good audio playback system with the right amp and speaker but there a few basics to keep in mind.

All audio equipment should be grounded together to avoid hums and buzzes caused by floating grounds. This can be done either by connecting the metal sections of each piece of equipment together by a piece of wire, or by using three-pronged AC plugs into three-pronged receptacles on the wall for each piece of AC operated audio hardware. If the audio equipment has three-pronged plugs but the wall receptacle doesn't have a place for the grounding prong, use a three-to-two prong adaptor but be sure to connect the grounding wire of the adaptor to the screw that holds the AC wall plate to the wall.



Make sure that the speaker is always connected to the amp whenever the amplifier is turned on. Many amps can be severely damaged if operated with the speaker disconnected.

Most common audio amps use 8-ohm speakers. The 8 ohms indicates the impedance of the speaker. To obtain the best sound quality it is important to observe the proper impedance. Speakers are usually marked with their impedance on the magnet at the center of the cone. If an audio amp has only one speaker output (if it's a stereo amp it will have a left and a right which should be considered as the outputs of separate amplifiers), then it is assumed that the output impedance is 8 ohms unless otherwise specified. If an amp has more than one speaker output, those outputs will be marked.

Looping through speakers is not too wise because it alters the overall impedance of the speakers and may in turn alter the sound quality.

The type of wire that connects the amp to the speaker is not particularly critical and needn't be shielded except in extraordinary circumstances.

Audio distribution isn't as critical as video distribution for two reasons. First, looping through a number of amplifiers usually diminishes the strength rather than the quality of the audio signal and it is usually possible for the amp to boost the signal enough to overcome this loss. Second, audio isn't limited to the TV screen and can reach more people with less hardware. Audio distribution amps are available and are useful in certain situations where a number of separate areas must be reached. Audio distribution amps can be cascaded just like video distribution amps.

EDITING/TRANSFER SYSTEMS

The processes of electronic transferring and electronic editing of tapes implies the same thing: re-recording an original tape. Because the processes are the same, the term *editing* will be used to cover both types of systems. The hardware systems for each process are essentially the same, yet they are changing so rapidly that it is impossible to be too specific. There are some elements of these processes that are not variables, and there are some generalizations that apply to all transfer and editing systems. Physical editing or splicing won't be discussed since it is primarily a maintenance procedure and is amply explained in the operating manuals that accompany most new 1/2" VTRs. There is also no need to go deeply into the procedural techniques of editing since there is ample information available on that subject, not to mention the fact that everyone seems to have his own method for achieving the best results.

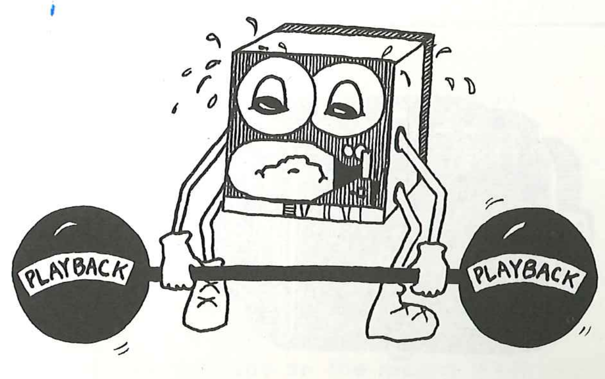
The basic technical considerations of any video tape editing system are these:

1. Quality of the original tape;
2. Quality of playback deck;
3. Quality of the recording deck;
4. What happens to the signal between playback and recording decks.

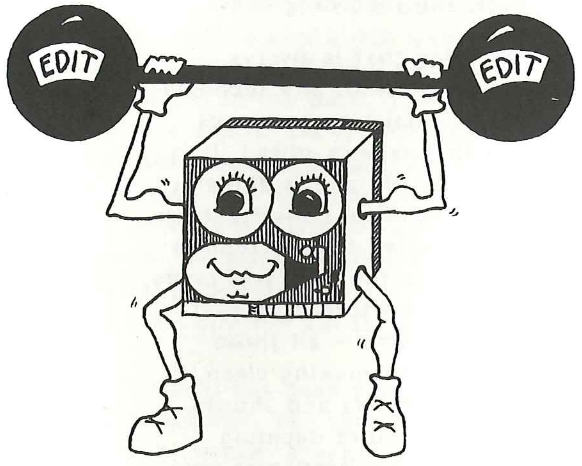
There is one thing that is always necessary to keep in mind: any technical problem in the original tape is always amplified when that tape is edited. It is an electronic fact of life and it explains the first of these technical considerations. Heavy dropout, crinkled tape, problems that arose at the time the tape was made, like weak batteries, mis-threading that causes tracking problems – all those things are deterrents to making clean, smooth edits and transfers and should influence you when you're deciding whether or not to edit a particular tape.

A basic editing system consists of two VTRs, one to playback and one to record. The choice of VTRs is crucial to the technical quality of the edited tape. It seems obvious that a more stable, sophisticated recording VTR will make better edits. Yet, equally important is the stability and sophistication of the playback VTR, since no matter how good the recording VTR is, the results cannot be satisfactory if the signal it is recording is coming from a relatively unstable VTR.

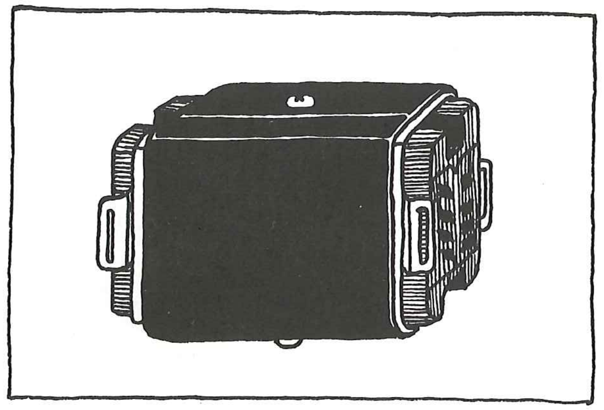
Due to its design, the Sony portable is the least desirable 1/2" playback deck in an editing situation. Any sort of 1/2" standard studio VTR is more desirable. If you are stuck with it, you're stuck with it and you shouldn't worry, but if you can avoid using the portable as a playback deck, you'll be a lot better off.



The Sony portable is, however, about the best 1/2" editing VTR outside of the 1/2" decks made specifically for electronic editing.



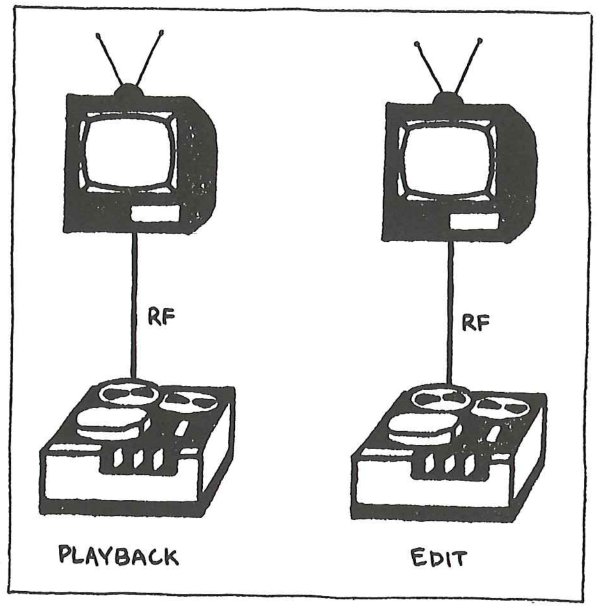
Perhaps the best way to explain editing is to use examples of various systems, both the simple and the complex. One of the simplest editing systems is one which uses a Sony AV 3400 VTR as the record VTR and another 1/2" VTR for playback. The pieces of equipment necessary besides the two VTRs are: 2 RF units, 2 TV sets, an 8- to 10-pin cable and an 8- to 8-pin cable if the playback deck is a studio type VTR or a second 8- to 10-pin cable if you are using two AV 3400s, and a specially wired 8-pin to 8-pin barrel connector (a barrel connector has female receptacles on both sides).



The set-up procedure is as follows:

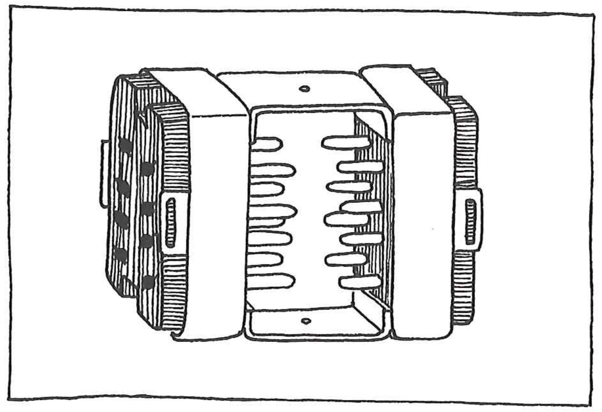
1. Put the original tape on the playback VTR. Put a blank tape on the recording VTR.

2. Connect each VTR to a TV set through an RF unit.

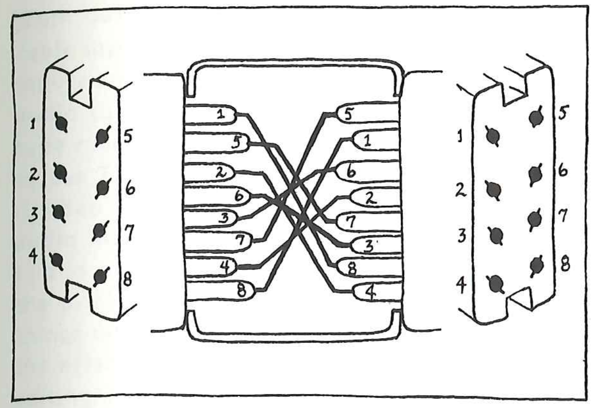


3. Connect the playback VTR to the recording VTR. This requires an 8 to 8 or an 8- to 10-pin cable from both decks and the specially wired 8- to 8-pin barrel to connect the two cables together. The 8-pin to 8-pin barrel must be wired to channel the video and audio outputs of the playback VTR to the video and audio inputs of the recording VTR.

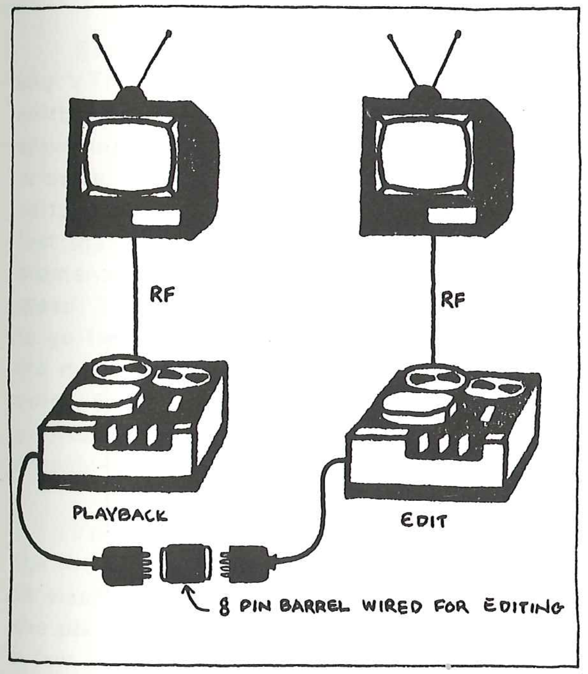
Each of the 8 holes on the 8-pin receptacle is numbered 1 through 8. If the 8-pin barrel is already wired straight through (pin 1 wired to pin 1, etc.) then unsolder all wires from one receptacle and resolder them in the following order:



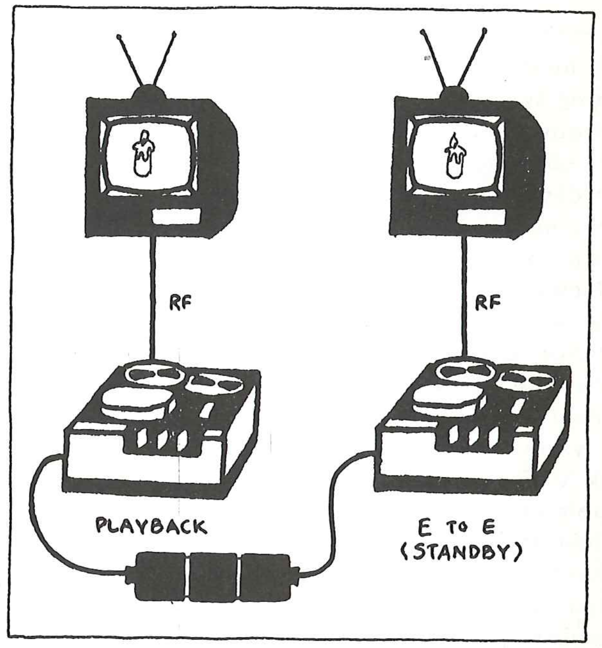
- pin 1 soldered to pin 8 (on the opposite receptacle)
- pin 2 soldered to pin 4
- pin 3 soldered to pin 6
- pin 4 soldered to pin 2
- pin 5 soldered to pin 7
- pin 6 soldered to pin 3
- pin 7 soldered to pin 5
- pin 8 soldered to pin 1



With this done and the two cables connected through the barrel, the original tape can be re-recorded on the record VTR.



4. Make sure that both VTRs are in the TV mode of operation and place the record VTR in the E to E (standby) mode of operation. This is done by holding the *still* button down and placing the VTR in *record* position. The reels should not move, but the recording VTR will be ready to record. If you are using a Sony studio VTR, put in *pause* mode and depress the *record* button. If you are using some other make of VTR, just depress the *record* button.



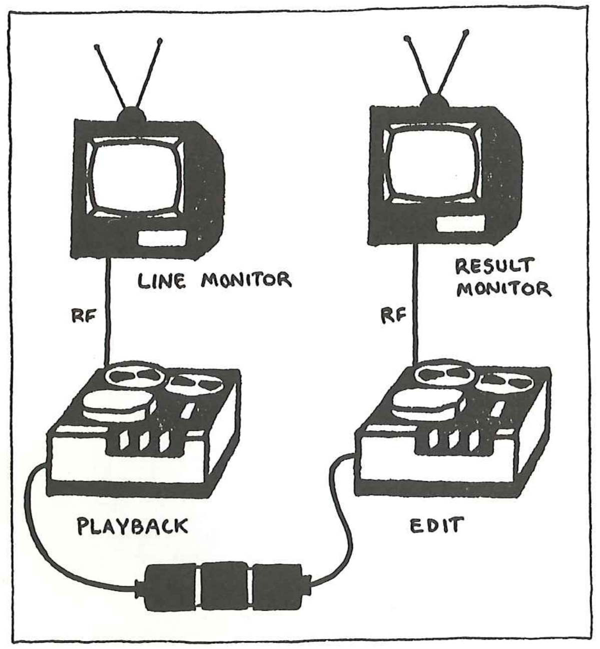
5. Next, place the playback VTR in *play*. The tape on the playback VTR should show both video and audio on both the TV sets. If that is the case, release the *still* button on the record VTR and make a test recording. If, for some reason, you don't get the same picture and sound on both TV sets, first check to see that the recording VTR is really in the *record* mode, then check *all* connections including the wiring of the 8-pin to 8-pin barrel and the connection of the recording VTR to its TV set. Then check to see that both VTRs are in *TV* mode.

6. If the recording you've just made on the record VTR is OK, then rewind to the beginning of the tape on the record VTR and put that VTR back into E to E.

7. Set up the tape on the playback deck so that there are about 5 to 10 seconds of tape before the part that you want to re-record is reached. Put the playback VTR in *play* and, when it reaches the correct point, release the *still* button on the recording deck and . . . voila! An edit is made.

8. To continue editing, simply put the record VTR in E to E at the end of each re-recorded segment and repeat step 7.

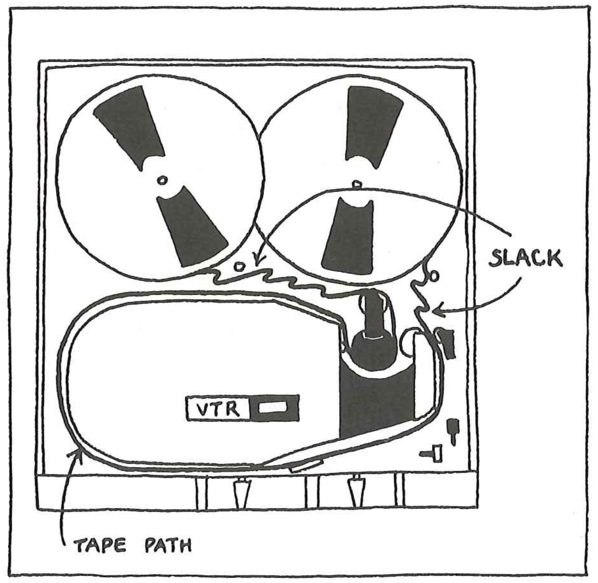
That's how to edit with the simplest non-editing system. It takes a little practice to get it down but there are reasons why it should be done as described. First of all, each deck should be monitored. This avoids the nuisance of having to constantly change cabling to see where each tape is at. It also facilitates trouble-shooting the system if and when something goes wrong. For instance, if you get no recording on the recording VTR but the playback VTR is fine in its TV monitor, then you don't have to waste time checking out the playback VTR. Instead, you can look for the trouble in the recording VTR and in the cabling. If you have 2 TVs and 2 RF units, they're a convenience you should use. When both VTRs are monitored, the TV (monitor) connected to the playback VTR is called the *line* monitor and the one connected to the recording VTR is called the *result.*



The playback VTR should be running 5-10 seconds before the tape it is playing back is re-recorded in order to insure that the playback VTR is as stable as possible. It takes a few seconds for the VTR to build up to the proper speed. Until it reaches that speed, it is not entirely stable. For the same reason the recording VTR should be in E to E mode rather than completely off. In E to E the heads, at least, are at full speed at the time of the edit. It is only the tape which must get up to speed.

Another hint is to stay as far away as practical from editing on or near camera clicks on the original tape. Every time there is a camera click there is an accompanying instability on the original tape due to the VTR having had to start up. Camera clicks are just like the other instabilities mentioned (tracking errors, dropout, etc.) and they cause the same problems.

The last thing you should remember about using a Sony 3400 as the recording VTR (or in the field shooting tapes) is to try to keep the tape taut throughout the tape path just before making a recording. When the VTR is stopped, it has a tendency to let a little slack develop in the tape path. This slack eases wear on the heads and tape, but when the VTR is again started up, it takes some extra time for this slack to be taken up.



By keeping the tape at the proper tension during the E to E mode, you will insure that you get the cleanest edits possible.

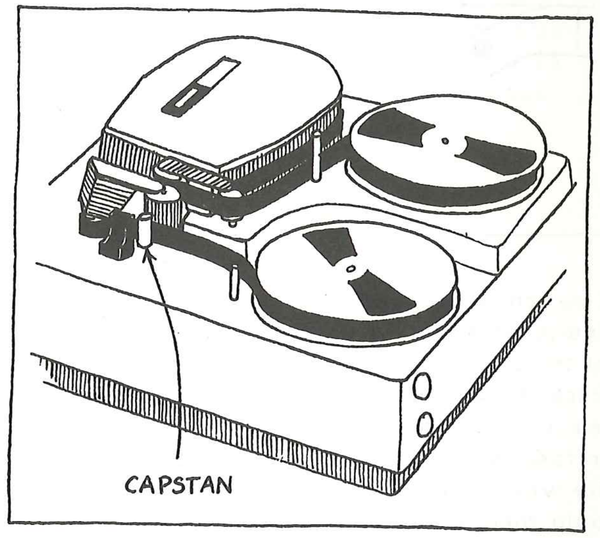
Although what's just been described is a system using either two 3400s or a 3400 and a studio VTR, the principles apply to a lot of other editing systems. Two studio decks can be set up in exactly the same way to do exactly the same job. Most studio VTRs have both an 8-pin output and UHF-connector co-axial cable inputs and outputs for video and inputs and outputs of some sort for audio (usually mini-jack or RCA/phono-type receptacles). This can save having to use TV sets for line and result monitors if video monitors are available. Also, an audio mixer can be added into the audio line in order to mix in sound not on the original tape. There are some other things which can be added to increase the effectiveness of these types of non-editing/editing systems, but if you can understand the basics of transferring the video and audio outputs of one VTR to the video and audio inputs of another, you should be able to figure out what fits your editing needs.

Editing onto an AV 3400 or onto any VTR not specifically made for electronic editing can never produce stable, visually appealing, "clean" edits. One of the primary reasons for the instability of edits made on a non-editing VTR is the fact that the record VTR must build up momentum to attain the proper tape speed. The time it takes for the record VTR to go from stop to full speed determines the duration of the instability at the edit point. Since it always takes some time to get from stop to full speed, there is always some instability at the edit.

The process of electronic editing avoids the momentum problem of non-editing VTRs. In electronic editing both the record and the playback VTRs are put in playback mode a few seconds before the edit is to be made. At the edit point, the record VTR is switched from playback into record and the edit is made. If this switch is accomplished at precisely the right time, and under the proper conditions, the edit will be stable. If the time and conditions are not right, the edit will be unstable.

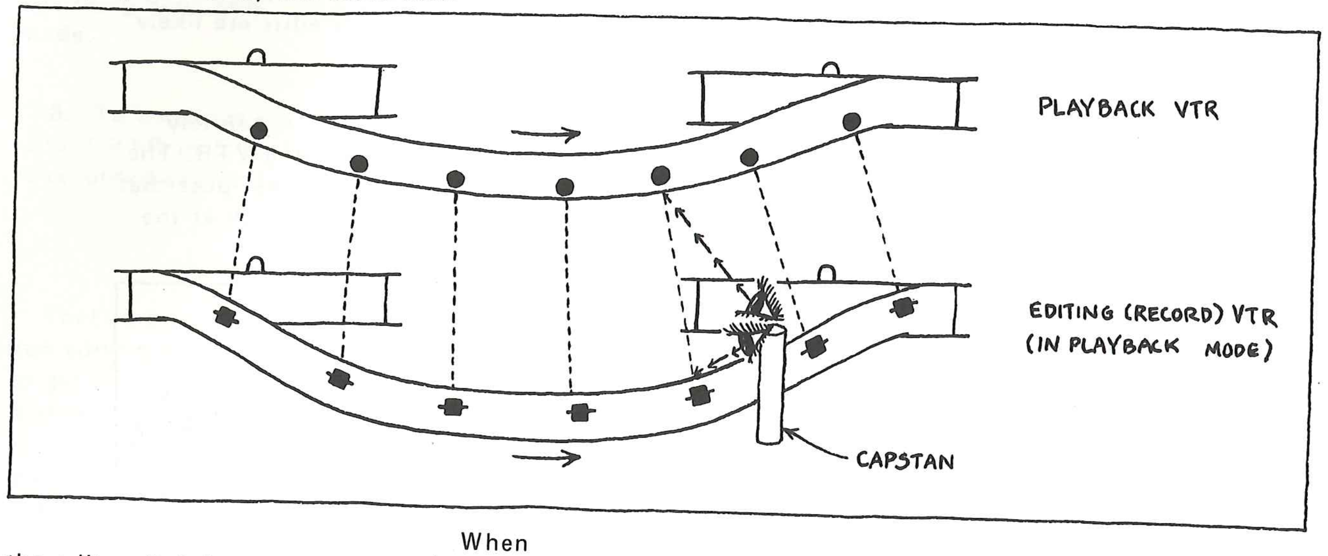
The cost of the systems which determine the time and conditions under which an edit is made has steadily dropped to the point where some of them can now be incorporated into 1/2" VTRs. The following information touches on a few of these editing systems, not all of which are currently available in 1/2" VTRs. The more of these systems any one VTR uses, the better its edits are likely to be.

A *capstan servo system* is absolutely essential to any electronic editing VTR. The capstan is the small, rotating, silver post that pulls the tape through the tape path at the proper speed.

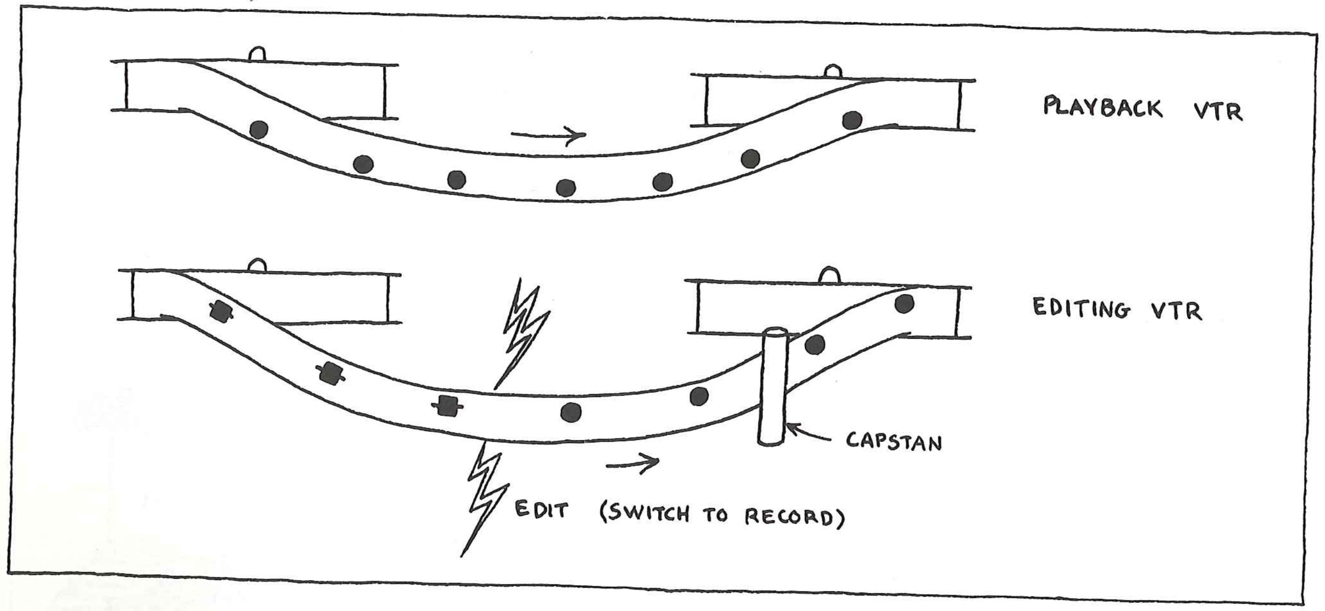


It is a very important part of the tape transport system. In a capstan servo system, the speed of the tape and the speed of the heads are completely interlocked. If there are small changes in the speed of one, the speed of the other acts to compensate for it. This serves to constantly maintain the proper relationship between the speeds of both the heads and the tape at all times. A capstan servo system is an added stability factor. It is neither essential to all video recorders, nor are all capstan servo VTRs electronic editors.

The capstan servo system in an editing VTR makes it possible to switch effectively from playback into record at the edit point. In normal playback the capstan servo system uses the control track pulses to determine tape and head speeds. When set up for editing, the capstan servo system not only uses the control track pulses from its own tape, but it also senses the pulses from the tape on the playback VTR. The capstan servo system compares the two sets of pulses in the brief period of playback before the edit switch is made. By comparing the two sets of pulses, the system adjusts the head and tape speeds of the record VTR so that the control track pulses on both record and playback VTRs are occurring at exactly the same rate.

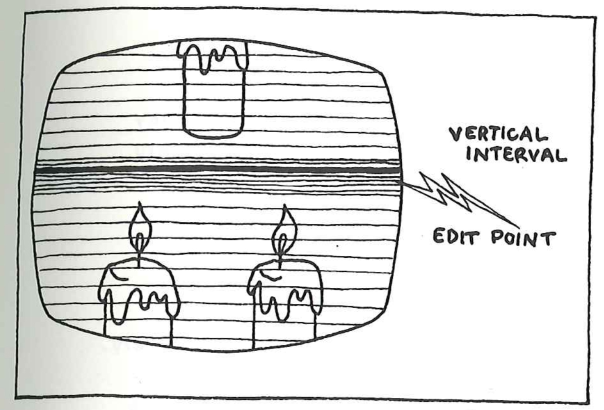


When the edit switch is made, there is no break in continuity between the control track pulses of the old and new pieces of tape. In playback the control track pulses are translated into vertical sync. If the pulses, and therefore the sync, are continuous, no instability will be observed on the monitor (nor should there be any in subsequent transfers).



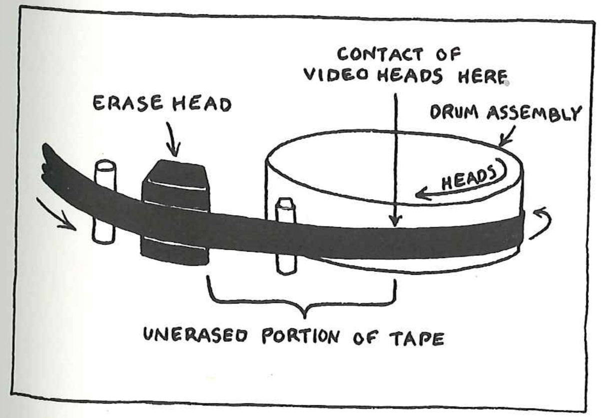
When an editing VTR is using only its own control track pulses to run in normal playback, it is said to be *internally locked.* That is, it is stabilized or locked-up to its own internal signal. When an editing VTR is comparing control track pulses in the edit mode, it is said to be *externally locked.*

Even within this complex system, there are degrees of complexity. A good deal of how "clean" an edit looks depends on where, within each frame of video, the edit occurs. Obviously, the best place to make an edit is when the exact change-over between old and new information can't be seen. The only time available for that to occur is during the vertical blanking period. That is what is meant by a *vertical interval editor.*

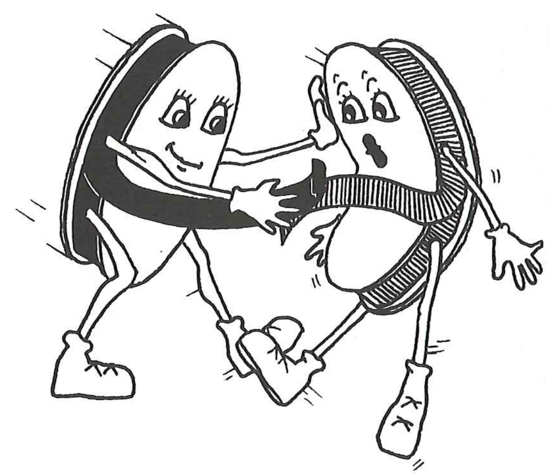


Some editing VTRs are *frame to frame editors* which means that they edit at any point within a given frame. While frame to frame editing is not as exact a method as vertical interval editing, it is still considered electronic editing.

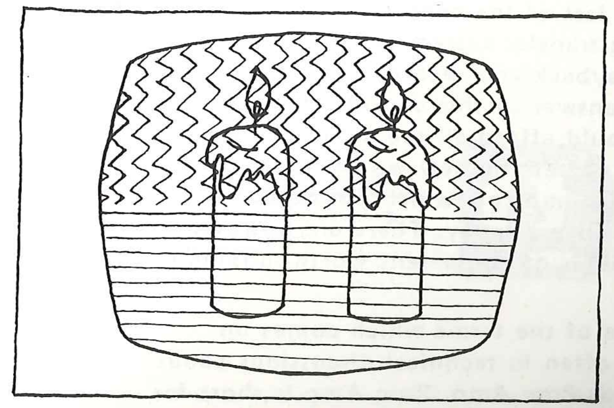
The method of erasing old video and audio is also a crucial factor in determining the quality of an editing VTR. In all VTRs the regular erase head precedes both the video heads and the audio control track heads in the tape path. As soon as the record button is pushed, the erase head is also activated. This is not the best system for electronic editing because the tape that lies between the erase and record heads at the time the edit switch is made will not have been erased when it reaches the record heads.



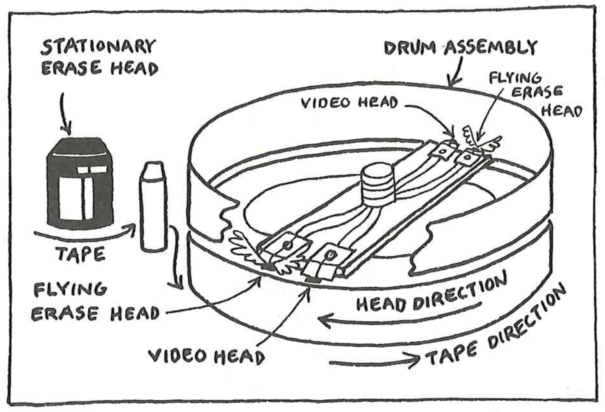
Therefore, the video, audio and control tracks are recording new information on top of the old. If there is video on the tape at the edit point, the only way the edit can be made is if the new video signal to be recorded is much stronger than the signal already on the tape. For this type of editing to be effective, the new video, audio, and control track must be amplified by the electronics of the editing VTR and recorded right on top of the old video. This type of editing is called *brute force* editing. The new signal is forced on top of the old for the few seconds until the newly erased tape reaches the video heads. This is the method that all current 1/2" editing VTRs use. This system is rather imperfect due to the variations in signal strength from tape to tape.



Most times, the new video overpowers the old but there is a considerable margin for error if, for example, the incoming signal is extremely low and the pre-recorded video is a good, strong signal. The result is usually a herring bone pattern called *moiré.*



Moiré is the visual result of the clash of the two video signals. To prevent this, some electronic editors add an extra erase head within the drum assembly itself. This head precedes the video heads as both heads spin around. It erases the old video one line before the new video is recorded. It is activated when the record button is pushed and stays on only until the erased tape from the stationary erase head reaches the video heads. This second erase head is called the *flying erase head* and it eliminates most of the problems of conflicting video signals in the editing process.



Controlling the tape and head speeds and the erase procedure is not the last stability factor necessary for perfect electronic editing. Tape tension is also important. The most sophisticated one- and two-inch VTRs integrate tape tension, tape speed and head speed into an entirely interdependent system that is able to compensate for errors in any one of its parts. This type of system eliminates any variations that might occur during record and playback. Uncorrected fluctuations affect the horizontal frequency and therefore the basic stability of the video signal. This level of sophistication in both playback and record is one of the things you pay for in a "broadcast quality" VTR.

The last of the considerations for any editing/transfer system is: what goes between the playback and record VTRs. There is no exact answer to this consideration. Even if you could afford all the auxilliary hardware made, something new would undoubtedly pop up tomorrow which obsoletes half of what's in use today. There are, however, a few pieces of equipment worth looking into.

One of the terms which comes up quite often in technical discussions about video is *Proc Amp.* Proc Amp is short for Signal Processing Amplifier. A Proc Amp usually serves two functions: 1) it electronically reshapes distorted sync pulses and 2) it amplifies and aligns certain video and sync levels. Distorted sync pulses can cause any number of stability problems. Among the sync problems you can see on a monitor are: vertical jitter or rollover, flagging or tearing at the top of the screen and tapes that just won't track. There is even some sync distortion inherent in all half-inch recordings since 1/2" VTRs are not technically able to record and play back all of the sync information they receive. Some sync problems, like tracking error, are irremediable; others can be overcome by use of a Proc Amp.

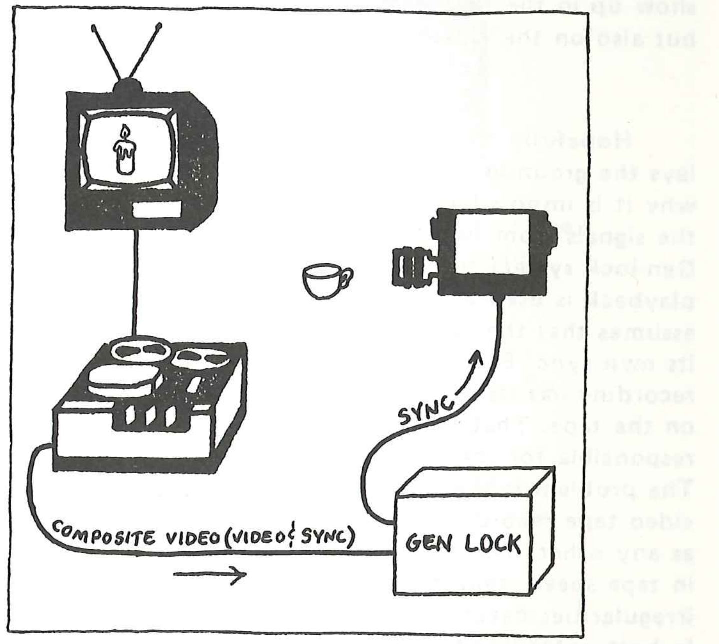
The first job a Proc Amp does is to separate the video from the sync pulses so that both signals can be processed separately. Most Proc Amps use one small portion of each old vertical sync pulse to regenerate a whole new vertical sync pulse. The new signal is at the same frequency as the old, but it is electronically much more stable since the noise and distortion have been eliminated. Since this new sync signal has been generated by the old, the new sync signal can be combined with the original video without any instability occurring.

The relative strengths of video and sync are also important. The second job of the Proc Amp is to insure that the proper video and sync relationships are maintained. It is essential that the video and sync signals do not interfere with each other. These amplification and separation functions of a Proc Amp, along with sync reshaping, make a Proc Amp a valuable addition to an editing/transfer system and also to systems where a video signal from a 1/2" VTR is being broad- or cablecast.

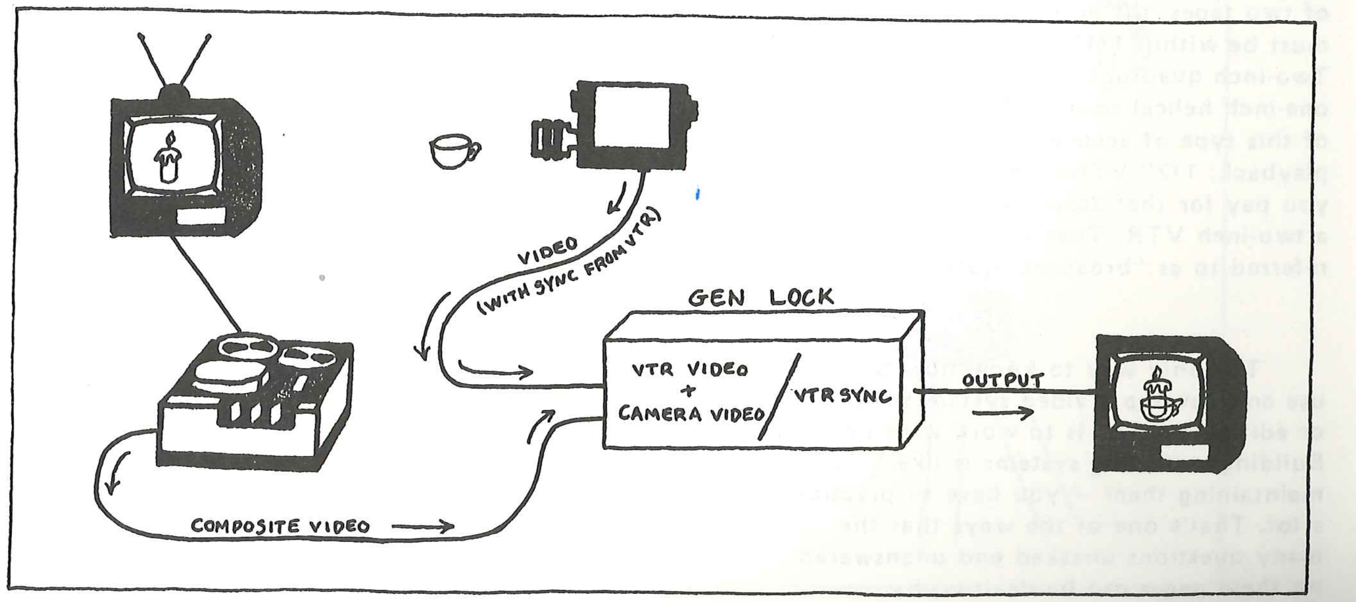
A Proc Amp is not a miracle machine. Its job is to improve an imperfect but basically stable signal. If the signal the Proc Amp receives is very unstable or extremely distorted, then the Proc Amp will simply amplify and reshape those instabilities and distortions, thereby causing problems greater than the original ones. The best way to know whether or not a Proc Amp is desirable for any particular system is to try one out. Many Proc Amps are not built to work with 1/2" VTRs. You can usually wangle a demonstration of your

tapes run through a Proc Amp from the people who sell that kind of hardware. A trial run can often tell you if you can use a Proc Amp or if you would be better off investing in a new set of batteries or something of that nature.

Another term that's often bandied about is *Gen-lock.* The longest explanation extant for that term is Signal Generation Lock-up Pulse. A Gen-lock is a system which allows you to electronically mix the signal from a VTR and the signal of one or more live cameras, just as if the tape were a live camera. The principle is simple. In order to operate properly, a camera needs a sync (drive) signal. A pre-recorded tape being played back has a sync signal associated with it. If the sync signal from the tape is also sent to the camera, in the form of horizontal and vertical drive, the camera can be run by that drive signal. In this situation, the horizontal frequency for the camera is the same as that of the tape, i.e., for every line of video scanned on the tape, there is a line of video scanned in the camera. The video information is different for the tape and the camera but the rate it is being produced is the same.



These two video signals can be electronically mixed by combining them in a video mixer with the Gen-lock feature. The mixed signal, whose sync signal is that of the original tape, can be recorded on a second VTR in the same way any composite video signal would be.



While the actual electronics of a Gen-lock are rather complicated, the theory of using the sync from a tape to drive a camera and then combining the signals of both camera and tape onto a single output should not be too difficult to understand. It is important to remember, however, that if there are any problems with the original tape or with the playback VTR, those problems will be magnified in a Gen-lock transfer. Those problems will not only show up in the tape part of the transfer, but also on the video from the camera.

Hopefully this Gen-lock explanation lays the groundwork for the explanation of why it is impossible to electronically mix the signals from two 1/2" VTRs. In the Gen-lock system the sync from a tape in playback is used to lock up a camera. This assumes that the camera is not generating its own sync. Each 1/2" video tape recording has its own sync signal recorded on the tape. That sync signal is directly responsible for the stability of the tape. The problem is that no one half-inch video tape recording is exactly the same as any other. This is due to the variations in tape speed, tape tension and other irregularities natural to all low-cost VTRs in both record and playback. In the Gen-lock system, where there was one line of video on the tape, one line of video was scanned on the camera. But in trying to mix two tapes, where there is one line of video on one tape, there may already be one line of sync or blanking on the other. In order to accomplish the exact match-up of two tapes, the accuracy of each machine must be within 1/15,750 of a second Two-inch quadruplex VTRs and certain one-inch helical scan VTRs are capable of this type of accuracy in record and playback; 1/2" VTRs are not. But then, you pay for that accuracy when you buy a two-inch VTR. That accuracy is what is referred to as "broadcast quality."

The only way to know how best to use and develop a video system for playback or editing/transfer is to work with one. Building and using systems is like maintaining them – you have to practice a lot. That's one of the ways that the many questions unasked and unanswered on these pages can be dealt with.

PATCH PANELS

Many playback and editing facilites use systems called *patch panels.* A patch panel is simply a convenience feature for more permanent systems. A patch panel eliminates the trouble of having to crawl around, under and behind each piece of equipment you want to connect to another. A patch panel is a place where wires from the inputs and outputs of each piece of equipment in a system are brought and connected to a standard type of receptacle. A standard set of interconnecting cables can then be made up to connect together decentralized pieces of hardware at a central location. The interconnecting cables are called *patch cables.* Usually there are separate audio and video patch panels and cables. The video connectors vary from panel to panel but the audio connectors are usually phone plugs.

Notes On ...

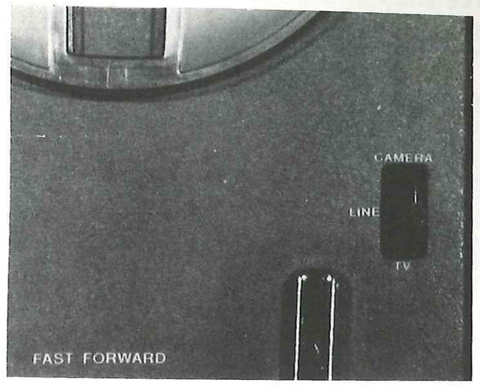
PRODUCTION SYSTEMS (SINGLE AND MULTI-CAMERA)

Most video systems are surprisingly flexible. With the proper information and the skills to apply it, you can expand the capabilities of most video systems far beyond the simple systems laid out by the manufacturers and salesmen. These notes deal with some of the basic requirements for any single- and multi-camera system and some of the practical considerations for meeting those requirements. Logically, once these requirements are met, any appropriate piece of equipment should fit with any other.

As with the other sections of this manual, this section is not intended to stand alone. It is only a logical extension of the previous sections and also leads into the following ones.

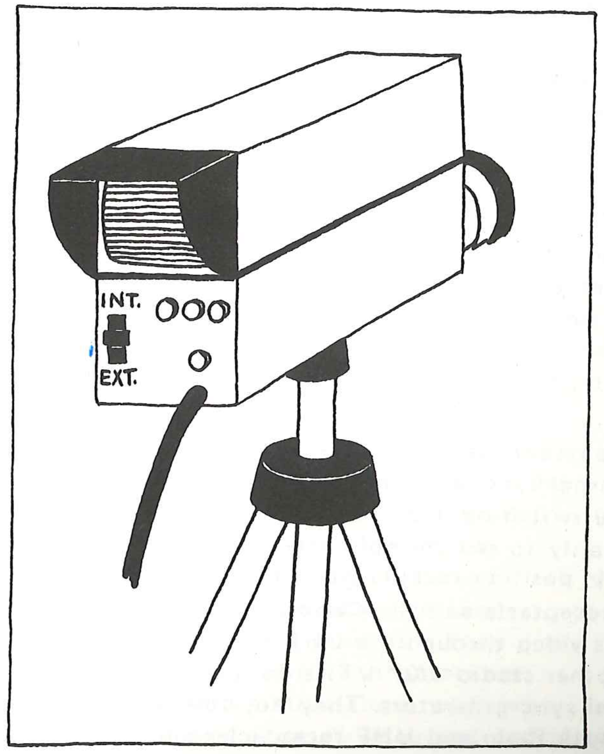
Any multi-camera production system is easy to cope with if you understand the basis for it, which is a single-camera system. The hardware requirements for either include: 1) a source of video, in this case a camera; 2) a sync generator; 3) a source of an audio signal; 4) a VTR; 5) a monitor for both audio and video and; 6) the proper cables for hooking them all together. All of these elements must be present for any production system to be complete. Most of them are straightforward and need no more explanation. The need for a sync generator and how cabling fits into the scheme of things often cause some confusion. Those two elements occupy the bulk of these notes. With sync and cabling straightened out, the other elements should fit into place.

The origin of the sync signal is very important. The *TV/Line/Camera* switch on Sony studio 1/2" VTRs determines this for the whole system to which the VTR is

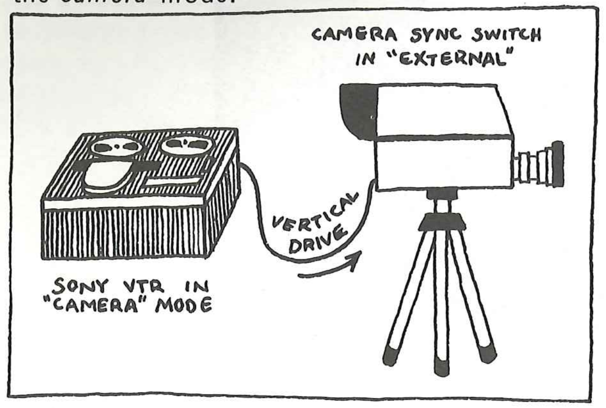


connected. All Sony 1/2" VTRs have some sort of built-in sync generator. When the VTR is operated in *camera* mode, this sync generator is activated and a vertical drive pulse is sent to the camera through the appropriate cable through the 6-pin cable on the studio decks.

Most studio cameras, Sony or others, also have a sync generator built into them. Some of these sync generators produce 2:1 EIAJ sync; others produce only random sync. The camera sync generator is controlled by the internal (Int.)/external (Ext.) switch on the back plate of the camera.



When this switch is in the *external* position, the sync generator in the camera is switched off. With the sync generator off, the camera is open to receive sync from an external source such as a Sony VTR in the *camera* mode.



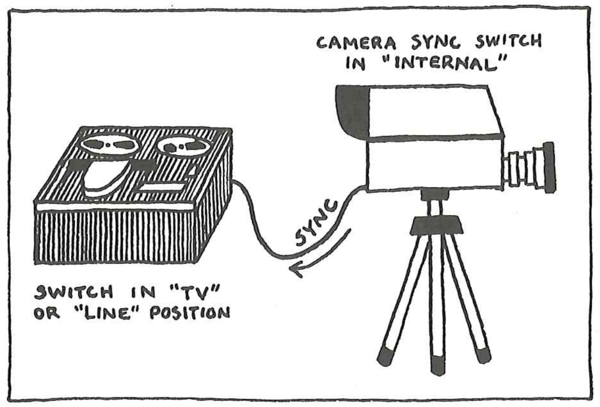
The *internal* side of the camera switch activates the internal sync generator in the camera. The internal sync of the camera can never be generated at exactly the same rate as the sync coming from the VTR. Therefore, if the camera switch is in the *internal* position and the VTR is in *camera* mode, the two sync signals will collide, resulting in horizontal and vertical distortion on both the recording and the monitor.

In order to avoid the clash of sync signals, the *TV* and *Line* modes on Sony 1/2" VTRs turn off the internal sync generator of the VTR. This allows the VTR to record a composite video signal whose sync was not generated from within the VTR. All TV signals are necessarily broadcast and received as composite video (in RF form).

In the *TV* position, both the video and audio inputs enter the VTR through the 8-pin receptacle. The *Line* position of the switch simply allows the video to be recorded through the UHF receptacle rather than through the 8-pin.

Panasonic studio VTRs do not have an internal sync generator so the *TV/Camera* switch on 1/2" Panasonic VTRs serves only to switch input receptacles. The *TV* position accepts video through the 8-pin receptacle and the *Camera* position accepts video through the UHF receptacle. Most other studio 1/2" VTRs do not have internal sync generators. They do, however, have both 8-pin and UHF receptacles and a switch that controls which one is used as an input.

When using a studio camera with a Sony VTR in *TV* or *Line* positions, or the VTR of some other manufacturer, be sure that the camera switch is in the *internal* position.



Otherwise, you will have no sync signal. Also, if the internal sync of the camera is only random interlace, at least be aware of the fact and the problems that go along with recording random sync signals (see sync section).

The *TV/Camera* switch on the AV 3400 portable VTR serves one additional function. In record it does exactly the same thing as the *TV/Line/Camera* switch on the Sony Studio VTRs. In the *Camera* position, the sync generator in the portable VTR is activated to send the drive pulses (both vertical and horizontal) to the camera. In the *TV* position, the sync generator is turned off to allow the VTR to accept a composite video signal from an external source. The portable camera, however, has no internal sync source and can only be properly operated when sync from an external source is fed to it.

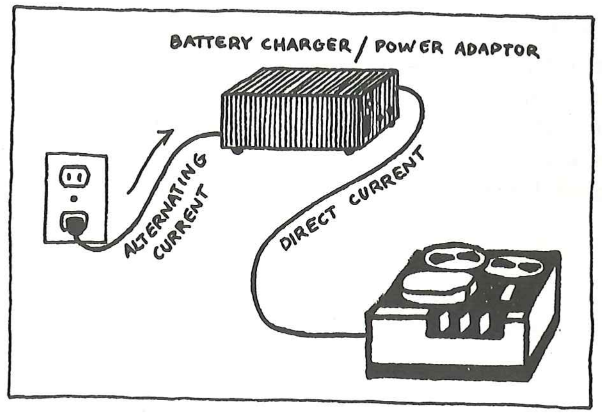
The *TV/Camera* switch on the portable also functions during playback. The video signal to the camera is also in a slightly different electronic form when played back in the camera. The *TV/Camera* switch is used in playback to shunt the video signal to the appropriate circuits for either camera viewfinder or regular monitor playback.

In both *TV* and *Camera* positions, there is a video signal being played back by the portable VTR. This is why the RF adaptor unit works regardless of the position of this switch. Many people have modified their portables by tapping the video signal within the circuits of the portable VTR (the RF unit connector located inside the VTR is a convenient spot for this) and bringing the playback and record video signal out to a UHF receptacle which can be mounted on the case of the VTR.

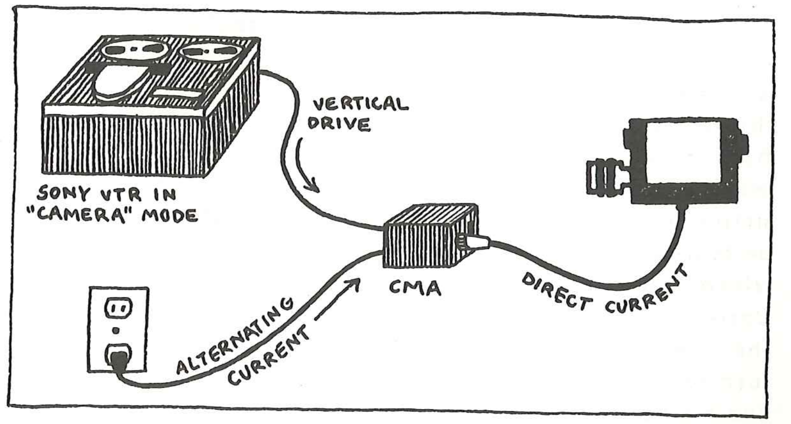
There are other considerations to sync generation in a production system. The sync generators of the studio type Sony VTRs depend on the alternations of the wall current in order to produce a stable sync signal. These alternations occur at the exact rate of 60 per second throughout North America. Because these alternations are so well regulated by the power companies, the alternations can be used as a reference for the VTR sync generator. There's more about this in the *AC/DC Notes.*

The portable VTR cannot use these alternations as a reference because it operates only on direct current (no alternations). Even though the battery charger/power adaptor uses wall current, none of those alternations get through to the portable. It is the job of the battery charger to convert alternating current from the wall socket to direct current needed to operate the portable VTR and camera and to charge the batteries. The sync generator in the portable is, therefore, completely self contained. Because it cannot use the wall current alternations as a reference, the basic horizontal frequency of the sync generator in the portable may drift away from the proper setting. This usually occurs after long use or when some damage has been done to the VTR. This may not be noticeable at first in the record process, but it can cause lots of problems in transferring tapes. The horizontal frequency and the procedure for adjusting it are listed in the service manual. When the horizontal frequency is correct, the sync generator in the portable VTR is a very good source of sync.

The portable camera is also operated on direct current. When it is used with the portable VTR, the camera receives its current from the batteries in the VTR or from the battery charger via the VTR.

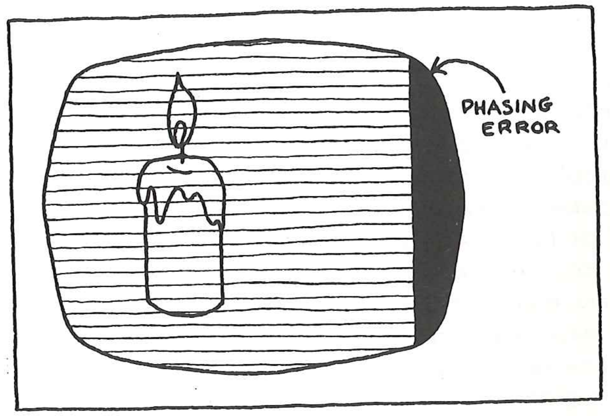


In order to operate the portable camera without the portable VTR, it is necessary to supply the camera with both direct current and drive pulses. Actually, the camera will develop a rather unstable picture with very random sync if only direct current is supplied it. But the best thing is to supply it with both DC and sync. Sony makes a device called a *CMA-2* (or *CMA-1* or *CMA-1B)* which supplies DC and, in conjunction with a Sony studio VTR in camera mode, it also supplies the camera with a reasonably stable horizontal drive pulse. The vertical drive pulse comes from the sync generator in the Sony VTR.



It is also possible to use cameras, portable or studio type, made by manufacturers other than Sony, with Sony equipment and vice versa. In these cases adaptor cables are usually required. But it is not only the connectors on the cables which must be interfaced. The *wiring* of the connector must also be adapted to meet the requirements of each individual piece of equipment being used. In other words, Shibaden or Panasonic portable camera isn't wired for audio and video on the same pins of the 10-pin cable as a Sony camera, even though their connectors are the same. The information about what wire goes where on any piece of video and audio equipment is in its service manual. How to get that information is covered in the "Not So Basic Maintenance" section of this manual. Suffice it to say that most cameras will work with most VTRs with little more than some fancy cabling.

There is a minor but common problem which may arise when using portable cameras with long camera cables through CMA-1 units, especially in multi-camera systems. It's called *phasing error.* Phasing error shows up as a black line from top to bottom, on the right hand side of the monitor screen.

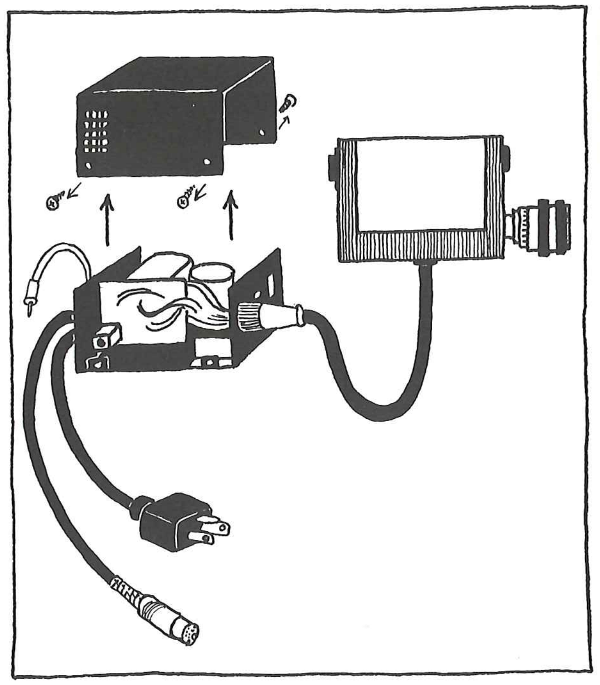


This black line is the horizontal blanking signal which is displaced (out of phase). If you record this phase error there is no way to remove it from your tape. If you spot it before you make a recording, then there is a relatively simple procedure to correct it. Some CMA-2 units have a hole drilled in one side through which a narrow bladed screwdriver can pass. Correct the phasing error by carefully inserting the screwdriver into the slot in the hole. Then, turn the screwdriver until the phasing error line moves out of sight off the side of the machine. With a multi-camera system, set up a superimpositon of two cameras and adjust the phasing of both so that no error is apparent for either camera. Remember to hold the screwdriver only by its insulated handle and not on the metal shaft.

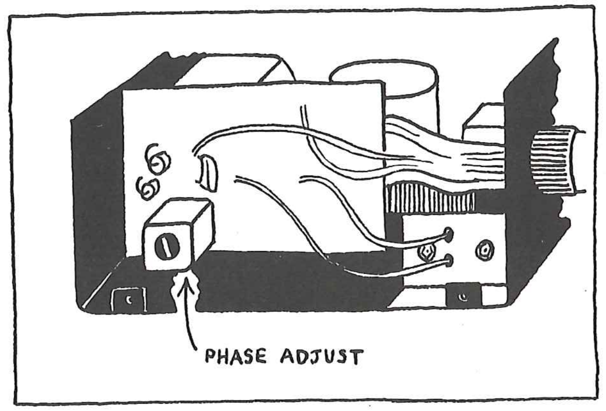
Some CMA units are not so obliging because they have no pre-made adjustment holes. To correct phasing error on these models, follow this procedure:

1. Unplug the CMA unit from the AC line.

2. Remove the screws at the four bottom corners and lift off the case.



3. Find the component side of the printed circuit board. Locate the small silver box with the hole in the top (it's an inductor coil or "can"). Inside the hole is a slot that will fit a thin screwdriver blade. The slot may be covered with a wax sealer that can be removed with the screwdriver blade.



4. Plug in the CMA unit and correct the phasing error by the same procedure used on the CMA-2 above.

5. When the phasing error has been corrected to your satisfaction, unplug the unit and replace the cover.

One afterthought about phase error adjustment is the set-up of the monitor on which the phase error is showing. On some monitors, the *horizontal hold* allows you to adjust the picture so that horizontal blanking will show up on the right side of the screen. This could be confused with a phase error if you aren't familiar with the monitor. One way to determine whether you have a phase error or just need to adjust the horizontal hold control on your monitor is to play back a tape made without a CMA unit. The monitor set-up is probably correct if, without adjusting the horizontal hold, the picture from the tape doesn't have a black line down the right side of the monitor.

So far, sync generators have only been discussed as parts of other pieces of equipment which they often are with 1/2" equipment. There are, however, separate devices, in their own boxes, called *sync generators.* They perform the same or more functions as the sync generators in VTRs and cameras. Most of the manufacturers of 1/2" equipment make EIAJ sync generators. These sync generators usually have an output cable or receptacle which fits with that manufacturer's other equipment (cameras, special effects boards, etc.). All of these sync generators can be adapted to work with the hardware of other manufacturers. Most sync generators have a second set of outputs (often on UHF receptacles) for horizontal and vertical drive pulses and for blanking. This is true of sync generators, whether they are EIAJ or EIA. Not all 1/2" hardware can use an EIA signal directly. Portable cameras, for instance, must first be modified. All 1/2" VTRs can record an EIA sync signal without problem.

The quality of any multi-camera system is as dependent on the quality of the switcher/special effects board as it is on the quality of the VTR cameras and sync generator. The simplest type of switch in a multi-camera system is a *passive* or *mechanical switch.* This type of switch was already discussed in the playback section. It is a very good way to make very bad tapes. Every time a switch is made on a passive switcher, the sync signal going to the VTR is interrupted. By the time the switch is completed, the VTR has started to electronically search for a pulse to stabilize on. By the time the VTR is again stabilized, the instability during the switch has been greatly extended on the recording.

The first requirement for a stable video switch is a constant sync output regardless of whether or not there is a switch being made. This requires active electronic circuits. The second requirement of a stable electronic video switcher is that it supply each camera in the system the exact same sync signal. It doesn't matter from where the sync is generated, only that there is one sync source for all cameras. If the sync for any two cameras were even slightly different, the sync signal to the VTR at the time of a switch would also have to be different. This too, causes a VTR to search which, in turn, produces instabilities in the recording.

This second requirement of the same sync for all the cameras is especially important in the production of special effects. The circuits which produce special effects such as superimpositions, dissolves, wipes, etc., use only the video signal to accomplish these effects. The circuits in the special effects board strip away the sync that accompanies the video from the cameras. The special effects are created by electronically mixing the separate video signals. Then the special effects video is recombined with the sync signal and sent to the VTR as composite video. This process of stripping and re-adding sync would be impossible if not for the fact that all of the cameras were receiving and producing video with the same sync signal.

One other consideration which determines the quality of the switcher/special effects board is the method of switching its uses. Many electronic video switchers are mechanical switchers. With mechanical switches, the video is switched whenever the operator pushes the switch. This means that some switches occur in the middle of a field. This can cause an annoying flash on some switches. Another problem with mechanical switches is that they eventually wear out. They also get dirty. Both wear and dirt can cause dropout in the video when the switch is made. This dropout does affect the sync and is usually a visual annoyance rather than a stability problem.

The most sophisticated switchers use electronic switches. When an electronic switch is pushed, the switch circuit waits until the next vertical blanking period before making the switch. Because the switch occurs in blanking, there can be no flash caused by two different video signals changing in mid-field. Electronic switches are not subject to mechanical wear and dirt, either.

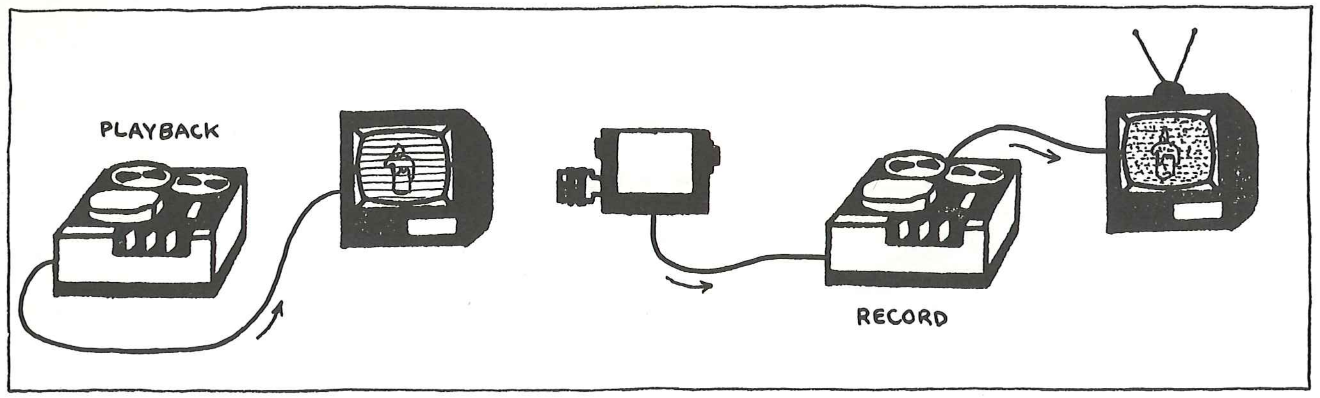
EDITING OFF A MONITOR (SCAN CONVERSION)

Some tapes just won't transfer electronically without adding horrendous stability problems to the copy. If you don't want to give up on an impossible tape, then the only way to transfer it is optically. The following is the way an optical or scan conversion transfer works.

The tape to be transferred is played back on the best monitor available. A camera attached to a second VTR is carefully pointed at that monitor and a recording is made of the image on the monitor.

without too much difficulty, that too, should be done. Ambient light should be minimized. Ambient light is general illumination not coming directly from the monitor screen. Ambient light increases glare on the monitor screen and cuts down the quality of the transfer.

Experiment with various distances between the camera and the monitor screen — the closer, the better. In order to get as close as possible, it may be necessary to screw the lens out from the camera a few turns. Be careful, however, to see that the lens is still securely anchored to the camera. Many camera stores carry *lens extenders* which can be temporarily installed between the camera and the lens. If possible, try to close down the iris of the lens as much as you can. This increases the depth of field of the lens which is important because the picture screen has a certain depth to it.



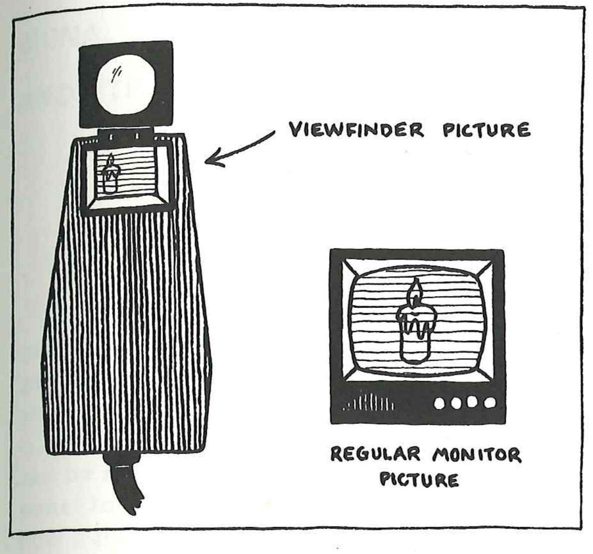
Any visual problems with the original tape such as tracking errors or heavy dropout will, of course, show up in the new recording. Yet the stability of the copy will be no problem (if the record VTR is working properly) because the copy is now a first generation tape.

The drawback with this method of transfer is a noticeable loss of picture quality between the original tape and the copy. This loss can be minimized, though not eliminated, by taking some time to set up the optimum conditions for the transfer.

The brightest monitor available should be used to play back the original tape because the camera will not record all the light radiated from the monitor. If the monitor has some sort of face plate which can be removed

Studio cameras (AC operated) rather than portable ones are desirable for use in this type of transfer. Studio cameras can be more easily adjusted for maximum sensitivity (target and beam adjustments). AC operated cameras and VTRs also use the wall current as an electronic reference, as do most monitors. The difference in frequency rates between AC operated devices is usually much less than the difference between AC and battery operated equipment.

If you are using a portable camera, make a test recording and play it back (a good procedure with any system) before making the final transfer. The camera monitor in the Sony AVC 3400 is misleading. It is off-set about 1/8 of the screen so that you can't see exactly what is being recorded. This is a quirk of the Sony camera, but it should be taken into account.



When a studio type VTR is being used as the record VTR, the audio should be connected directly from the *line output* of the playback VTR (the earphone out on the portable) to the *line in* on the record VTR. If the transfer is being made between two portable VTRs, there are two ways to transfer the audio. The first way is to use an attenuator. Take the audio from the original tape out of the earphone jack of the VTR. Come out of the attenuator and into the mic input on the record VTR.

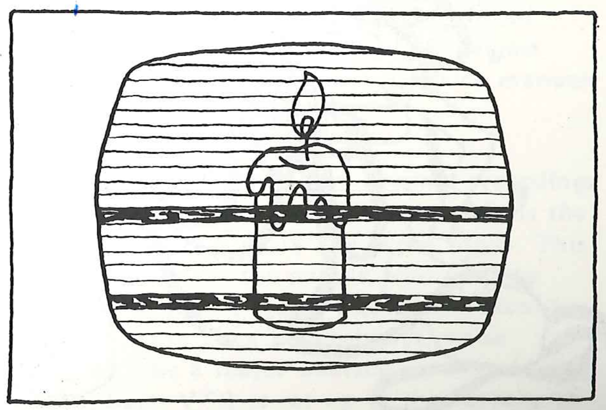
The second way is to transfer the audio in the same manner as the video, i.e., put a mic in front of the speaker of the playback monitor.

VIDEO TAPE

It is very possible that the best brand of video tape is the brand that the individual manufacturer recommends. And, while this is certainly not universally true, it is as good a basis for deciding which tape to buy as any. As of this writing, the most reliable tape has a shiny recording surface and a dull backing, but this type of tape is marketed by a number of manufacturers.

But no matter what brand of tape you end up buying, *USE ONLY VIDEO TAPE! DO NOT USE COMPUTER TAPE!* Video tape is very ruggedly constructed in order to withstand the impact of the video heads. The bond between the oxide and the backing is extremely strong for just that purpose. Computer tape must only pass over stationary record heads and the bond between the oxide and the backing is much weaker. The result of using computer tape on a VTR is that the oxide gradually dislodges from the tape and clogs the heads of the VTR. Eventually, the original recording becomes damaged from excessive dropout and the heads of the VTR may break or become very worn.

Even though there is a strong bond between the oxide and the backing on video tape, the oxide eventually tends to fall off. Anywhere there is no oxide on the tape, no video can be recorded or played back. This lack of even minute areas of oxide shows up on the monitor screen as *dropout.*

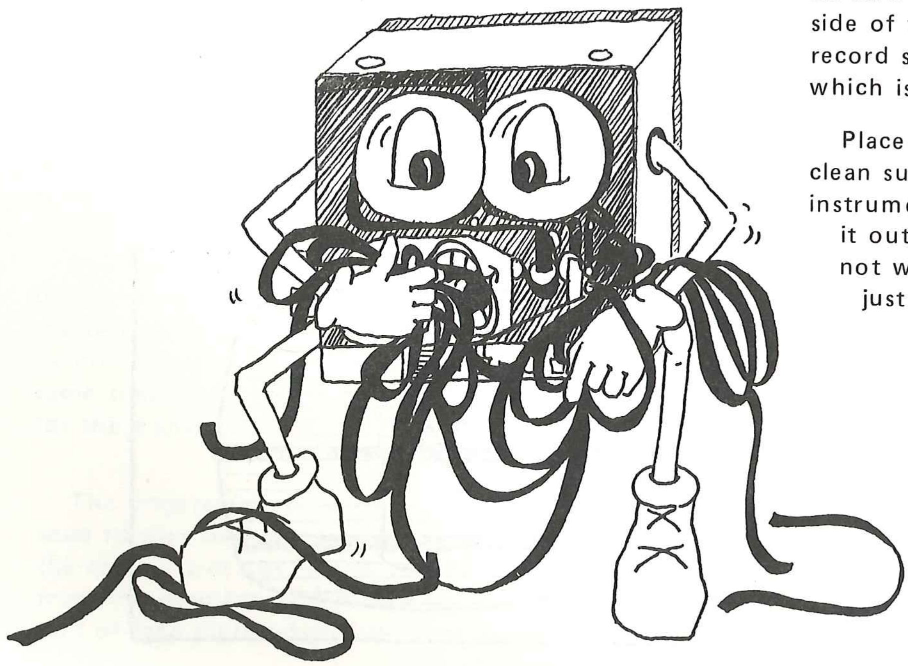


However, dropout is not just caused by lack of oxide. It may be caused by anything that gets between the heads and the tape, such as dirt or grease. For this reason, the better the conditions under which tapes are stored and used, the less dropout they will develop.

Every once in a while, a VTR will eat some tape for lunch. The portable VTRs are especially noted for doing this by winding tape around the capstan. Other VTRs do things like swallow tape under the reels or into the drum assembly. What you have then is crinkled tape which may or may not be salvageable.

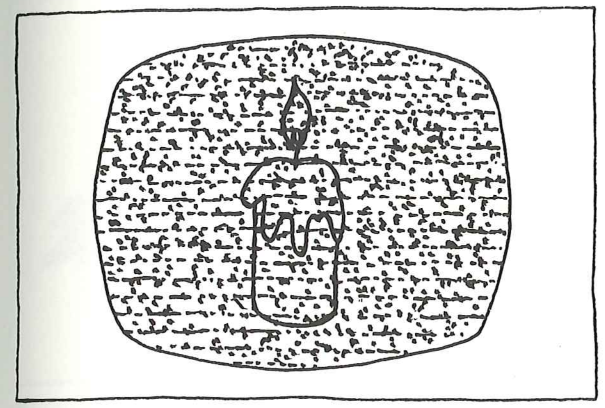
Crinkled tape should not be used to record over, since the bond between the backing and the oxide has been permanently weakened and using such tape again only runs the risk of clogging the heads during the next recording. If the tape is badly mangled, the best thing to do is to cut out the worst part and splice the tape back together where the crinkle ends. If you feel it necessary to take a look at what's left on the less devastated sections of the tape, try to flatten out as many of the crinkles as possible before playing it back. Much of the oxide was dislodged at the time of the crinkle and those areas will always show up as dropout. However, some of what might appear as dropout is actually sections of the tape which are not able to make contact with the heads due to the crinkle. To straighten out the tape, be sure to work only on the non-recording side of the tape, since working on the record side will only dislodge more oxide which is now picture information.

Place the crinkled tape on a smooth, solid, clean surface and with a dull, clean instrument like the back of a spoon, smooth it out as best you can. This method may not work any real wonders, but it may just make the tape watchable.



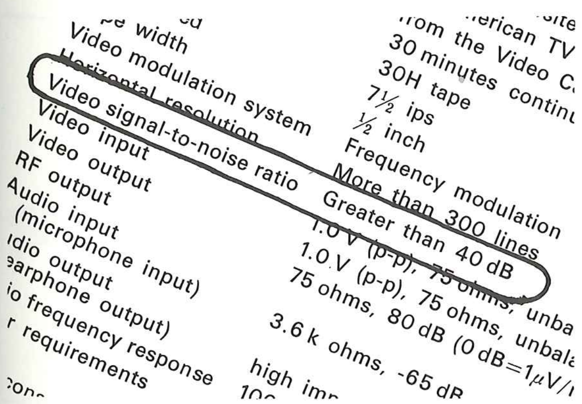
SIGNAL TO NOISE RATIO AND VTR RECORD CURRENT

Two of the basic elements that determine the quality of any piece of video equipment and the picture it produces are its resolution and its signal to noise ration. Resolution is simply a measure of how much information can be defined on the monitor screen. The signal to noise ratio (S/N) is a measure of how "grainy" the picture looks. The "grain" in a video picture is extraneous information called noise.



The S/N is a measure of the relative strengths of the picture information (signal) and noise. The higher the S/N, the less noise is visible in the picture.

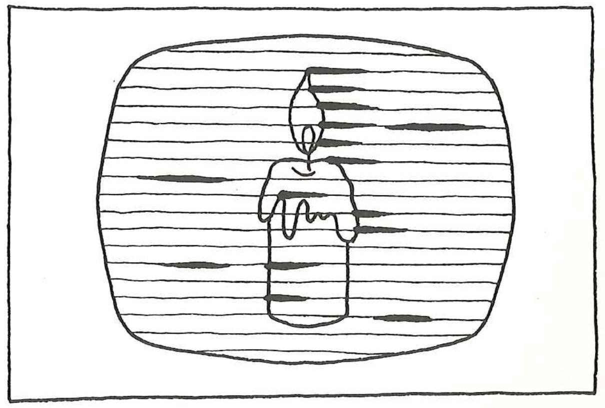
The S/N is expressed in decibels (dB) and is usually written as a negative number (e.g., -40dB which is read as "forty Dee Bee down"). The specification charts for most cameras and VTRs list the S/N along with the other essential information about the piece of equipment (resolution, power consumption, etc.).



Most 1/2" VTRs have a listed S/N of about -40 to -42dB. Any S/N greater than that is under the general EIAJ type 1 standards, and VTR with an S/N less that -42dB is worth investigating as it should have a noticeably better picture.

An E to E picture has resolution and signal to noise figures associated with it that are functions of the quality of the camera and the monitor. Once a signal is recorded, the VTR resolution and S/N must also be considered. Recorded signals always have a greater (worse) S/N and usually a decreased resolution. But the type of video used also has a great deal to do with the S/N and resolution of any video recording.

Each brand and type (not reel size) of video tape requires a slightly different amount of record current from each type of VTR on which it is used. In order to make the best possible recordings, the VTR record current should be adjusted every time a new type of tape is used. Too low a record current causes unnecessary noise. This is especially important to remember when using high energy tapes which require much higher record current than normal. Too high a record current can cause picture distortion.



In general, improper record current will also lower the resolution of any recording. The procedure for record current set-up is listed in the service manuals for each VTR.

Noise isn't apparent on original recordings but by the second and third generations the picture becomes more and more foggy. This is a big problem for people who wish to copy their edited tapes. But, if the record currents have been properly set, noise shouldn't be a major obstacle to transferring tapes. Each VTR is set up at the factory to have the proper record current for its own manufacturer's tape. This means that if you use tape not made by the manufacturer of your VTR, you should set up the record current on your VTR so that you can make the best possible recordings on the tape you are using.

No brand of 1/2" video tape is perfect. Every kind has its drawbacks — whether it's the price, S/N, the dropout or something unforeseen. There are two ways to determine which brand of tape is best for your purposes:
1) make exhaustive tests yourself or,
2) take the VTR manufacturer's word for what's best for his machine.

CABLES

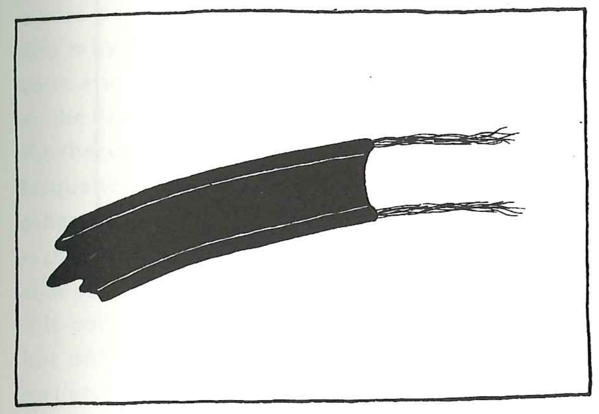
Most video signals in half-inch video work travel over cables with an impedance of 75 ohms. Those cables are almost invariably co-axial cables. Not all co-axial cables have an impedance of 75 ohms, however, and it is important to remember this when working with video equipment. Sending a video signal over a cable of the wrong impedance can cause a lot of headaches.

The impedance of a cable is a measure of how the cable electronically reacts when a signal is passed through it. The impedance of a cable indicates what impedance signal that cable is best suited to carry. Thus, a 75 ohm cable is ideal for a video signal with an impedance of 75 ohms.

Co-axial cable is actually composed of two cables in one casing. The center cable is a single strand of wire surrounded by a plastic case. Wrapped around the outside of the plastic case is a group of thin strands of wire which form the outer axis of the co-axial cable. The impedance of any co-axial cable is determined by a relationship between the diameters and circumferences of the wires. This means that a cable with an impedance of 75 ohms can have an overall diameter of almost any size as long as the proper relationship is maintained between inner and outer axes.

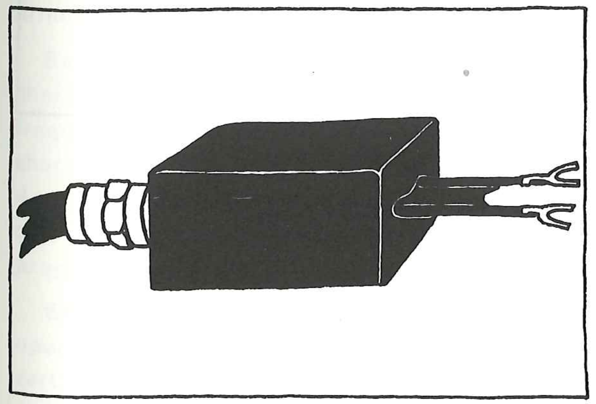
There are two very common types of 75 ohm co-axial video cable. The type most often used to hook various pieces of video gear together is called *RG-59/U*. RG-59/U has a diameter of approximately 1/4". The other common type of co-axial cable is designated *RG-174*. RG-174 is much smaller in diameter than RG-59/U and is used where saving space is important (e.g., on circuit boards and in Japanese mini-cables and components). The major drawback to a video cable the diameter of RG-174 is its susceptability to adding noise to the video signal if the cable is used over long distances.

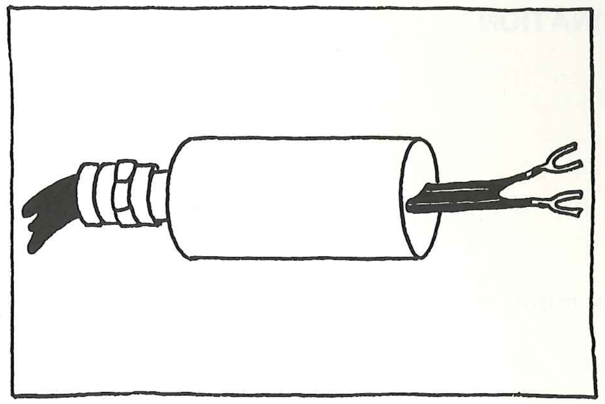
There are other types of cables over which video can travel, but sending a video signal on cable other than co-axial type involves making some sort of change in the video signal itself. One of the other ways in which video is sent over a cable is as an RF signal. Here again, impedance is an important consideration. An RF video signal in the VHF range can travel quite nicely on both 75 ohm and 300 ohm cable, depending on the impedance of the signal itself. 300 ohm cable is often called antenna wire because it is the type of cable most often used to hook up TV sets to their antennas. Most 300 ohm cable is composed of two different sets of twisted wires set at a specific distance apart and usually covered with a flat plastic coating.



The distance between the two sets of wires must be maintained if the impedance of the cable is to stay at 300 ohms.

Sending a signal of the wrong impedance over the wrong type of cable not only adds noise to the signal, but it also seriously distorts it. Some of the problems of using different types of cables with RF signals, can be solved with a device called an *impedance matcher.*





Most people who have cable TV and anyone who has an RF unit has one of these. Cable companies send their signals over co-axial cable (although the impedance may not be 75 ohms). When the cable reaches the individual subscriber, the impedance of the signal must be matched to the impedance of the antenna connections on the back of the subscriber's TV set. The small device which accomplished this interface is an impedance matcher.

The Sony RF unit puts out an RF signal with an impedance of 75 ohms. Many Sony monitor/receivers have a mini-jack RF imput so that the output of the RF unit can be directly connected to the monitor. The little back box with the switch on it that indicates either TV or VTR is an impedance matcher also. This box is part of the RF unit kit. Sony also makes a small back box — as an option — to clip onto the back of monitor/receivers which have only the mini-jack RF input. This too is an impedance matcher. Panasonic's RF converter has a 300 ohm output, so they provide an impedance matcher to convert the signal to 75 ohms when necessary. One nice thing about many low-cost impedance matchers is that they work both ways: they convert 300 ohms to 75 ohms and vice-versa.

TERMINATION

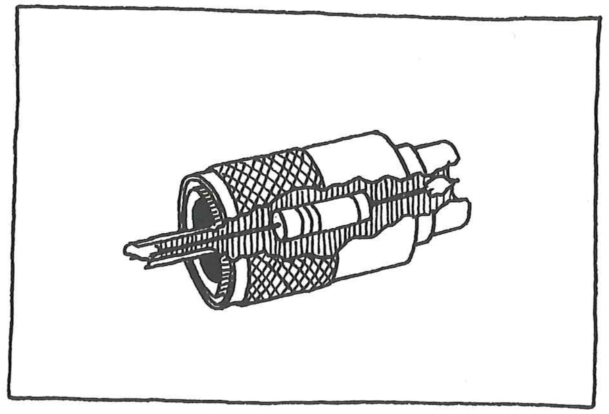
Many monitors have a termination switch. The switch is usually marked "75 ohms" and is either on or off. Proper termination prevents a type of video signal distortion called *ringing.* It also prevents a kind of video reverberation that occurs when a video signal is sent over long cable runs.

Some of the things on the monitor screen that indicate termination problems are an overly contrasty picture or a washed out one, and, with longer cables, a shadow or double edge on the border of images. These visual clues are the only way to know whether termination is a problem with a particular video signal in a monitor (unless, of course, you have a wave form monitor and a trained person to read it). Both lack of termination and multiple termination can cause problems. The best way around these problems is to experiment to see which way your signal looks best. Here are a few suggestions:

1. Any signal being fed into a VTR will be terminated at the VTR.

2. Some Japanese monitors have automatic terminations which are engaged and disengaged as connectors are attached and removed.

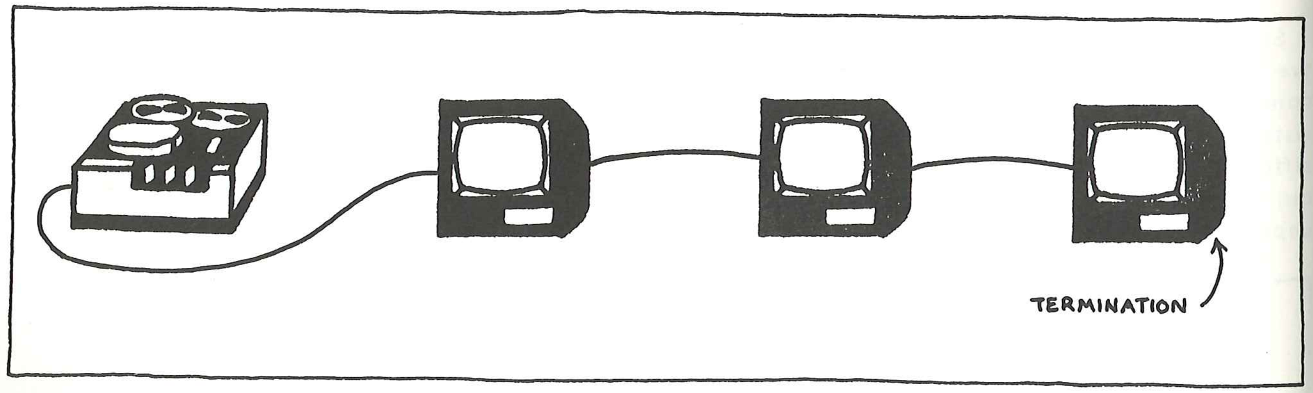
3. If you are unsure, or want to experiment, go to an electronics store and buy a 75 ohm, 1/4 watt resistor. Take the appropriate video connector and connect one end of the resistor to the center conductor and the other side to the shield.



That is what a terminator is and you're all set to go.

4. A video signal from a VTR to a monitor should be terminated at the monitor either with the terminator switch or with a separate terminator.

5. When looping through a series of monitors it is usually necessary to terminate only the last monitor in the line.



AC AND DC POWER SOURCES

Using alternating current (AC) and direct current (DC) has already been mentioned in the "Production Systems" notes. Here are some more notes about both.

The outlet on the wall is usually referred to as the *"AC line."* The AC line has two important characteristics: its frequency (alternations per second), and its voltage. In all of North America the AC line frequency is a very closely regulated 60 cycles per second. The voltage of the AC line may be anywhere from 105 to 120 volts and is not nearly as closely regulated as the frequency of the current. Furthermore, the voltage and the current frequency are totally independent of each other. If the voltage drops, there is no reason to expect that the frequency should change. Many VTRs are dependent on this constant frequency of the AC line, not only for sync generation, as mentioned earlier, but also for a stable picture in playback. VTR equipment which depends on the line frequency is said to be *line-locked.*

Not all AC operated equipment is necessarily line-locked. Many pieces of AC operated equipment use the AC line only for power. They convert the AC to DC in an electronic process called *rectification.* Non-line-locked hardware which needs certain frequencies in order to function properly, generates its own frequencies by internal oscillation. The portable VTR, with the battery charger, operates on this principle of internal oscillation.

Because the function of the battery charger is to convert AC to DC, the frequency of the input line to the battery charger doesn't matter in record or playback. As long as there is enough AC voltage going to the battery charger, it will function properly.

Batteries supply only DC. Any battery operated piece of equipment requiring a certain frequency must also generate it by internal oscillation.

The voltage input, whether AC or DC, is extremely important to any piece of video hardware. If you've ever tried to make a recording on a portable VTR with low batteries, the necessity of the proper DC voltage has already been impressed on you. Low voltage to the portable VTR means that the parts which use the most energy from the batteries cannot function properly. The heaviest drain on the batteries comes from the motors. When the voltage from the batteries is low, the motors slow down, decreasing the speed of the tapes. Decreased tape speed means, among other things, that headswitching cannot be positioned correctly. In playback this shows up as tapes which won't track. Tapes which are recorded while there is low voltage from the batteries have the tracking errors recorded on them.

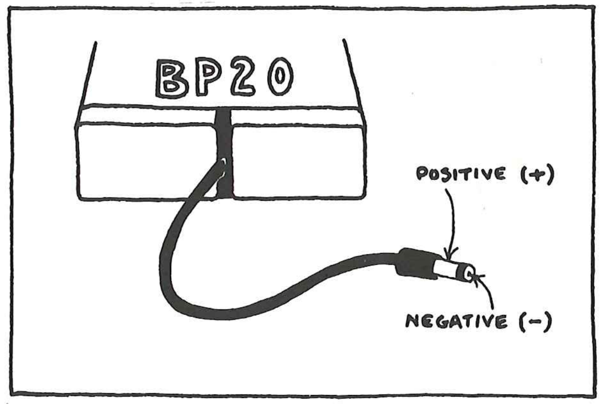
The camera also drains the batteries in order to operate the high voltage circuits. The high voltage circuits control the electron beams for both the camera and monitor tubes. If the batteries cannot supply the high voltage section with the proper voltage, the picture on the monitor and on the recording will become blurry.

Too high DC voltage can also cause problems. To prevent too high a voltage from reaching the portable VTR and camera, the battery charger also serves as a voltage regulator. It insures that the voltage supplied to the portable VTR remains constant, regardless of the fluctuations which may occur in the AC line. Both the portable VTR and the portable camera have voltage regulation circuits, too. This double regulation is necessary to insure both the protection and the proper functioning of the electronically delicate components in the camera and VTR.

The batteries that come with the portable VTR are made so that they cannot overcharge. Overcharged batteries can burn out the voltage regulation circuits and other circuits as well. The CMA units also have voltage regulation.

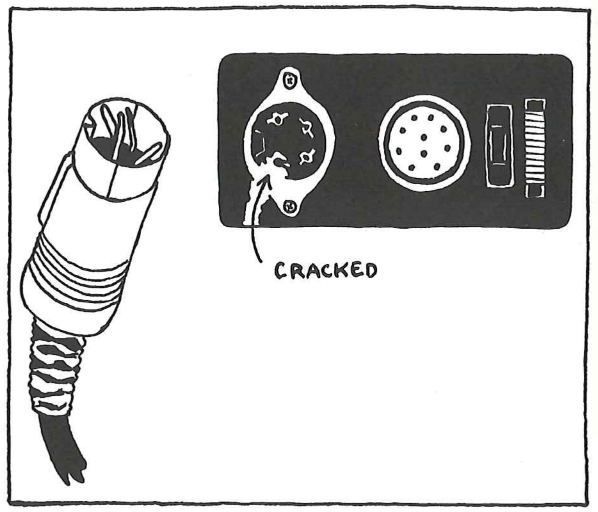
Not all batteries and DC power supplies are well regulated. Wet cell batteries, like motorcycle batteries, tend to overcharge if they are not properly metered while charging. If you are planning to use any but the manufacturer's recommended batteries, make sure that the battery you use is producing no more than the voltage that your equipment requires. The same holds true of separate DC power supplies.

The *polarity,* or positive and negative, of DC voltage is extremely critical. The positive and negative poles of most batteries are clearly marked. The Gel-Cell company which makes the Sony BP-20, marks the positive pole of each battery with red paint and a "+" sign. The plug which Sony uses to connect the BP-20 battery pack (the one that fits inside the VTR) to the VTR is rather odd. The outside part of the connector is the positive output from the BP-20 and the inside is the negative.



This is not a very conventional way to wire a connector, but it seems to work.

The prongs of the 4-pin connector that attach the battery charger to the Sony portable VTR are not marked to show polarity. After prolonged use, these 4-pins get bent out of shape and can be plugged in backwards. Look at the connector and



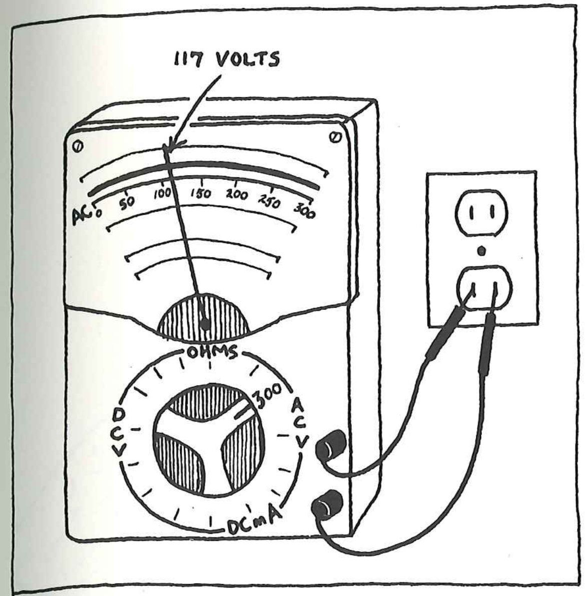
receptacle each time you plug them together. Plugging the connector in the wrong way reverses the polarity of the DC to the VTR. Reversing the polarity to the VTR destroys most of the transistors in the power supply and regulation circuits. It also blows out a few esoteric components in the servo system circuits and they are real headaches to locate and replace — to say nothing of the cost involved. 'Nuff said about observing polarity.

AC operated equipment has its voltage hassles too. All AC operated equipment lists its voltage requirements on a small, unobtrusive plate which also lists the model and serial numbers. Most 1/2" VTRs list their voltage requirements as 115VAC (volts AC). The owner and service manuals usually list the voltage requirements as either a maximum and minimum voltage (e.g., 90-125 volts) or as a recommended voltage followed by a plus and minus percentage figure (e.g., 115 volts, ±10%).

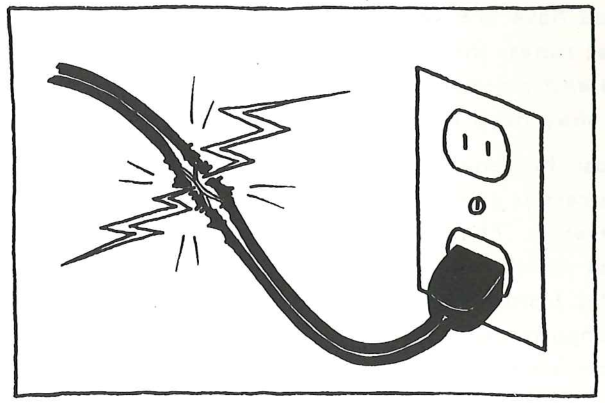
Since AC by definition has a constantly changing polarity, positive and negative are not considerations. However, too high a voltage can burn out any piece of AC operated equipment.

Low voltage is a more common problem with AC equipment. Low voltage causes AC motors to overheat rather than slow down. Overheating can cause severe damage to mechanical and electronic components.

The easiest way to check the AC line voltage is to test it with your multimeter



at the wall socket you are planning to use. Most likely, if there is any problem, it will be low voltage. Some areas which experience "brownouts" and the like, have chronic low voltage. The power companies are supposed to be required by law to keep the voltage above a certain minimum. But before you try to hustle the bureaucracy of the local power company for a few more electrons, check out the AC line with the low voltage. The more appliances, light, TV sets, etc. that are plugged into the line, the lower the voltage will be. Remember that the one outlet at which you measured the low voltage is probably not the only outlet on that particular AC line. Power tools, refrigerators, air conditioners, bright lights and washing machines are a few of the more notorious causes of voltage drops. Too many things on one AC line, especially heavy lights, can be dangerous to you as well as to the equipment. The wires for the AC tend to heat up if there is too much of a burden placed on them. If the wires get hot enough, the insulation will melt and the wires will touch. This is called a *short circuit* and it usually involves a hefty spark.



Short circuits caused by overheating can, and do, cause fires. Even though most 1/2" and 1" VTRs don't put much of a strain on the line, they can be the last straw on an already overloaded line.

The first step towards a low voltage remedy is to distribute the things that drain the AC as evenly as possible over as many different AC lines as possible. If you're unsure of how to do this in the space where you are working, the advice of your friendly local electrician might be in order. The fuse box is not the best place to start learning about AC.

If evening out the load on the AC is not enough, there are two devices which, if used individually or in combination, may provide a solution to a low voltage problem. If your voltage doesn't fluctuate, but is just low all the time, then you may only need a *step-up transformer.* A step-up transformer is inserted in the AC line between the wall outlet and the equipment to be operated. It boosts the line voltage up to the desired level. These devices use up a good deal of power themselves in performing the voltage step-up. It's wise to remember that when figuring the load on the AC line. Powerstat and Variac are the brand names of two very good step-up transformers. They come in various sizes to meet the needs of most any system.

The other device to help with low voltage problems is called a *constant voltage transformer.* If the AC line voltage is fluctuating a great deal, a constant voltage transformer may help stabilize it. A constant voltage transformer attempts to maintain a constant voltage output regardless of the dips and rises in the AC line input. Stancor is one company which makes good constant voltage transformers.

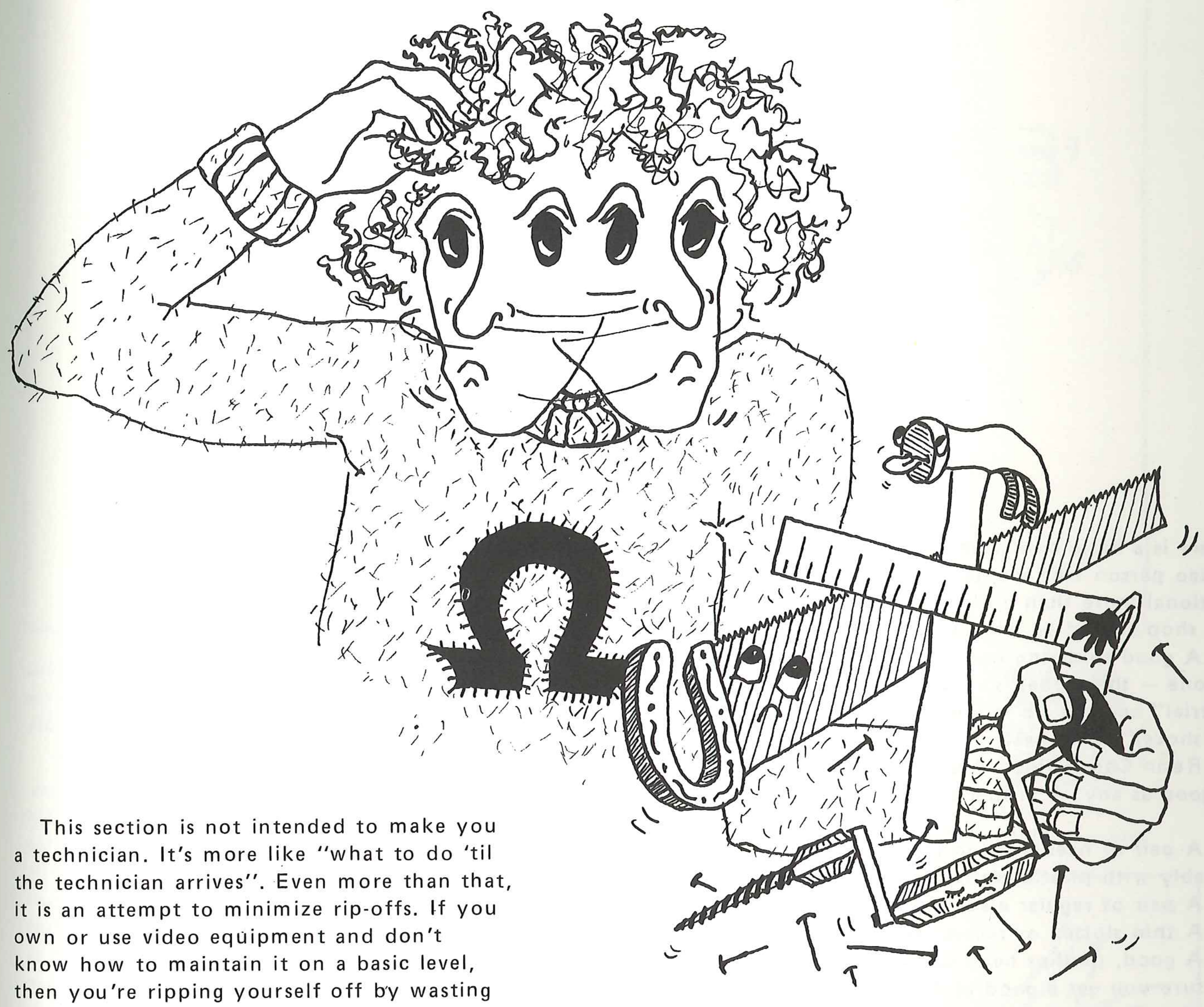
If you have low voltage that dips even lower at times, then you may need both a step-up *and* a constant voltage transformer or you may need your place rewired.

AC can be generated from a DC source. The process is called *inversion* and the device is an *inverter.* There are a number of inverters which can produce 110 volts AC, 60 cycles from a car battery (12 volts DC). They range in cost from around $40 to thousands of dollars. The cost depends not so much on the power (which is really a function of the DC source) but on the regulation of the line frequency. With line-locked equipment, this frequency regulation is extremely important. The type of alternations in the current are important also. The output of many low cost invertors is a *square wave* rather than the *sine wave* of the normal AC line. VTR motors have some problems with square waves. They may overheat after extended use on a square wave AC line. The internal sync board in Sony 1/2" studio VTRs also depends on a sine wave to produce vertical drive for the camera. It's best to consult the manufacturer of your VTR equipment before prolonged use of any line-locked VTR with an inverter.

Inverters are very inefficient machines. They can drain a car battery within a short time if the car isn't running to recharge the battery. This inefficiency also results in a lot of heat . . . enough to burn up the back seat of a car. So remember to turn off the inverter when it isn't in use.

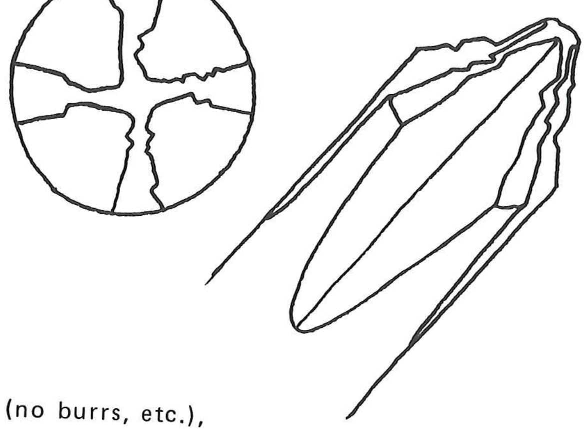
Generators, like inverters, range in price and quality. Their frequencies tend to drift off 60 cycles per second and the voltage may vary if not properly monitored and regulated. They too are inefficient with the extra problems of bulkiness and noise. If you operate too close to a gasoline engine-operated generator, you may also pick up interference from the spark plugs.

Basic Maintenance



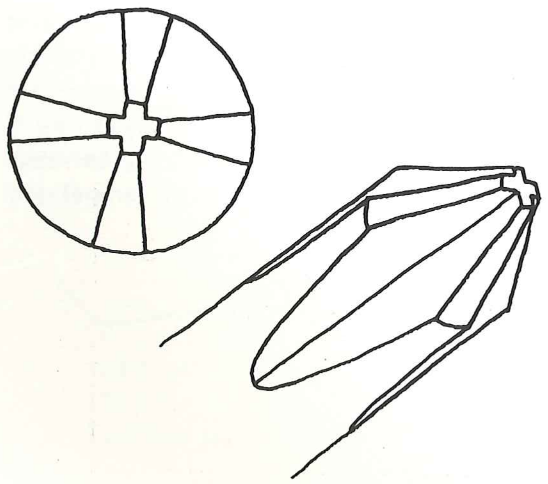
This section is not intended to make you a technician. It's more like "what to do 'til the technician arrives". Even more than that, it is an attempt to minimize rip-offs. If you own or use video equipment and don't know how to maintain it on a basic level, then you're ripping yourself off by wasting time, energy, and money in unnecessary trips to the repair shop and you're also contributing to technical elitism that comes from the mystification of electronic service and design. If low cost video equipment were really all that complicated, you probably wouldn't have access to it. It isn't, so you do, and there are a few practical skills you should develop for your own benefit – if only to know when you should call the repair shop.

This section is divided into three parts: "Preventive Maintenance and Trouble Shooting," "Basic Maintenance Procedures," and "Not So Basic Maintenance Procedures." Each section can be read and considered separately, but all of them rely on the vocabulary and theory of all the preceding sections. So if you only wanted the information in this section to begin with, it might be wise to at least skim the other sections first.

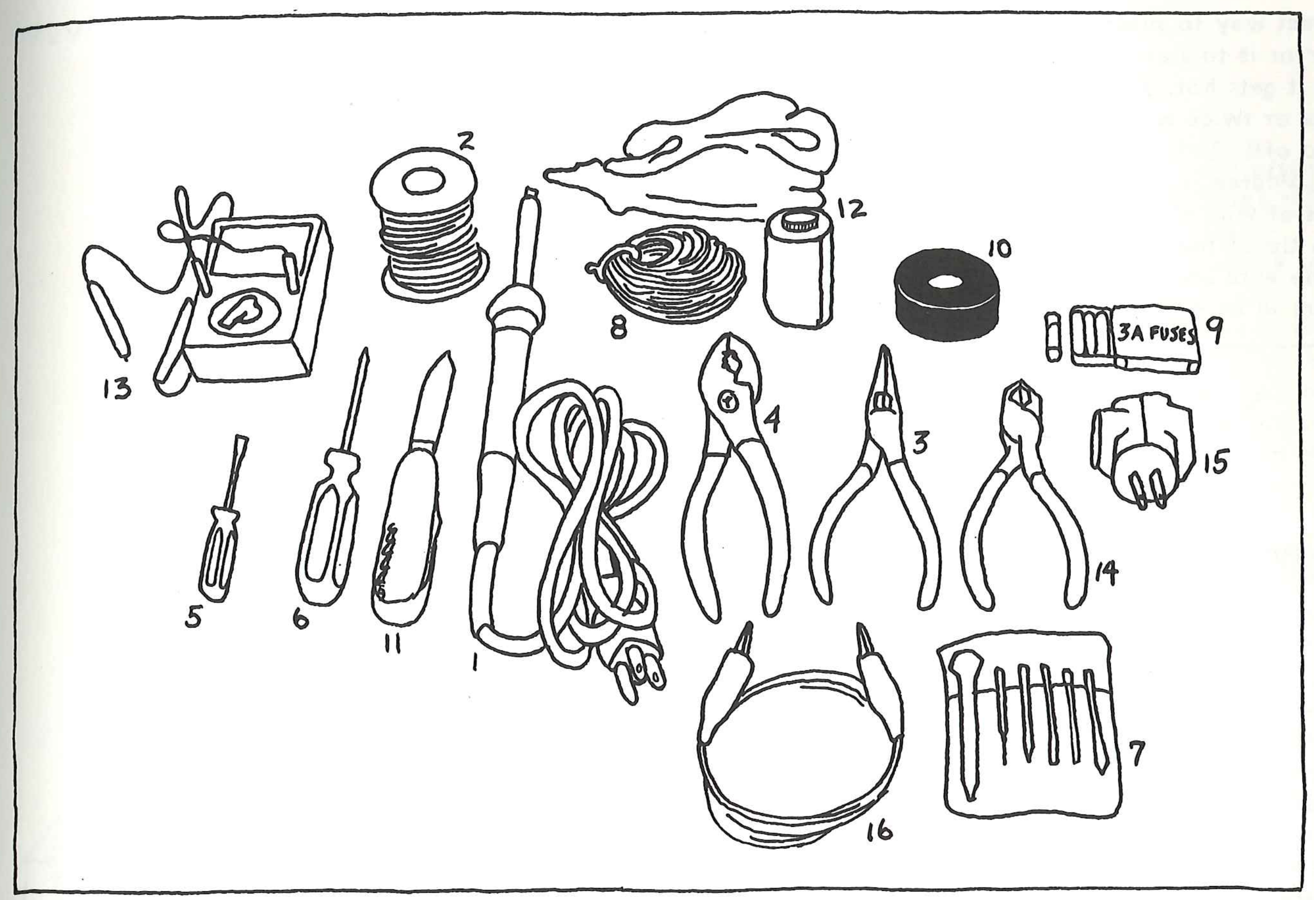


There is a basic minimum tool kit that no video person who wants to stay operational more than a block from the repair shop should be without. It includes:

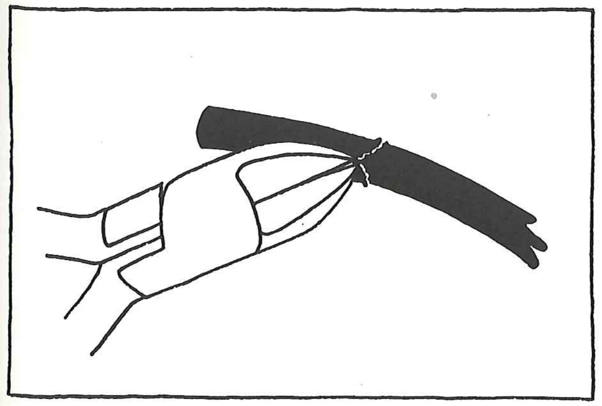
1. A good soldering iron. Unger makes a good one – the model is called an "Imperial" and the tip is replaceable. A thin "shovel" tip is best.
2. Resin Core Solder. Kester "44" is as good as any. A proper diameter is .032.
3. A pair of needle-nosed pliers, preferably with plastic around the handles.
4. A pair of regular electrician's pliers.
5. A thin slotted or regular screwdriver.
6. A good, phillips head screwdriver. Make sure you get a good phillips, i.e., one with a well-made tip (no burrs, etc.), a shaft of a strong metal and one that's all one piece, not with interchangeable shafts. It wouldn't be a bad idea to take your camera and recorder with you when you go to the hardware store to buy these things and make sure, for instance, that the phillips head fits snugly into the screws.
7. A set of jeweler's screwdrivers with interchangeable shafts.
8. A spool of "hook-up wire" (this is just any kind of thin wire with a plastic casing).
9. Fuses for the various types of equipment you're using (3 amps – 25 volts for the Sony 3400 – but the regular type – NOT SLOW BLOW FUSES!).
10. A roll of plastic electric tape.
11. A jack knife with a sharp blade.
12. Splicing and cleaning paraphanelia. This is provided with most VTRs, but can be augmented with rubbing alcohol, a chamois cloth and a degausser.
13. A battery-operated multi-meter. Lafayette Radio Electronics makes a whole line of inexpensive, easy-to-use battery-operated meters, as do a number of other companies. Unless you want to play electrical genius, you don't need to invest more than $10 or $15 at the most in a meter, but if you want to do much repairing at all, you'll need a meter.
14. Diagonal wire cutters (called dikes).
15. A "cube tap" or 3-way A.C. plug.
16. 3 pieces of wire (approx. 8" to 12" long) with "alligator" clips connected to the ends of each.



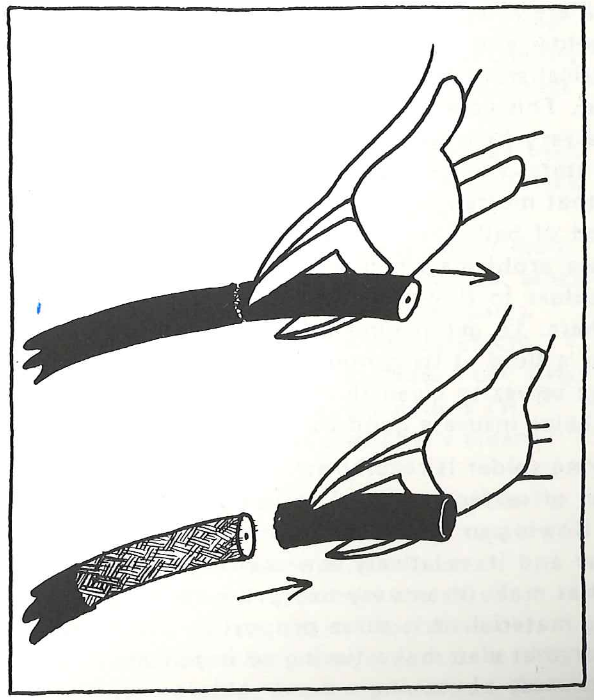
There are some basic techniques which go with the basic tool kit. Knowing how to solder, strip wires and deal with stubborn screws is essential to doing any work with video equipment.



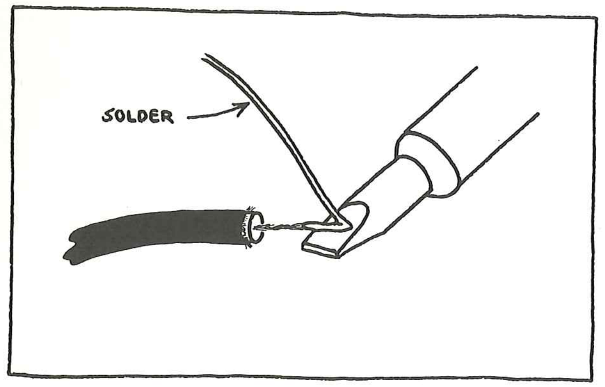
No matter what kind of wire you're working with, there are two procedures to follow when preparing the wire to be soldered: 1) Use the tip of the diagonal cutters (not a knife) to nip a circle around the casing of the wire. Be careful not to touch the wire underneath the casing. This is easy enough to avoid if you pinch the casing gently at first as you bite down with the tip of the dikes – you should feel only the plastic or rubber coating being cut – if you feel the wire underneath, back off and take less of a bite;



2) Using the cutters, grab the casing of the wire somewhere between the cut you have just made and the end of the wire; when you are ready to pull the casing of the wire off, use the cutters to exert just enough pressure on the casing to pull the casing off the wire.



The correct way to solder a single wire to a connector is to start with a clean, hot iron (when it gets hot, you can wipe it briskly once or twice with an old rag to get the crud off). Twist the end of the wire to be soldered so that there are no loose stands of wire sticking out. Lay the wire on the tip of the iron, then lay the solder on the wire until the solder flows over the wire in an even coating.



Remove the wire from the iron and the solder will harden almost immediately. That's called *tinning* the wire and the process should be repeated for the receptacle on the connector. When both the wire and the connector have been tinned, all you need do to connect them is to heat the receptacle on the connector, slip the wire in, and remove the iron. Make sure that the solder joint (the point of connection) doesn't move. Don't jar it for at least 4 or 5 seconds to be certain that the solder has hardened.

There are a few things to keep in mind about solder and soldering. The solder used in electrical work is a compound of tin and lead. This combination of metals gives solder a very high surface tension in its molten state. For practical purposes, this means that molten solder tends to stay put in a kind of ball when it's melted. This can cause problems when you are trying to get solder to flow from the iron *to* somewhere. To get around this, most solder contains a fluid at its center called flux. The flux serves to clean the metal surfaces and – helps insure a good connection.

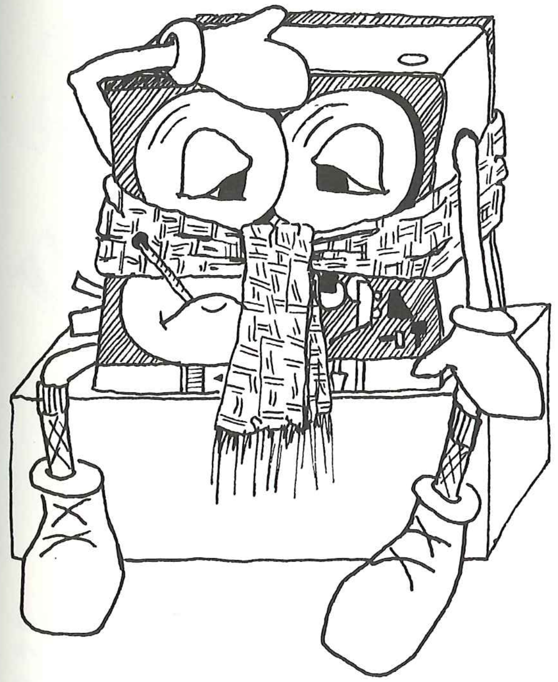
Flowing solder is readily attracted (because of surface tension) to other molten solder, flowing or not. It is this property of solder and its relatively low melting point that make it an easy-to-work-with bonding material. It is these properties of solder that also make timing so important in the process of making a good solder joint.

A good solder joint is determined by how well the solder flows between the two areas being connected. If a wire is to be attached to a connector and only the wire is tinned, it is possible that the solder will be sluggish in flowing onto the connector or that the solder will hardly flow at all. This prevents good, solid connections from being made. If the solder on the wire or the connector or both is old, the chances are that the flux has dried up or been burned away by previous solderings. Lack of flux means sluggish solder. There are two ways around this problem: 1) re-tin the areas with old solder on them; or, 2) buy some flux at an electronics store. The better method is re-tinning.

Another property of solder is a tendency to crystalize if jarred during the cooling process. Non-crystalized solder is shiny or lustrous. Crystalized solder is dull silver. This is not an aesthetic problem, but an electronic one. Crystalized solder is a poor conductor and a weak bond. Crystalized solder is not the most desirable way to hook up a cable to a connector. Therefore, it is extremely important to keep solder joints absolutely still while the solder is cooling. There is a readily visible physical change that comes over solder the moment it changes from a molten to a solid state – watch for it. If the joint cools a dull color, it is crystalized and you've made a Cold Solder Joint.

It is also possible to make an apparently good solder joint that is actually held together only by flux. Since flux is neither a conductor nor a strong physical bonding agent, flux joints are useless. By inspecting each joint you solder, it should be possible to avoid cold solder joints.

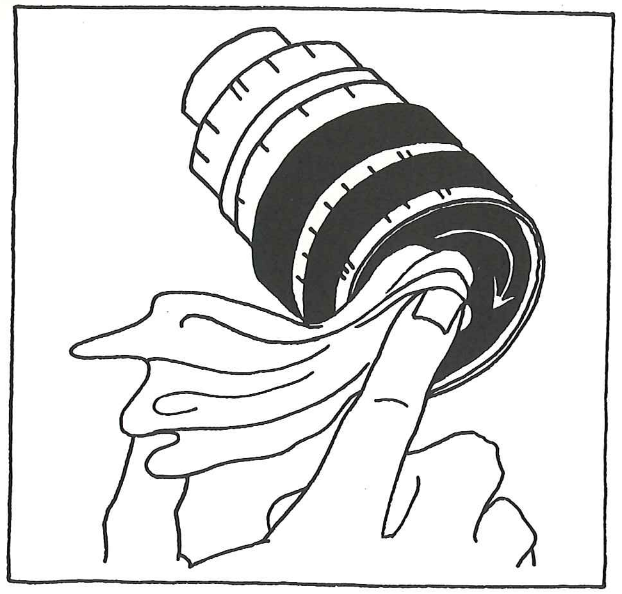
PREVENTIVE MAINTENANCE



Preventive maintenance means spotting and correcting potential trouble before it becomes a real problem. Cleaning is the most important and effective preventive maintenance procedure for all VTR equipment. The user's instruction manual that accompanies every new VTR has ample instructions on how to clean the heads. What some manuals don't emphasize enough is that the entire tape path should be periodically cleaned. The frequency of cleaning is up to you. It depends a lot on how often and under what conditions you use your VTR. If you are taping in a dusty car garage with grease and dirt dripping from the ceiling or in a sand blasting factory, you may have to clean the VTR every hour or two that it's in use. If you are working in a climate-controlled studio you can often go for weeks of use without cleaning the VTR. If you're somewhere between those extremes, you have to decide. Here are some considerations:

1. Most 1/2" VTRs come with a small plastic bottle of cleaning fluid and a package of plastic popsicle sticks with material on the end. The fluid is usually denatured alcohol and the material is chamois (deer skin). When the original cleaning materials run out or get lost, they can be replaced with pure denatured alcohol and the sticks can be replaced with chamois cloth (hardware and automobile supply stores carry chamois). Even better than alcohol is a liquid freon solution. It's hard to find but it's the best solvent.
2. Even though the manufacturers supply these materials, they have their drawbacks. Chamois is a soft material and eventually shreds into very small particles. These particles can stick to the video heads and form a crusty deposit that can cause damage. This can be avoided by being light-handed in the cleaning process. A couple of swipes at each video head during each cleaning is usually sufficient. Don't be overzealous. Too much cleaning can cause problems, too.
3. The Miller Stephenson Chemical Co. puts out a spray can of magnetic head cleaner (MS200). The problem with this stuff is that it is not as effective a solvent as the alcohol when it is sprayed, and consequently it often is not able to dissolve the crud that accumulates on the heads.
4. Some cleaning fluids shouldn't be used on the rubber rollers in the tape path. Check the instruction book and the cleaner container to make sure that you don't melt important parts of your VTR. Alcohol, when used lightly, won't hurt the rubber parts.
5. Even if you're not in an extremely dusty or dirty situation (like New York City, L.A., etc.) keep the cover on your VTR whenever possible. That's what it's meant for.
6. The chamois cloth is also valuable for cleaning the optical surfaces of the camera and the monitor, although lens paper (available at drug and camera stores) is better. There are six optical surfaces to clean on the portable camera and since they are all inter-related, you have to clean them

all in order to know whether or not you have a "clean" picture. The first two are the front and rear elements of the lens. Clean these and all others with a circular motion.



This is the way the lenses were ground and it produces less scratches to clean them this way. Once the lens is screwed off, look into the camera down the hole where the lens should be and you'll see a red or maroon glass surface. That's the face of the vidicon tube and it too should be cleaned. Next, flip up the eyepiece (un-tape it if you've had the camera more than a week) and clean both sides of it. The last surface to clean is the face of the viewfinder monitor. You may have to reach in with your finger, but you may notice a startling change when it's done. Try not to put too much pressure on the camera monitor screen as it can be dislodged.

7. Cleaning the face of the monitor is obvious. If you're using lens paper, however, check to see if there is a warning against using the paper on plastic surfaces. Many monitors and TVs have plastic picture tube guard plates.

Degaussing (or de-magnetizing) is an infrequent but necessary addition to the cleaning ritual. It needn't be done as often as cleaning, but at, say, every 4th or 5th cleaning. That's a completely arbitrary time span.

No electromagnet is perfect, especially not video heads. After a certain amount of time the heads start to build up a permanent magnetic charge. This shows up as noise on the tape in both the audio and the video. There are a number of degaussers on the market and all of them come with instructions. There are two important factors to remember when degaussing the video heads, because video heads are more delicate than audio, control track and erase heads. The first is that the metal surface of the degausser should not actually touch the video head. The degausser is electromagnetically vibrating at a very high frequency in order to disrupt the magnetic alignment built up in the video heads. The vibrations can break or weaken the head. But in order to accomplish the job, the degausser has to be very close to the head. One way to avoid the problem is to put a layer or two of plastic electrical tape over the end of the degausser. The tape acts as a cushion and degausser can then be lightly placed against the video heads.

The second factor to keep in mind is that if the degausser is suddenly withdrawn from the head, the head can again become a permanent magnet, putting you right back where you started from. Withdraw the degausser *very slowly* when you finish with each head. Degaussing is a tedious procedure and you should allow some time to do it right.

Extreme environmental conditions are not good for any VTR equipment. But if the equipment and the tapes are subjected to unexpected changes in temperature or moisture they're still likely to work if they're treated properly.

One of the most common occurrences is a VTR, camera or monitor that has had to travel or be stored in extremely cold conditions (freezing or below). The most important thing is to let the equipment warm up before it is used. Cold metal is brittle and cold video heads break easily. Another phenomenon you may notice is that warm tapes often will not budge when put on a cold VTR. The attraction between a cold drum and a tape is so great that the tape simply will not move. If this happens, just wait until the machine is warmer. Cold also effects the camera. The vidicon tube is much more sluggish when first turned on in cold weather. The batteries, too, discharge more rapidly in the cold. So if you're planning on cold weather shooting, take extra batteries.

Most 1/2" video equipment is built to be operated by "untrained personnel" which means that the manufacturers expect that

every once in a while a VTR will be left on the seat of a car at noon in August in the Mojave desert or that a portable camera and cameraman will fall into a stream. And, strangely enough, if you're properly apologetic to the equipment and let it cool off or dry out, it'll probably work. That's not a recommendation, just an observation.

Trouble or not, it's wise to give VTR equipment an occasional "once over" inspection.

You need your hands, ears and eyes for this. Check the VTR for anything that sounds funny — like any new rattles, clicks or clanks that may not have been there before. With portables, remove the carrying case, hold it in two hands and gently shake it around. There shouldn't be any noise. If there is, then something is loose or broken. Look for loose screws on latches and handles. Check the carrying case handles and straps. Look for dents and bumps on the surface of the portable. They are usually indications of some sort of sharp impact which may cause problems. Another thing to do is to check the alignment of your VTR by playing back a tape made when the machine was new or a tape made on another machine that you are sure is in good shape. That can give you an indication of whether or not your VTR is still making standard tapes. Watch the tape as it's playing to see if it changes speed or if it rides unevenly in the tape path. If your VTR has been kept reasonably well, none of these things should crop up, but it's a good idea to keep them in mind and periodically keep an eye out for them.

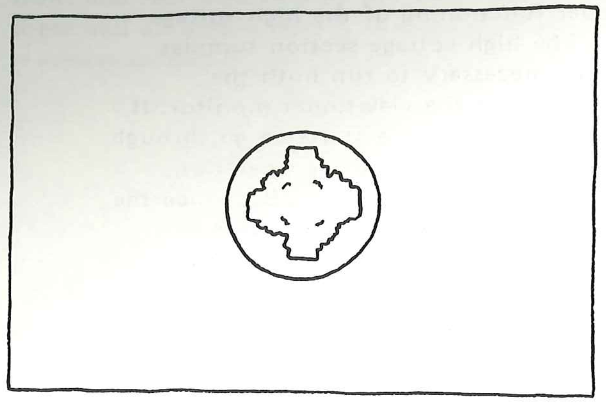
Listen to the camera. There is a regular, high-pitched whistle that is an indication of the proper functioning of the high voltage circuits. The high voltage section supplies the voltage necessary to run both the vidicon tube and the viewfinder monitor. If that high voltage whistle starts to go through changes during regular camera operation, then something may be wrong. But since the high voltage section is so closely tied to the rest of the camera, trouble symptoms will probably show up elsewhere. Flickering in the viewfinder or trouble in focusing also indicate camera troubles (or it just may be weak batteries).

Monitors have the same type of high voltage circuits as viewfinder cameras, so keep an ear out there, too. Besides a change in pitch, cracks or pops indicate a high voltage problem in monitors. Old TV sets and monitors have a tendency to have very weak brightness and contrast and may also have a tendency to overemphasize the white sections of the picture. A flickering picture indicates problems, too.

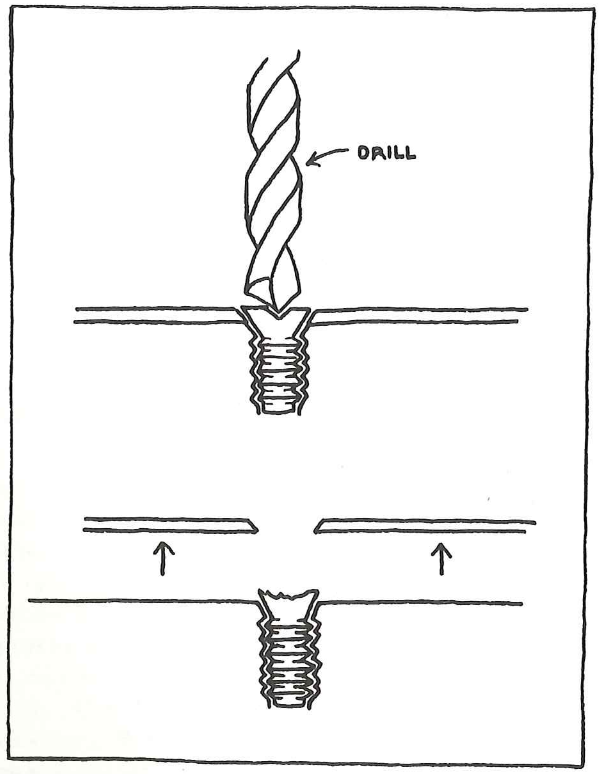
With audio, the symptom is usually a buzz or low hum somewhere in the system. They're awfully hard to put a finger on and can come from anywhere in the audio system. Check your cables. Cables should be firmly anchored in their connectors. If screws are missing on the connectors or if the connectors are cracked or broken, they should be replaced as soon as possible.

None of this information is intended to make anyone a raving electronic hypochondriac; it's just hints on what to keep an eye out for. If you know no more than where to expect trouble, you're a long way towards avoiding it. The next sections are some practical procedures and methods for coping with video equipment, expecially the portable Sony.

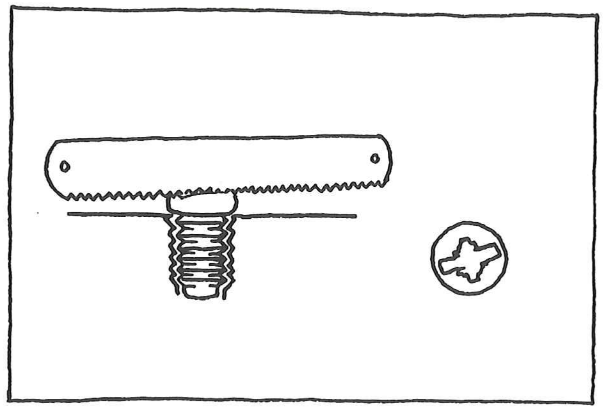
Unfortunately, most of the screws in most 1/2" video equipment are made of brass which is a very soft metal. So if you're not careful when you are removing and replacing them, you may strip the tops off. You can also mess them up by using a poorly-made phillips-head screwdriver. If you run into a stubborn screw, don't be worried about exerting a little pressure *downward* on the screw. That sometimes breaks the lacquer seal or whatever else is holding it back. Occasionally you may run into a phillips head screw that simply isn't a phillips head any more because the grooves have been completely stripped off.



You have two choices of how to get it out, the more extreme of which is to drill.



Drilling is not recommended except as a last resort because it usually ruins the threads in the hole and runs the risk of breaking a lot of things besides a stubborn screw. The other alternative is to take a hacksaw blade and make one groove across the diameter of the screw.

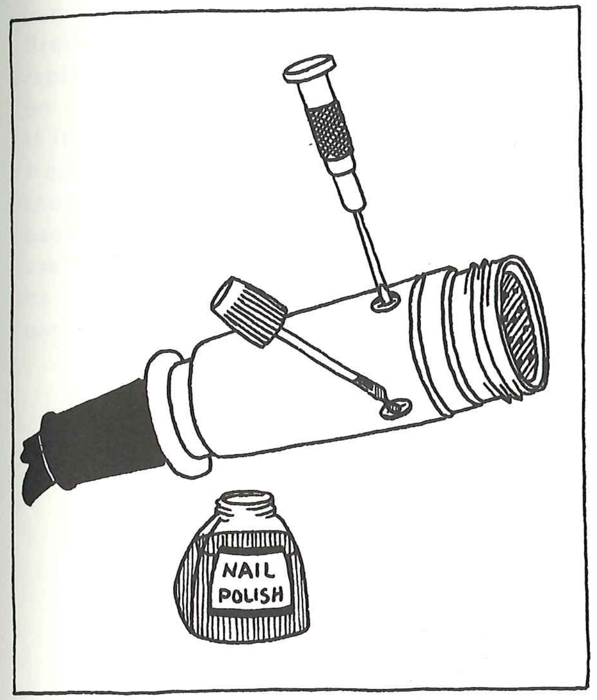


You can then remove it with a slotted screwdriver.

There are a lot of techniques that are applicable to special situations but soldering and screwing will get you a long way. However, making the best solder joint in the world won't help you if you've lost the screws, washers, and various other minuscule paraphernalia needed to put the machine back together. A cardinal rule of all good technicians is to put all losable parts in some sort of reliable container. Cat food cans are great; hot cups with half a sip left of sticky sweet coffee are not. If you're on the road, the lens cap usually serves quite well. If you are prone to ending up with more parts than you started with, it might be wise to store them in a clear plastic box with compartments.

MAINTENANCE PROCEDURES FOR THE SONY AV/AVC-3400

Latch screws on the AV 3400 and the 3 small set screws on the 10-pin connectors (the camera cable connector) are notorious for falling out. You will need a jeweler's screwdriver to tighten the screws on the 10-pin, but both those screws and the ones on the latches can be held in place with a little dab of fingernail polish which acts as a seal.



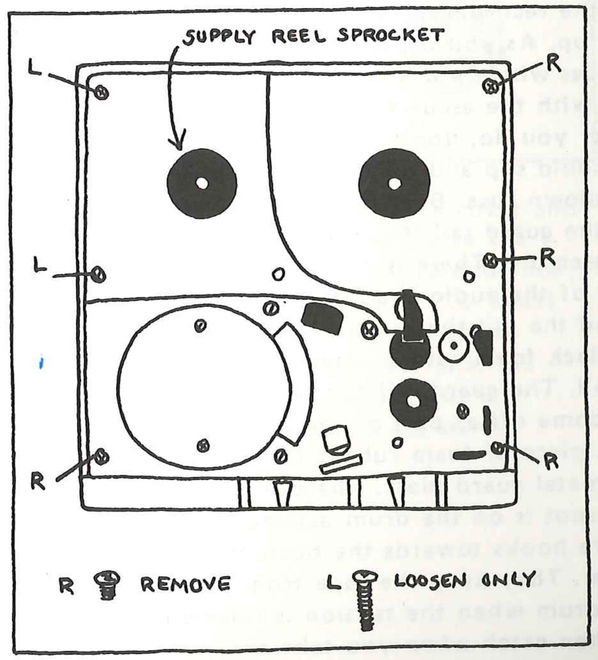
Also, check the wires that lead from the batteries to the VTR. If they are frayed, burned, or otherwise mutilated, tape them up or replace them. The same is true of the battery connector. Replacements can be obtained at most electrical equipment and hi-fi stores.

The plug that goes from the battery charger (AC adapter) into the deck is not indestructible, nor is the plastic receptacle on the VTR, so *look* each time before you insert the battery charger cable. The channel or groove on the connector is always on the side farthest from the camera cable connector. If you plug it in the wrong way, you can blow a fuse — or worse.

Changing a Fuse

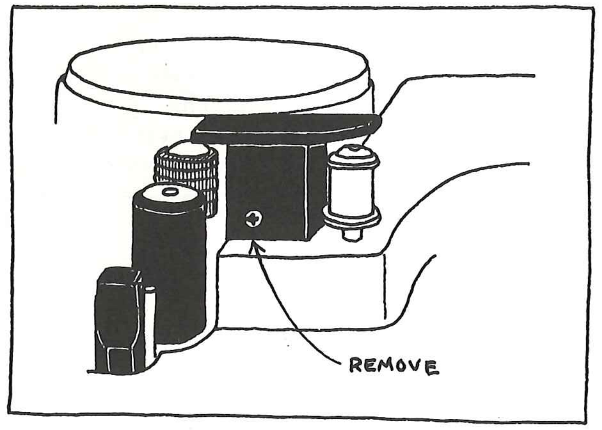
Fuses seldom, if ever, blow out just for the hell of it, so if your fuse goes, look for the cause (shorted battery wire, battery charger, or battery charger cable, etc.) before you replace the fuse. If you find the cause and correct it, or if none is apparent, then it's time to replace the fuse, which Sony has conveniently placed under 8 screws and the top deck assembly. The process for changing the fuse on the Sony AV 3400 portable is this:

1. Remove the carrying case. Remove both reels from the deck. Unplug the batteries, the battery charger cable and the camera cable.
2. Remove the plastic head cover. The head cover is the silver colored piece with the "Sony" name plate and the hole, for the "Minutes" counter. It just snaps on and off of two posts underneath. There should be no problem if you just pull it straight up when you take it off. Pull off the "Sound Dub" and "Still" buttons by pulling them straight up.
3. Loosen the 6 bronze colored screws that hold the grey deck to the rest of the portable unit.



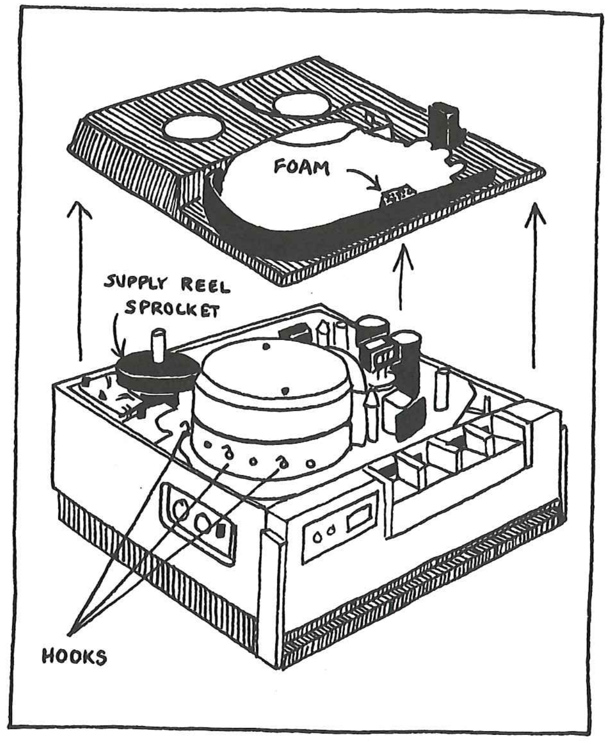
This grey top of the VTR is called the *escutcheon*. The two screws nearest the supply reel sprocket should only be loosened, but the other 4 screws can be completely removed.

4. Remove the screw from the side of the "T"-shaped plastic roller assembly cover. The first white arrow in the threading path points toward a white roller. Above that roller is a kind of roof that can be removed by taking out the screw which is directly above the head of the second arrow on the threading path.

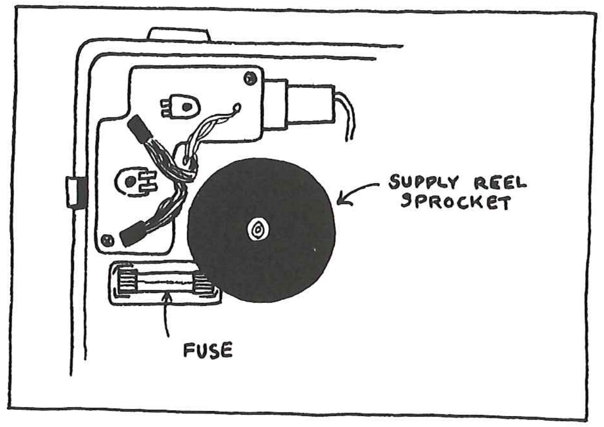


5. Remove the white plastic roller assembly by unscrewing the phillips head on top of the assembly. Observe the order in which pieces come apart so you can put it back together properly.

6. Remove the escutcheon from the rest of the recorder by pulling it *gently* – straight up. As you lift it off, there are two places where you may have some trouble with the escutcheon catching. Whatever you do, don't yank the escutcheon off. It could slip and do more damage than a blown fuse. Both places that catch are on the guard rail that runs around the drum assembly. There is a guard plate in front of the audio head. Between that plate and the rail there is a piece of heavy black foam rubber attached to the guard rail. The guard rail and the foam rubber come off as part of the escutcheon and this piece of foam rubber often catches on the metal guard plate. The other trouble spot is on the drum assembly. There are hooks towards the bottom of the drum. They keep the tape from falling off the drum when the tension is released. They often catch when you take the escutcheon off. Both of these problems can be overcome by carefully maneuvering the escutcheon around until it is free.



7. Replace the fuse which is located just below the feed (upper) reel assembly. Use a 3 amp, 25 volt fuse for AV 3400 – NOT A SLOW BLOW FUSE!



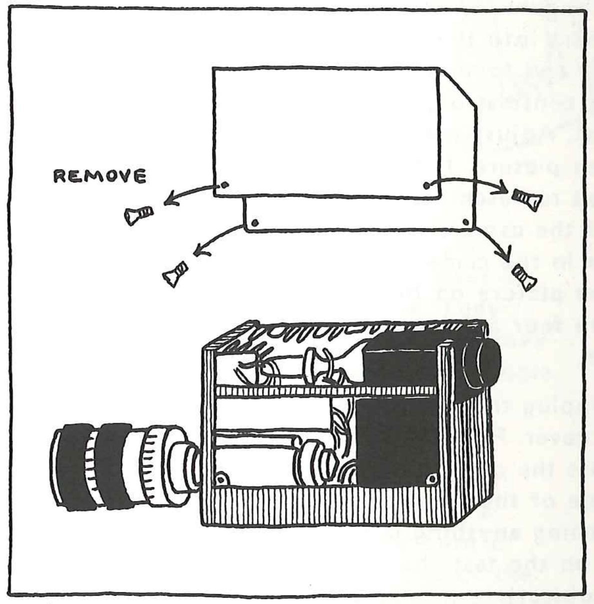
8. Replace the escutcheon and roller assembly. Make sure that the silver colored spacers that sit between the screw holes nearest the feed reel, and the screw holes, are in place. As you're taking the deck off, they may topple into the machine but they should be easily visible and they are very important. They keep the escutcheon from rubbing against the reel assembly as it turns.

Replacing Handles

Probably the weakest mechanical parts on the Sony portable are the handles that put the VTR in "play" and "record." The biggest hassle in replacing them is waiting in line at Sony for the parts (which must come by canoe from Japan). The plastic handles are simply extensions of metal shafts which engage the proper switches. By grabbing the broken end of the plastic handle with a pair of pliers and pulling firmly, the handles can be removed. To replace them, put a drop of plastic cement on the inside of the replacement handle. If it's necessary, add a few long shavings from a wooden match stick to insure a snug fit, and firmly push the new handle back onto the shaft. Be careful not to use too much cement in order to avoid its spilling out and fouling some other part of the machine.

Replacing the Eyepiece

If the handles are the weakest part of the VTR, then the eyepiece is the weakest part of the camera. With normal usage, the eyepiece seems to last no longer than 50 to 100 hours. Again, the biggest hassle is getting the replacement part. The eyepiece is held to the camera by 4 screws, two of which are partially visible. They are on the top of the camera on the maroon section where the eyepiece is attached. These two and the other two screws are accessible by removing the camera cover. Do this by unplugging the camera and removing the four phillips head screws located at the corners where the cover meets the maroon body of the camera.



Remove the cover and unscrew the four screws that secure the eyepiece assembly, tip it forward and slide it out through the viewing hold. To insert the replacement, just reverse the above procedure. Until you get a new one, the most effective way to hold a broken eyepiece to the camera is to get some gaffers tape and tape it on.

Adjusting the Viewfinder

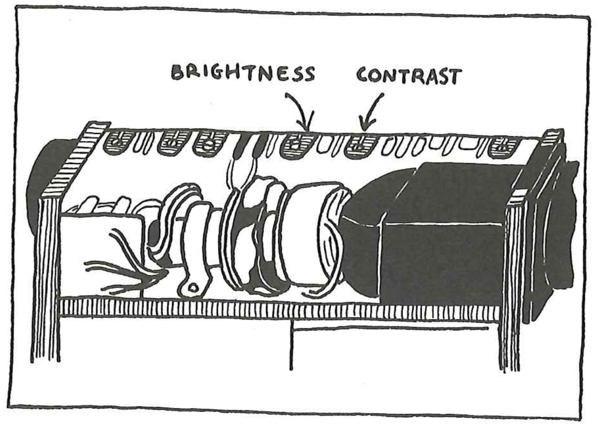
It's possible that after you use the portable camera for awhile, the viewfinder monitor in the camera will go out of adjustment. The symptom is simply that what you see in the camera is not what you see on the monitor. Adjusting the viewfinder monitor has no effect on how the camera functions, but proper viewfinder adjustment is essential if you want a true representation of the contrast and brightness of what you are recording. If you believe that your viewfinder is out of adjustment and you have an RF adaptor or some way of plugging the camera into a monitor (a CMA unit), the procedure for setting up the viewfinder is as follows:

1. Connect the VTR to a TV set. Plug the camera into the VTR. Put the VTR in *Standby* and focus the camera on a well-lit, high contrast object (a TV test chart is the best). Adjust the camera and the TV to optimum picture. If the picture on the TV is a good representation of the scene in front of the camera and the viewfinder monitor in the camera is markedly different from the picture on the TV screen, then there are four adjustments for the viewfinder monitor.

2. Unplug the camera and remove the camera cover. Plug the camera into the VTR again. Set the camera on a tripod. Be sure that none of the exposed parts of the camera are touching anything metallic. Focus the camera on the test chart (or on some well-lit object).

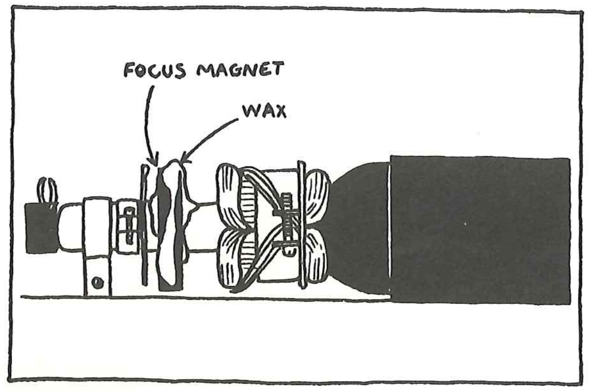
3. The viewfinder controls are located on the top of the large printed circuit board. They are small button-shaped objects that extend out from the circuit board towards the viewfinder on thin platforms. Each one has a small amount of white paint on it. The paint is put there at the factory in order to hold the adjustments made at the time of the original factory alignment. Use needle nose pliers to break the paint seals on each of the knobs required for proper viewfinder adjustment. Once the seal has been broken, adjustments can be made with a thin screwdriver or your fingers. Do not bear down on these adjustments. They are weak and bend easily.

The contrast adjustment is adjacent to the copper yoke of the viewfinder. It serves the same function as any TV contrast control of the picture on the TV screen. Moving toward the lens, the next adjustment is the *brightness.*

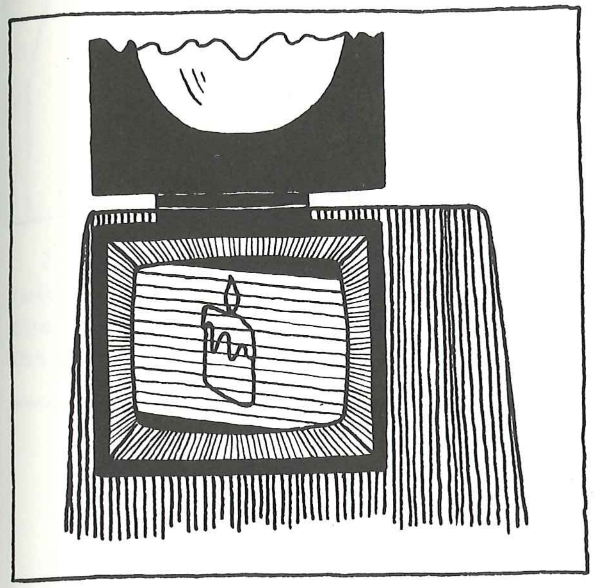


Next in line is the *Bias Control,* an electronic adjustment that won't need to be played with. The next is the *Vertical Height* which controls the size of the screen, i.e., if the picture or the viewfinder screen has shrunk to fill only a portion of the screen, it is this adjustment which should correct that. The last knob in this line is the *Vertical Linearity.* This adjustment along with the *Vertical Height,* is used to correct a viewfinder picture that is either exaggeratedly stretched or flattened.

There is only one other viewfinder adjustment you might want to try and that's the *focus magnet.* Unfortunately, it can be one of the most tedious operations in 1/2" video repair. It's only necessary when the picture on the TV monitor is in focus and the picture on the viewfinder is not. Even when you notice the above situation you should exhaust all other possibilities before you attempt a focus magnet adjustment. The focus magnet, a dark grey ring, is located just in front of the copper yoke around the viewfinder. The top of the magnet is covered with wax.



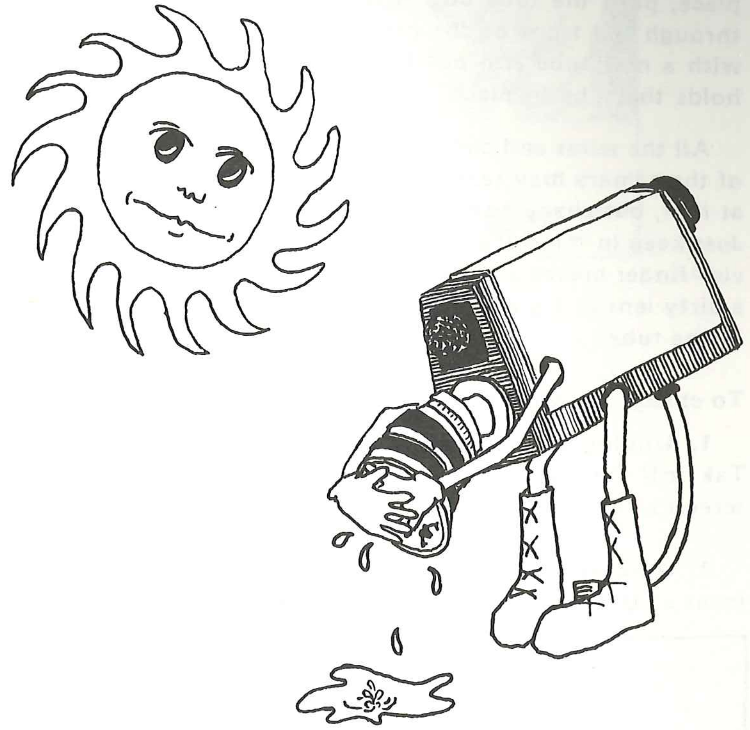
The wax is what holds it in place. If the magnet is jarred or if the wax either melts or comes loose, then the magnet not only makes the picture out of focus, but also skews or *keystones* the picture on the viewfinder screen.



The best tools for adjusting the magnet are a small hand-held hot air hair dryer and your fingers. The camera must be on during the adjustment and its just a matter of your eye vs. your patience. The wax should be heated with the hair dryer until it is pliable. Then the magnet should be moved back and forth until maximum focus is obtained and held in the proper position until the wax has had a chance to dry. *Please,* do not forget to keep the camera in optimum focus while you're trying to adjust the viewfinder focus magnet. This is a tedious, time-consuming process and should only be undertaken if you are *sure* it is necessary.

The most important thing to remember is that the viewfinder is not exactly analogous to a regular TV set. It is not adapted for regular adjustment. It's a pretty decent monitor for its size and limited usage and it should need only infrequent adjustment.

Changing the Vidicon



These procedures are the next level of do-it-yourself video maintenance. They require more time and more care but they are quite possible for inexperienced people to perform with a little patience.

The vidicon tube is the eye of the camera. If you point it at the sun or at another intense light source, such as a laser, it will invariably sustain a *burn* or streak that is permanent. The face of the vidicon is the glass maroon circle that can be seen by looking into the camera when the lens has been removed. It is coated on the inside with a photo-sensitive material. It is this material which is destroyed when the vidicon burns. There are times when, due to a sudden change in the intensity of light, the vidicon retains an image that appears to be a burn. If you think you have burned the vidicon but aren't completely sure, open the F stop on the lens as wide as it will go (1.8 on the new lenses, 2.0 on the older lens). Turn the camera on and point it at a brightly lit white surface which completely fills the field of the lens. Leave the camera on for about 10 minutes. This may help to erase some of the minor burns and retained images.

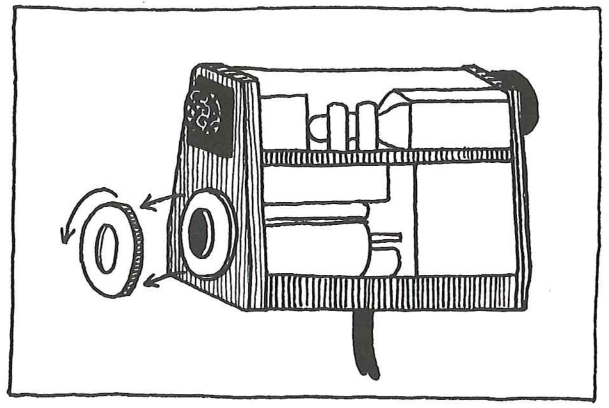
If the above procedure has little or no effect, then you may want to try replacing the vidicon yourself. The procedure is to remove the ring that holds the tube in place, push the tube out of its socket, through the front of the camera, replace it with a new tube and put back the ring that holds the tube in place.

All the wires and components on the inside of the camera may seem somewhat intimidating at first, but changing a tube is basically simple. Just keep in mind that not every streak on the viewfinder means a burnt vidicon. It could be a dirty lens or a greasy fingerprint on the face of the tube.

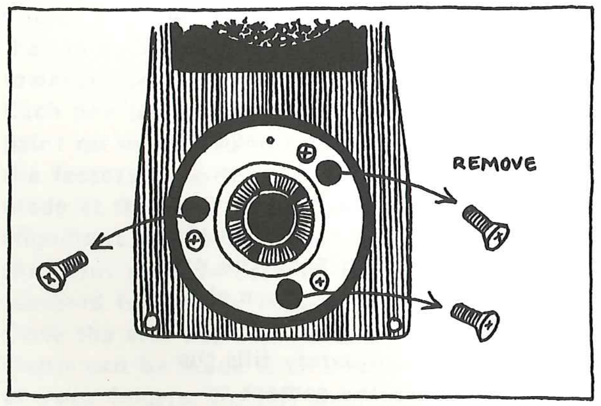
To change the vidicon tube:

1. Unplug the camera and remove the lens. Take off the camera cover by removing phillips screws at four corners.

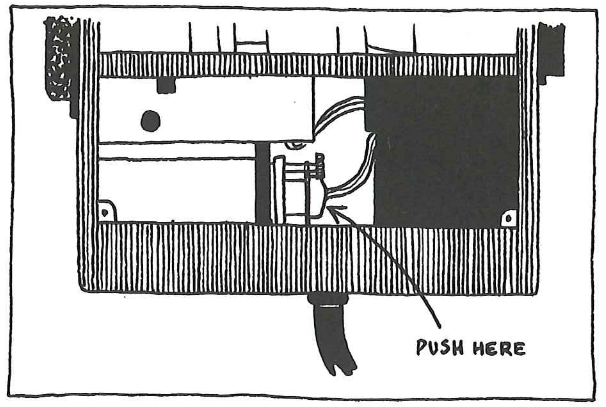
2. Unscrew the ornamental rings on the front of the camera.



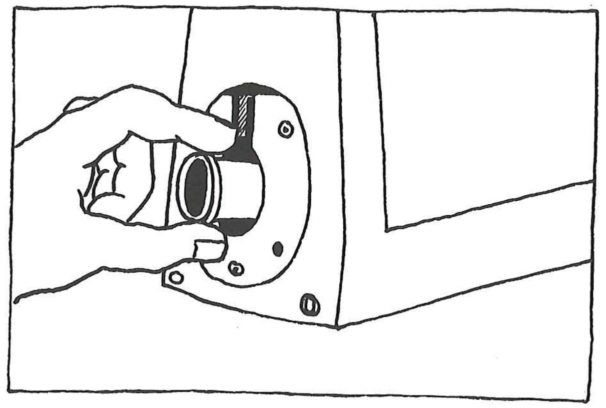
3. Remove the 3 phillips head screws that hold the lens mount assembly in place. Of the 6 screws (3 pairs) the larger one in each pair is the one to remove.



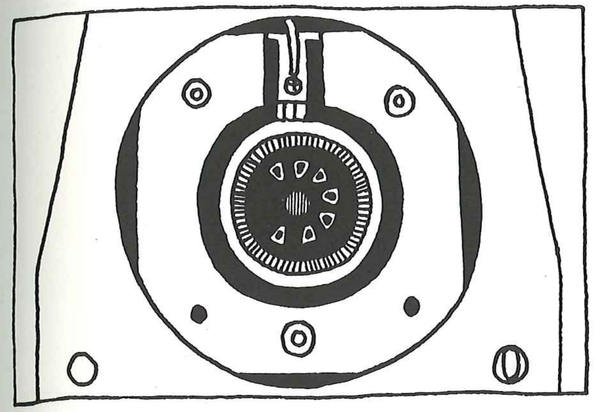
4. With the camera on its side – the "Danger – High Voltage" sign facing up – you will see a plastic cap with wires extending out of it in the center of the camera just to the left of the "High Voltage" section. This cap is the end of the vidicon tube. Push it towards the front of the camera and the face of the vidicon will extend through the lens opening.



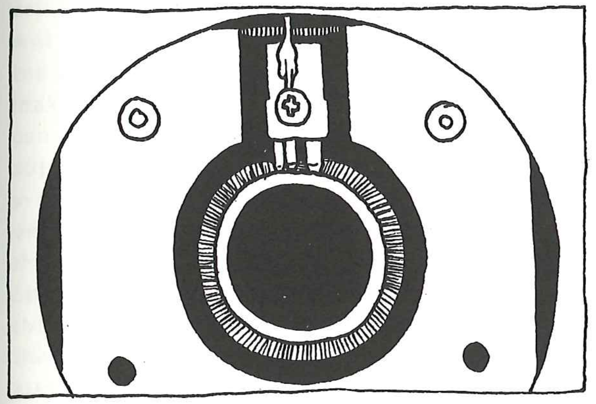
5. Grasp the rim of the vidicon and gently but firmly pull the tube completely out, moving it slightly from side to side to loosen it if necessary. Previously unchanged tubes usually stick, so take your time pulling it out – if you break the glass tube, it's really a problem.



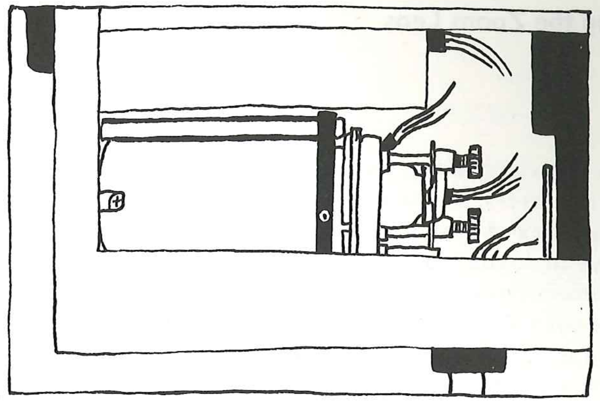
6. Replace the old tube with a new one, being careful to align the pins correctly. There is only *one* way the tube can be inserted into its socket, and there is a space which acts as a key. The tube fits snugly but smoothly, so if you have to force it, there's probably something wrong. If you look at the camera as you insert the tube – first "down the barrel" to approximately line up the pins and secondly, at the side, you can see how the pins are going into the socket. If need be, you can put your finger behind the plastic cap and exert some forward pressure on the tube while pushing in from the front. The pin alignment is essential for the tube to go in, so keep checking to see that none of the pins are being bent instead of sliding into their proper holes.



7. Make sure that the three copper colored prongs which extend into the lens opening are touching the rim of the face of the vidicon.



Replace the lens mount ring. The lens mount ring should push lightly against the face of the vidicon. Since the vidicon tube is spring-mounted from the rear, this pressure helps prevent the tube from breaking when the camera is dropped, clubbed or otherwise abused. But if you have to force the lens mount ring in against the vidicon tube, then the vidicon mounting assembly must be adjusted. Before you do this, check to see that the tube is all the way into its socket. There are two threaded shafts parallel to the socket at the end of the vidicon. Each has a nut type adjustment. One, on the "High voltage" side, is above the tube and the other is diagonally across the vidicon assembly from it.



If the lens mount ring is pressing too tightly against the vidicon, screw these adjustments back the same distance on both sides until there is only a small amount of pressure on the vidicon by the mount ring. Make sure the ring pushes lightly against the face of the vidicon.

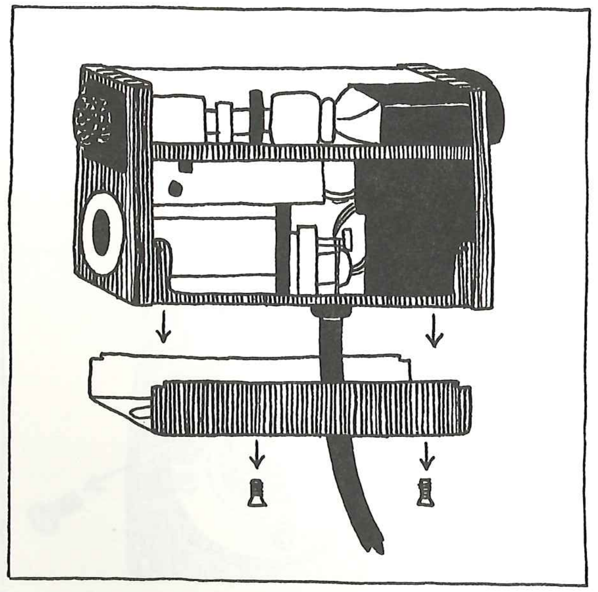
8. Replace the lens without the ornamental ring around the lens mounting. That's all there is to replacing the vidicon.

9. Turn on the camera and check to see if there is an image in the viewfinder. If there isn't, it most likely means that the 3 prongs that extend into the lens opening are not properly touching the vidicon. If that's not the problem then take the new tube out and put the old one back in. If the old one won't work either then it's time to consult your friendly neighborhood video service center.

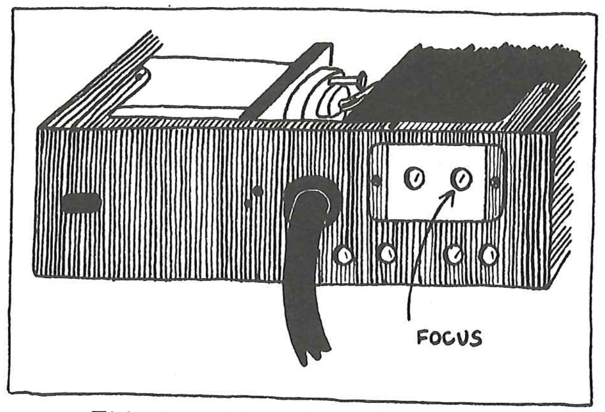
Tracking the Zoom Lens

Once the vidicon has been replaced, it is usually necessary to *track* the zoom lens. In a properly tracked lens, the image in the zoom lens stays in focus from maximum telephoto to maximum wide angle without any adjustment to the focus ring of the lens during the zoom. Tracking the lens is a mechanical procedure but there are a few electronic adjustments which you may wish to make at the same time but which are not absolutely necessary to perform each time you change the vidicon tube.

Zoom the lens out to maximum telephoto on a well-lit object — about 15 to 30 feet away, and focus the lens as well as possible on it. Try to adjust the lens through focus, i.e., try to bring the object from out of focus into focus and back out again by turning the focus ring in one direction. If you can adjust through focus and the maximum focus isn't as sharp as with the previous vidicon, then you may want to try adjusting the electronic focus. The electronic focus is located underneath the camera in the recessed area directly under the high voltage section. Remove the bottom plate of the camera by unscrewing the two small phillips head screws (one near the middle and one near the rear of the camera).

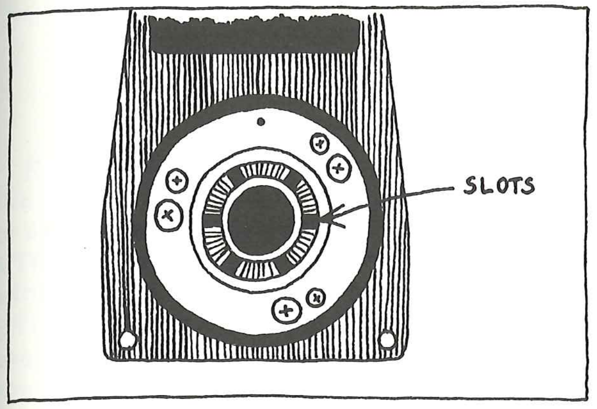


At the rear of the camera there are six holes, two of which are slightly recessed. Of those two, the one towards the rear (eyepiece) of the camera is the electronic focus.



This should be adjusted with a screwdriver so that the camera produces the best focused image possible. This adjustment knob, even though it is hidden in a hole, is the same type of device as the viewfinder monitor adjustments on the top of the camera. It is as delicate as those controls, and if it hasn't been previously adjusted, it will be firmly lacquered in place. If you press too heavily on this adjustment with a screwdriver, you will bend it back and make it almost impossible to work with, so handle it with care and the best fitting screwdriver you can find. If the adjustment gets bent too far back to work with, the only thing you can do is remove the circuit board to which it is attached and bend it back. Also, this is the high voltage section of the camera and while it won't electrocute you, it would be a wise idea to proceed with caution. One safety measure is to wrap some plastic tape around the shaft of the screwdriver so that it can't short out on the case.

When the electronic focus is as well adjusted as possible, zoom to wide angle and see if the picture is still well focused. If it is not, then zoom lens must be tracked. When properly tracked, the lens should hold the image in focus from maximum telephoto through maximum wide angle. The procedure of tracking simply moves the rear element of the lens closer to — or farther away from — the face of the vidicon. This is done by screwing a ring located inside the lens mount ring, in or out. When you take the lens off and look at the front of the lens mount ring, you can see slots on a recessed ring inside.



These slots are accessible to a thin screwdriver blade without taking the lens off. There is a hole that takes up roughly 1/4 of the lens mount ring through which you can insert a screwdriver blade into the slots in the inner ring and make the tracking adjustment by pushing the inner ring in the desired direction. Sony makes a tool to do this job, but even if you can get one, there is a chance that the adjustment ring will be too tight to be moved through the adjustment slot. The only way to adjust a tight ring is to remove the lens and stick a screwdriver directly into one of the slots from the front. If you do this and it still won't move, try loosening the three screws that hold the lens mount assembly to the camera.

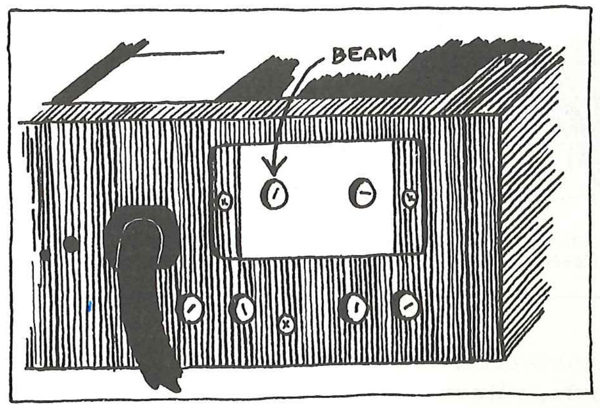
One way to tell which direction the adjustment ring should go is to focus the camera as well as possible, then unscrew the lens a little and see if the focus improves by moving the lens away from the vidicon. If the focus does improve, then the ring must be screwed inward (or clockwise as you face the lens) in order to separate the vidicon and the lens more when the lens is firmly in place. If the focus gets worse when the lens is screwed out, you should screw the ring out, etc. ad nauseum. When the camera stays in focus from maximum zoom to maximum wide angle, the lens is tracked, you can unplug the camera, put the covers back on, replace the ornamental ring and go get stoned on the money you saved.

Setting Up the Camera

After long use, especially in low light, you may end up with what's called a "sticky" vidicon — one that retains after-images. Or, you may find that there is a "bleached" effect on the camera in bright sunlight even when the F stop is as high as it will go. If either of these cases occur, the *beam* and *target* voltages in the camera should be adjusted. There are precise, electronically measured settings for both beam and target but both can also be adjusted by the eye with relative effectiveness.

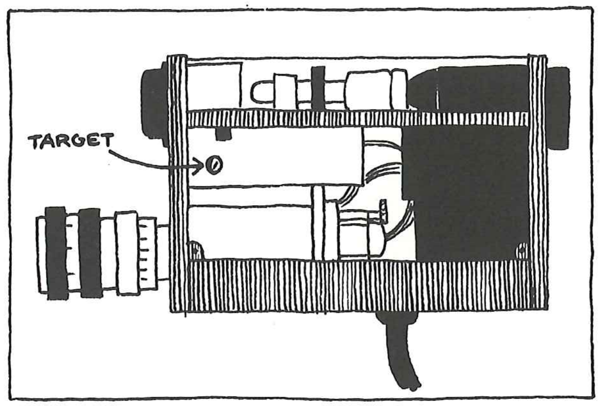
The beam adjustment controls the intensity of the beam of electrons in the vidicon and functions as a kind of brightness control. The Target controls the sensitivity of the face of the vidicon and is analogous to a contrast control. Both Beam and Target affect the overall sensitivity of the camera.

The optimum adjustment for the beam is accomplished by turning the adjustment knob (located next to the focus adjustment and just like it) clockwise until the picture on the viewfinder and/or monitor goes completely white (called *blooming).*



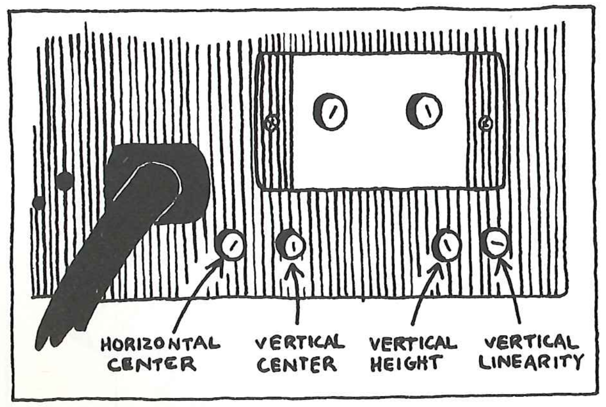
Then back off on the adjustment until the picture first reappears with good contrast.

Then the target voltage must be set to produce the desired picture. The target control is located in the rectangular silver box above the vidicon housing on the high voltage section side of the camera.



It is another screw hole adjustment like the beam and focus and is also just as fragile.

The last adjustments you may want to make are the ones which affect the size and shape of the picture. These adjustments are best made with a test chart that gives accurate indications of linearity, height and center. Some expert help would be advisable here, since charts differ and fouling up these adjustments can throw the camera out electronically as well as optically. For the brave or experimentally minded these adjustments are located in the 4 holes parallel to the beam and focus holes. Starting from the eyepiece end of the camera and working forward, the adjustments are — *Vertical Linearity, Vertical Height,* and *Vertical Center* and *Horizontal Center.*



These adjustment procedures are covered in the "Not So Basic Maintenance" section.

It's good to keep in mind that all of these adjustments (focus, beam, target, vertical center, etc.) are not meant to be fooled with because the portable camera wasn't designed that way. There are cameras where those controls are external and are supposed to be frequently adjusted, but they're not portable . . . yet.

TROUBLESHOOTING

Troubleshooting is the process of locating the source of a problem. It's a combination of logic, trial and error testing, educated guessing, and dumb luck. It can save you hours of frustrating work on the camera, when the problem was really in the monitor all the time. The actual procedure is one of first trying to find out what the problem is, then where it is and, lastly, what is causing it — all of which are necessary to the understanding of what is needed to fix it.

Look for the most obvious things first. Don't jump to any conclusions and, above all, stay calm. Any piece of equipment which has caused trouble before, whether or not it has been repaired, should be checked out right away. Try to avoid duplication of effort. If you think about each troubleshooting step you are performing, you may save yourself some time. Make sure you understand what you're looking for and what the results mean. If you get stumped, give up for a while. Maybe the fairy godmother of video will turn your pumpkin into a perfectly working VTR while you're resting. If not, at least you'll have a clearer head to work with.

The most obvious starting point in any fouled-up system is the cables. Interchange cables if it's possible; check for continuity if not. Eliminate dirt as a variable, not only on the VTR, but also on any old connectors which may be corroded. Check the power supply — the batteries in the portable deck, the line voltage for studio equipment. From there on, you're on your own with your specific problem. Here is an example of a common problem. It covers the basics of troubleshooting any system.

You have just shot a tape on the Sony portable and are playing it back on a monitor and . . . no picture!!! The first step is to check out all of the obvious things. Do this as calmly as possible in order to avoid running around for an hour only to find that the VTR isn't plugged into the monitor. Check the cabling. Check to see that if the monitor is also a TV, that it is in VTR mode, or, if you are using an RF signal, that the TV is on the proper channel and that the RF cabling is on the *VHF* antenna inputs (UHF gets you nowhere fast). Check also to see that the VTR is in *TV* mode if you are using a portable.

If the cabling appears to check out O.K., the next thing to do is to ascertain whether or not any sort of signal is getting from the VTR to the monitor. Looking at the monitor with the VTR in the "Stop" position, put the VTR in "Play" and see if noise — salt and pepper — appears on the screen. If it does, then both the monitor and the cable are reacting properly. If not, then there may be a problem in either the monitor or the cable, since putting the VTR in "Play" usually induces some kind of response in the monitor. Therefore, either the signal is not getting to the monitor because the cable is bad, or the monitor is on the fritz. To check the cable, refer to the section on repairing and making cables. If you're really sure it's the monitor that's at fault, you might be wisest taking it to a repair shop since you can get a nice electrical shock if you fool around inside a monitor you know nothing about (you could also take a course in TV repair, depending on how fast you need the monitor fixed).

If a signal is getting through, check for some obvious problems in the deck, like dirty heads or mis-threading. Something that frequently happens is that heads will clog during the recording, but during rewind, the cause of the problem disappears. The result is no recording, even though the reels were definitely moving and the red light was on. The best way to insure you got what you shot is to play back immediately in the camera. However, the best way to definitely determine whether or not there actually was a recording is to play back another tape which you know has a good recording on it. This will tell you whether or not the VTR is functioning properly.

By the time you get through the point of playing back another tape, you should have reached some sort of decision as to what the problem was, and perhaps even how to remedy it. If not, it may be time to seek out some expert help and relay to that person, as unemotionally as possible, what you just went through.

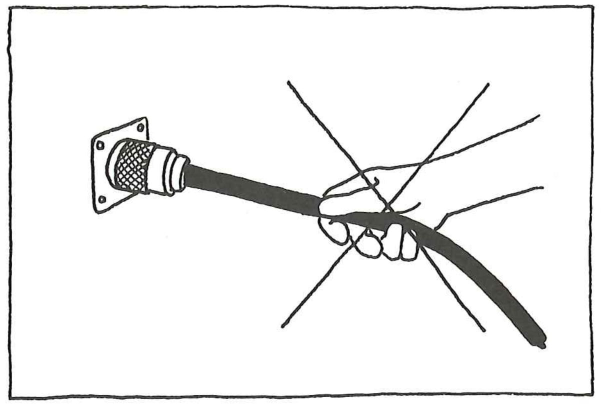
The technique of playing back another tape that you know to be of good quality is one to keep in mind, for it is useful not only in checking for no picture, but also to check for relative quality of picture, stability and standardization.

Audio troubleshooting follows right along with the video. Audio cables, especially mic cables, are highly susceptible to breakage. Hums and buzzes are the bane of anyone who works with audio and they are most often caused by a broken shield on an audio cable, but sometimes the problem comes from the environment and is untraceable. If you have a tape with an audio hum, check cables first. Then try to recall whether or not the tape was made in close proximity to any sort of heavy electrical gear (including large banks of fluorescent lights).

Video equipment, even one specific piece of it, is too complex to run down in terms of all the specific trouble spots that might occur when it's being used within a system, but by systematically approaching a problem with a basic knowledge of what's supposed to be going on, life with video equipment can be a lot simpler.

MAKING AND BREAKING CABLES

The cabling of a video system is fairly simple to repair and expand. Cables are also the main source of trouble when they are poorly made or abused. Almost invariably, problems arise not within a cable itself, but at points where the cable is attached to the connector. Connectors serve not only as convenient ways to connect cables, but also as handles for cables. The most common abuse to which cables are subjected is when a cable is removed from a receptacle by a yank on the cable rather than on the connector.

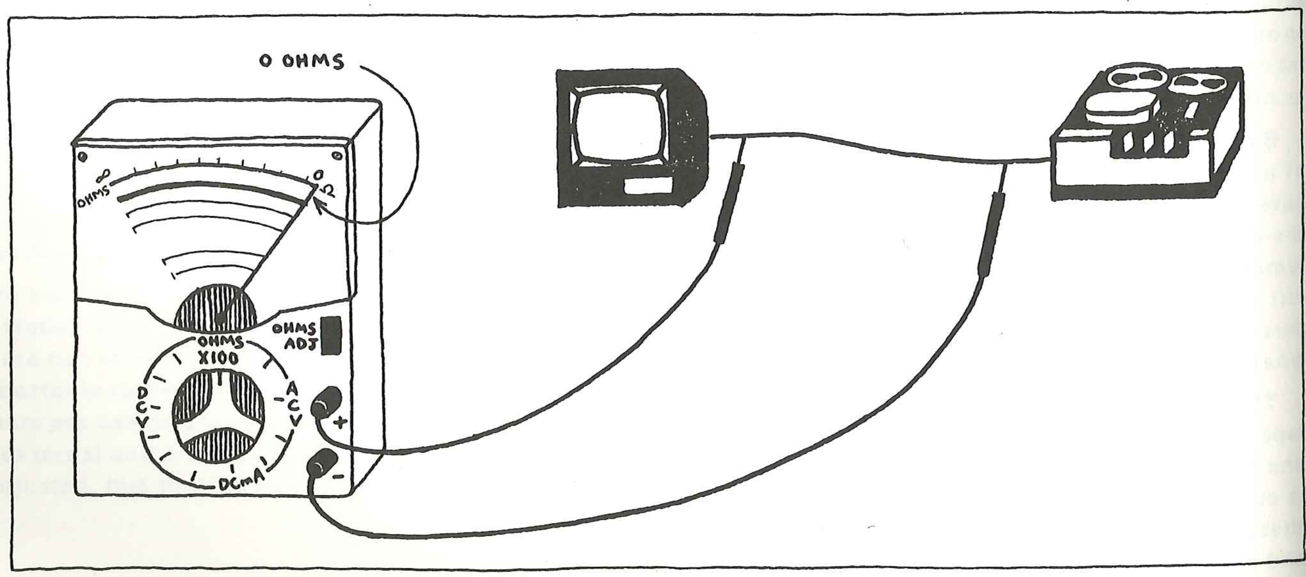


The connector is where pressure should be applied. The strength of solder has its limit and a strong pull on the cable often surpasses it, causing the solder joint to break and the cable to be rendered useless until repaired.

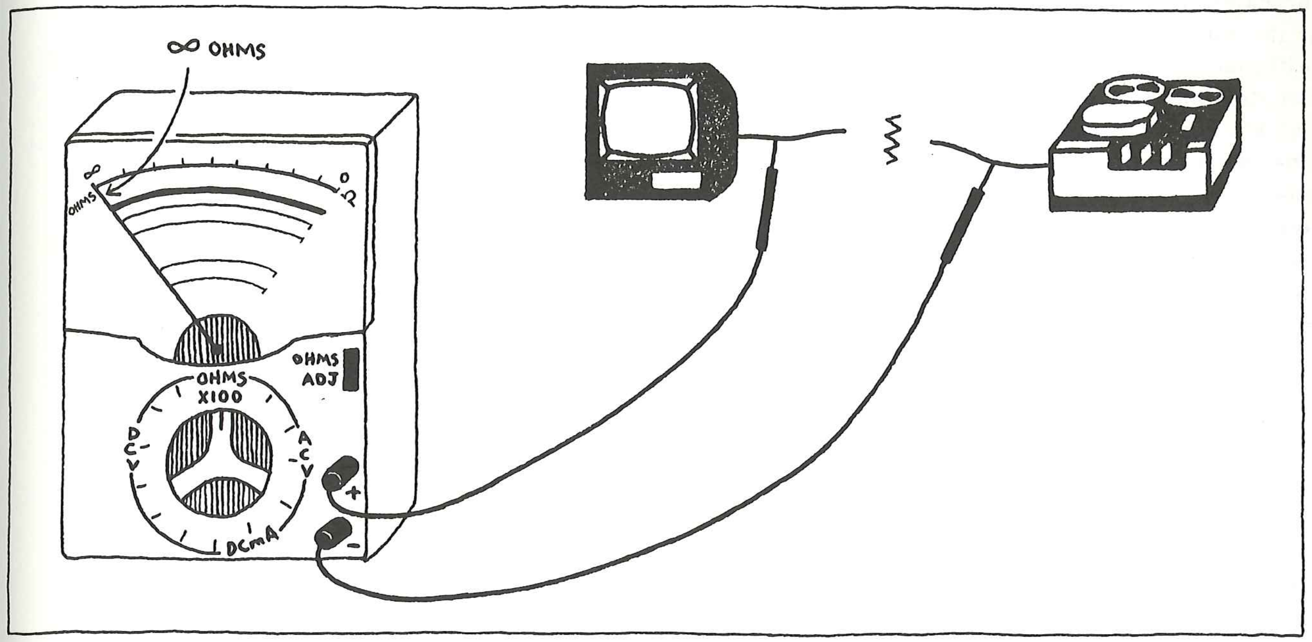
Most broken cables can be easily repaired since most breaks are readily apparent to even an untrained eye. Once you've resoldered an obvious break in a connector, be sure to test that cable in a circuit before assuming that it is repaired. Wiggle the cable slightly at the point where it enters the connector and check to see that the wiggle causes no disturbance in the signal (audio or video). If some interference should arise, the cable still needs work.

If the cause of a cabling problem is not obvious or if it would be very difficult to examine the connector (e.g., a 10-pin camera connector), then a *continuity check* must be made to determine the source of the problem. A continuity check means just that – is or is not the cable continuously connected from one connector to the other. If the cable or any of the wires in it is broken at any point between the contact parts of the connectors on either end, then the cable is said to be *Open.* If everything is properly connected, the cable is *Continuous.* If any of the wires within the cable are improperly crossed, the cable is *Shorted* or *Short-circuited.*

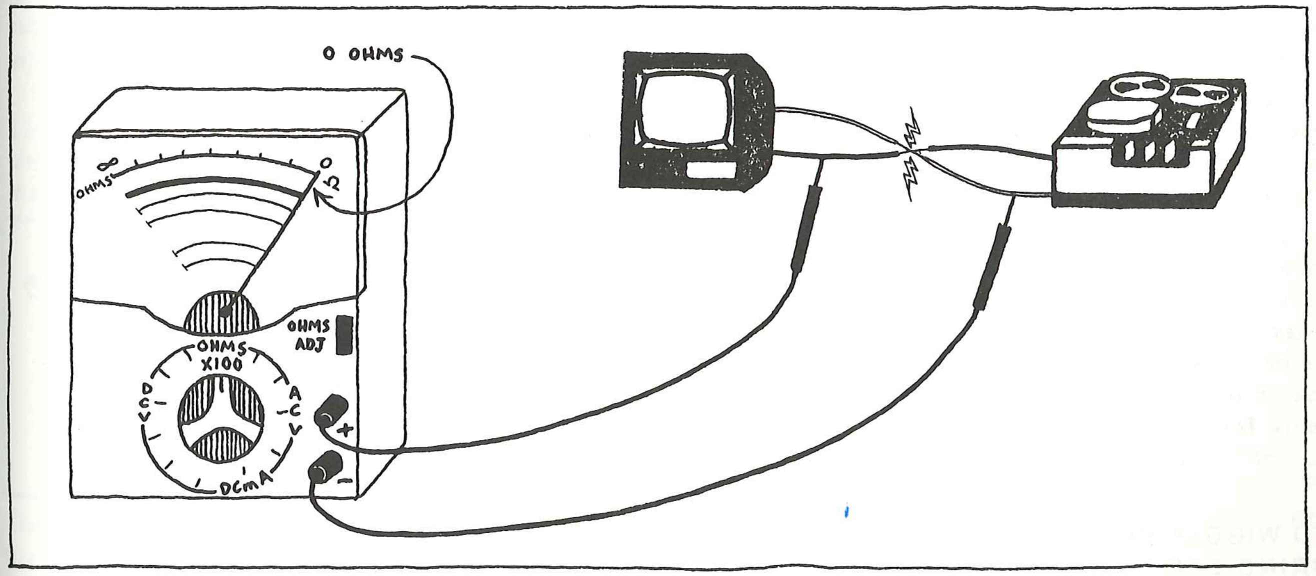
In order to perform a continuity check, you need a *multi-meter.* The Ohms scale is used to check for continuity. The multi-meter sends out a small electrical current through its probes. When one probe is connected to each end of an unbroken wire, the current flows with little or no resistance through that wire. Since Ohms are a measure of electrical resistance, the Ohms scale, in this case, reads O.



If the wire is open when the probes are attached to either end, then the current is totally unable to flow through the wire and the Ohms scale reads that there is an infinite amount of resistance.



Short circuited cables read continuous – O Ohms – where they should read open.



In continuity checks, the readings of the multimeter are definite – either open *or* continuous. no in between.

The probes or test cables that come with each multimeter are usually colored – one red and one black. This distinction is not important when making continuity checks. Meters vary in terms of the options they offer you. Some of the less expensive ones have only one or two resistance scales, while others have four or five. Most often the different scales are indicated by Ω (the Greek letter Omega) and some multiple of 10 (e.g., Ω X100, Ω X1,000). Sometimes there is a multiple of 10 followed by the letter K. K indicates the prefix "kilo" and indicates that the number preceding it should be multiplied by 1,000. No matter what particular designations your meter has, use any of the scales to measure continuity. The instruction booklet that comes with the meter will give you ample instructions on the way to hook up the probes for a continuity check, but here are some tips and some reminders when using a multimeter to check cables:

1. It sometimes helps to attach the wires with alligator clips on the ends onto the ends of the probes. Doing that allows you to clip the probes onto the connectors. Be sure to check that the alligator clip wires are continuous, since they are notoriously weak. Also check to see that the alligator clips are clipped only to the part of the connector on which you want them and that they aren't shorted to somewhere else.

2. Make sure that you are only measuring what you want to measure. Measuring cables for continuity on a metal surface may show you that the surface is continuous, but that doesn't tell you a whole lot about the cable.

3. Connectors can corrode. Make sure that the probes are making firm contact with the *metal* parts of the connector and not with a layer of rust or sticky tape residue.

4. A good procedure to follow when checking continuity is as follows:

A. Measure for continuity between the *hot* or center conductor parts of the connectors on either end of the cable.

B. Check continuity of the shields.

C. Measure for shorts by connecting one probe to a "hot" part and one probe to a shield.

BE SURE TO WIGGLE THE CABLE A LITTLE LITTLE DURING EACH CONTINUITY CHECK.

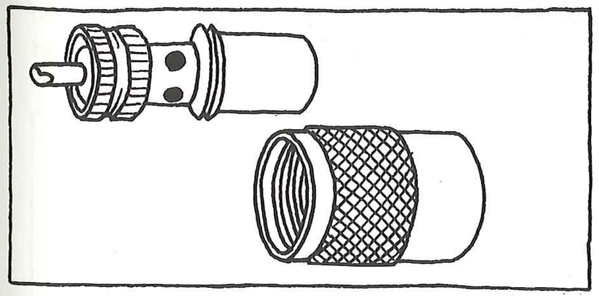
5. Once you've repaired a cable and checked the continuity, there is one last check to be made. Many cables check out fine while their cases are off, but once the case is put back on, the cables may be shorted. This can be caused by two things: 1) If the case of the connector is metal, the hot wire in the cable may be touching it; since the case is usually connected to the shield, this causes a short; or 2) Sometimes, when the case is slipped over the elements of the connector, those elements are squeezed together. To prevent both of these occurrences, keep all solder joints small enough to allow a few wrappings of electrical tape to be put around the "hot" element of the connector, (this procedure is mainly for audio plugs, *not* video connectors). If the solder joint is properly made, the cover should slip on smoothly, even with the tape on the "hot" element of the connector.

Making new cables, i.e., attaching new connectors, involves exactly the same procedures without, of course, having to check for problems first. Be sure, however, to test the continuity of each new cable before putting it into use in your system.

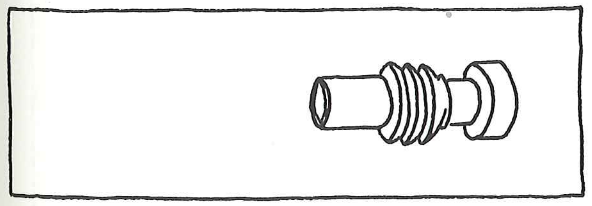
HOW TO PUT A UHF CONNECTOR ON A CO-AX CABLE

The video connector most often used with 1/2" video hardware is called a *UHF connector.* It is rugged and easy to use when it is properly attached to RG-59/U co-axial cable. When it is improperly attached, it is undependable and difficult to use.

There are three pieces to a UHF connector. Two of them are classified as the *PL-259* UHF connector. Those two pieces are called the *center conductor* and the *case* or *sleeve.*

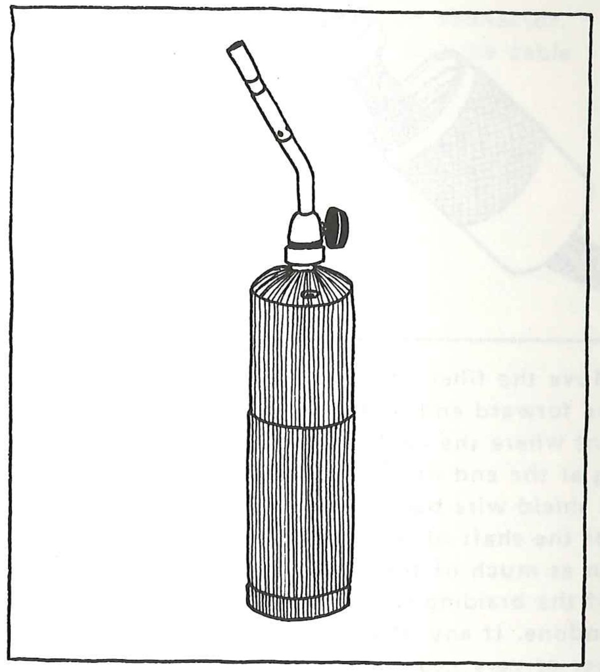


The third and equally important piece is the *UG-176/U filler.*



The filler is not always sold in the same package as the PL-259, but it is absolutely essential if the connector is to be properly attached.

The tools necessary are the dikes, the soldering iron, solder, a pair of pliers and, if possible, a very large soldering iron or a small propane torch (available at most hardware and department stores for about $5).



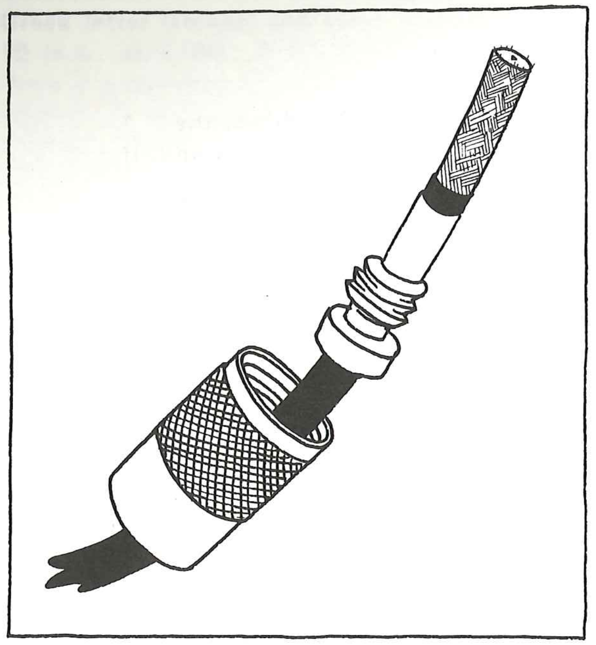
1. The first step is to trim the end of the RG-59/U co-ax cable so that there is a clean cut with no old wires, solder, and nicks to the cable visible.

2. Next, slip the sleeve of the PL-259 over the end of the cable and let it slide away from the area in which you will be working. Be sure that the sleeve is facing in the proper direction to be correctly re-attached to the connector when the connector is added to the end of the cable.

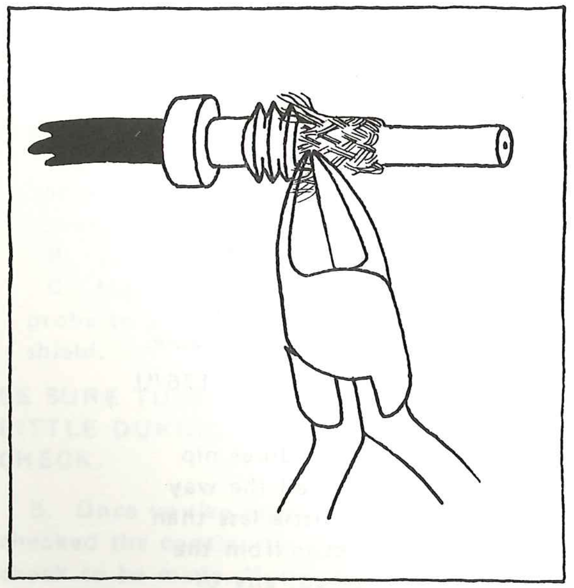
3. Then do the same with the UG-176/U sleeve.

4. With the very tips of the dikes nip the rubber casing of the cable all the way around. Do this at a point a little less than 1/2 the length of the connector from the end of the cable. Try not to cut any of the braided shield wire underneath. When you have cut the rubber casing around the entire circumference, take the dikes and grab the casing between the spot where you have cut and the end of the cable. Pull the rubber casing off to expose the braided

shield wire.

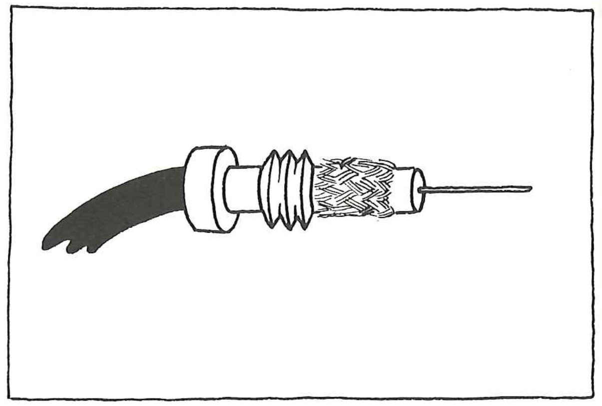


5. Move the filler back up the cable until the forward end of the filler reaches the point where the cable casing ends. Starting at the end of the cable, work the braided shield wire back down the cable and over the shaft of the filler. Try to maintain as much of the braiding as possible. Some of the braiding will undoubtedly come undone. If any of the loose strands hang over or very near the threads on the filler, clip those strands off with the dikes.



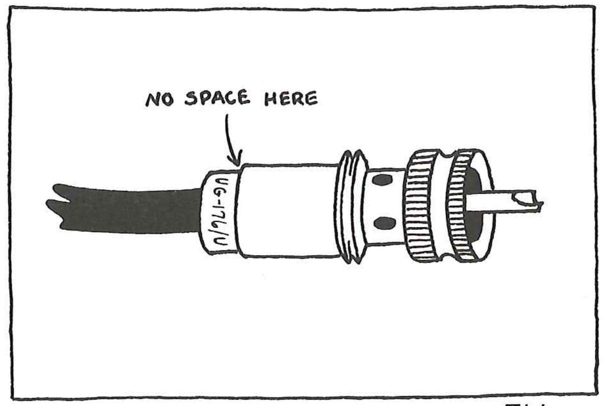
Be sure that *all* strands are folded back down the cable and over the filler.

6. Next, clip around the insulation to the center wire about 1/2" up the cable from where the braid is folded back. Be extremely careful not to nick the center



wire while cutting the insulation. Any cuts on the center wire drastically weaken it and could cause it to break even after it has been soldered into place. If you nick the center wire, it is best to start over again rather than risk adding another faulty connection to the ever growing legions of them. Once you have freed the insulation from the center wire, pull the insulation off in the same manner as the outside rubber casing.

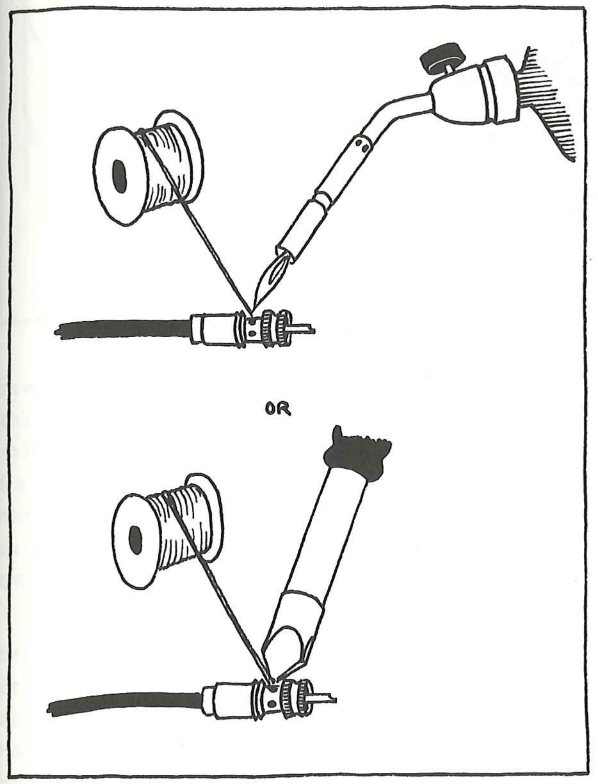
7. Now, put the connector on by threading the center wire of the cable through the center shaft of the connector and screwing the connector down until it sits flush against the end of the filler.



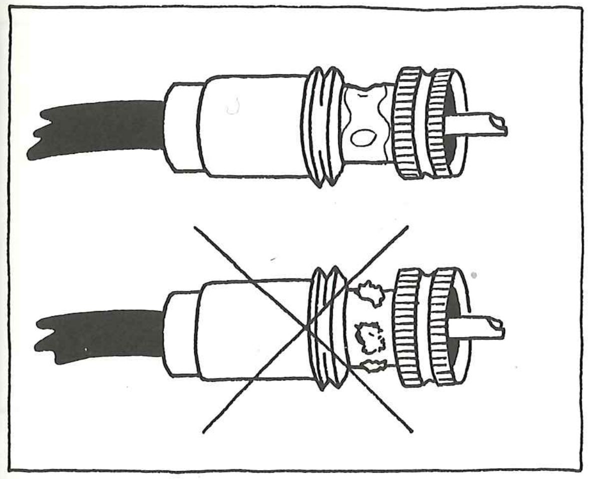
This process may prove difficult. If any of the strands from the shield wire have been forced into the threads of the filler, you may need the pliers and, in some cases, two pairs of pliers. However, if the connector will not sit flush on the filler, you should unscrew the connector, trim the braided wire, and start again, since the connector cannot be properly made this way.

8. There are two places that must be soldered on the assembled connector. Near the center of the connector you will see an indented section with holes in it. Through at least two of those holes you should see

the braided shield wire. This solder joint requires a great deal of heat. A regular soldering iron can seldom provide enough heat to the connector to cause the solder to flow into the shield wire. Either an extra large soldering iron or a propane torch is necessary to get the solder to flow through the holes in the connector and properly bond the shield wire between the connector and the filler.



In the absence of either a large iron or a torch, two or three smaller irons may also work. The end result should be a smooth covering of solder over the holes where the shield wire was visible.



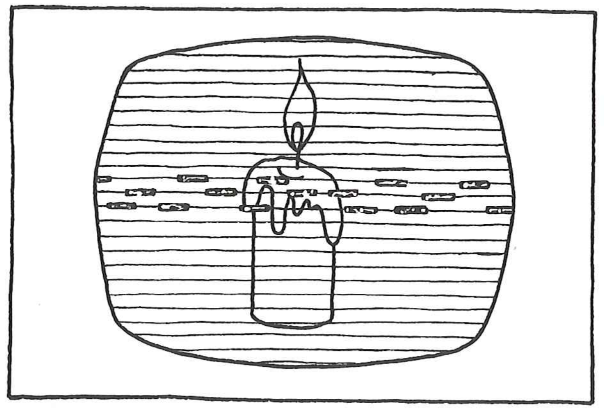
9. Without moving the connector, use the smaller iron on the center shaft of the connector to fill it with solder in order to bond the center wire to the connector.

10. After the soldering has been completed, let the connector sit undisturbed for a few minutes to cool off. Moving it while it is very hot can disturb the solder joints and can also cause the insulation of the case to be melted.

11. Once the connector has cooled, trim off the excess center wire (if there is any) coming from the front of the connector. Also make sure that there is no excess solder on the outside of any parts of the connector. Then, screw on the case and test the cable for continuity and shorts.

CLEANING THE BRUSHES

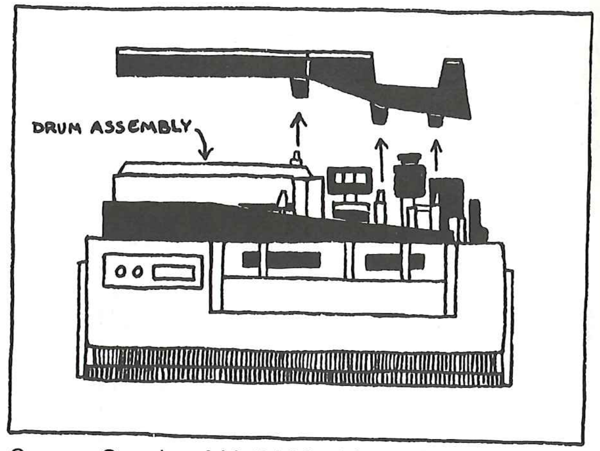
Another VTR cleaning procedure that should be performed only when necessary is the cleaning of the video brushes. The indication that cleaning the brushes is necessary is *brush noise.* Brush noise shows up on the monitor screen as small black streaks running along the scan lines.



The difference between brush noise and tape dropout (which may also show up as black streaks) is that brush noise appears regularly on the same portion of the screen rather than moving at irregular intervals across the screen as dropout does. If you notice these regular streaks in playing back your tapes, then it's time you cleaned the brushes on that VTR. The following procedure applies *only to Sony AV series equipment.* To find out the procedure for cleaning the brushes in equipment made by other manufacturers, it's best to consult a competent service person.

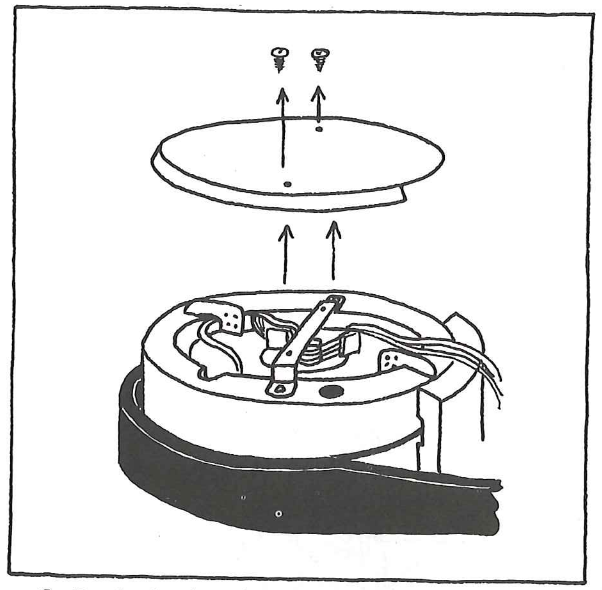
To clean the brushes on all Sony AV series VTR equipment:

1. Remove the plastic Head Assembly

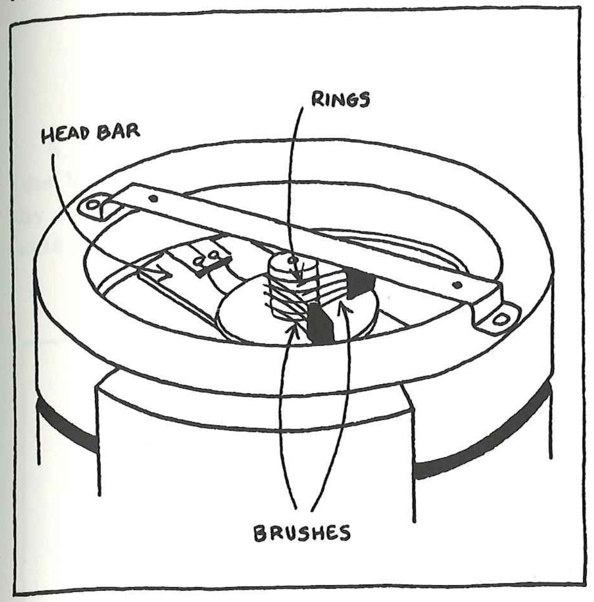


Cover. On the AV 3400 this cover snaps right off by pulling it straight up. On the 3600, 3650, and 5000 series VTRs, there are two large screws on the back of the head assembly cover (the side facing the reels).

2. Remove the two phillips head screws that secure the drum assembly cover. With the drum cover off, the brush assembly is clearly visible, although the post on which the rings are mounted is protected by a bar which spans the diameter of the drum.

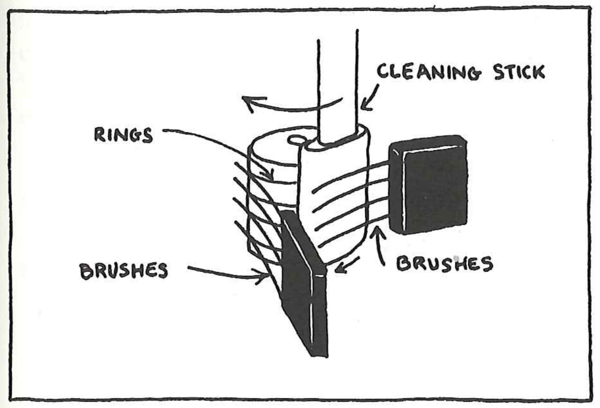


3. Both the brushes and the rings should be cleaned. The materials necessary are: denatured alcohol and a chamois cloth or the Sony cleaning sticks. Moisten the chamois cloth with alcohol and wrap the cloth over the end of your index finger so that your fingernail protrudes enough to get into the groove in the slip ring. (Use a Sony cleaning stick if you bit your fingernails off trying to figure out what was wrong.)



Gently move the head bar 360° in both directions with the chamois cloth in the slip ring. Repeat this procedure for each of the four rings. Be sure to use a different section of chamois cloth for each ring you clean in order to avoid transferring the crud from one ring onto the next.

4. There is only one way to clean the brushes . . . VERY CAREFULLY! The brushes are thin, brittle pieces of metal, and they are already under pressure. They have enough flexibility to allow for a piece of chamois cloth or a Sony cleaning stick to be passed between them and the slip rings, but not much more. Move the cloth or stick in the direction the brushes point (i.e., away from the piece of plastic to which they are anchored).



Slip the cloth between the brushes and the rings, trying to clean all the brushes at once. This procedure needn't be repeated more than once or twice for each set of brushes.

5. Often, in the process of cleaning, one or more of the brushes will not fall back into its ring, but instead will rest either on the plastic portion of the post or on another ring. After you have cleaned the brushes, CHECK AND DOUBLE CHECK TO SEE THAT EACH BRUSH IS IN ITS PROPER RING. There are only four rings and there are only four brushes per set so it's easy to see if something is amiss. If one of the brushes is out of place, gently nudge or lift it back into place with either the cleaning stick or a small screwdriver. Be careful not to lift the brush any farther from the post than necessary because excess pressure can cause the brush to snap off.

6. Two other things are also important. The first is not to put any pressure on the drum assembly while you are cleaning the brushes. The drum is critically aligned, and any strong pressure like elbows or forearms can foul up that alignment. The second thing is to make sure not to leave anything inside the drum assembly that wasn't there already.

7. Replace the drum assembly cover after making a final check to be sure that all the brushes are seated properly and that there is nothing new added to the drum. Once the screws on the cover have been tightened, play back a tape that you know was well recorded. If that tape plays back without brush noise, replace the plastic head assembly cover. To do this, match up the hollow plastic cylinders on the bottom of the cover with the metal posts on the VTR. The cover should then snap firmly into place. To be sure that it's on correctly, make a test recording and watch the tape as it moves through the tape path. If the cover doesn't interfere with the movement of the tape, and if the recording checks out O.K., then you're done.

If the brush noise persists, repeat the cleaning procedure. If the noise is still there, then the brushes may be worn and need to be replaced (something which you may or may not want to undertake yourself).

CLEANING AND CHANGING THE BELTS

After prolonged use, the rubber belts which connect the VTR motor(s) to the heads and tape transport system may start to slip. This is especially true when the VTR has been used in less than ideal environmental conditions. When the belts start to slip, they must be either cleaned or replaced.

The sign that the belts are slipping is when tapes you know to be good won't track on your VTR any more. There are a lot of other things which can cause the same symptoms to appear. The following *"ifs"* are some of those other things to eliminate before suspecting the belts: *if* the machine hasn't been recently man-handled by dropping it, stepping on it, etc.; *if* there are no strange noises emanating from the bowels of the VTR; *if* there is no recurrent fuseblowing (if the battery charger with the portable VTR hasn't been plugged in wrong); and *if* the entire tape path is free from interference (follow the tape through with your eye) and the VTR is correctly threaded . . . then the problem *may* be the belts.

In order to clean or replace the belts you must remove the case of the VTR. The service manual for every VTR indicates the procedure for removing the case in the exploded diagram. In most instances, this procedure is pretty straightforward.

The most important thing is to remember to unplug the AC cord and all other cables before starting.

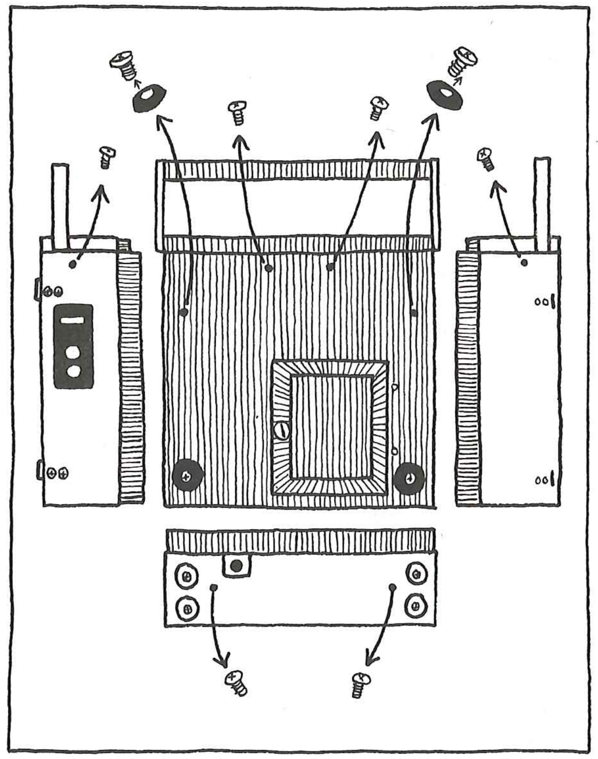
These are the steps for removing the case to Sony AV 3400:

1. Remove the camera and battery charger cables and the carrying case. Remove the lid to the VTR and take out the BP-20 battery from inside.

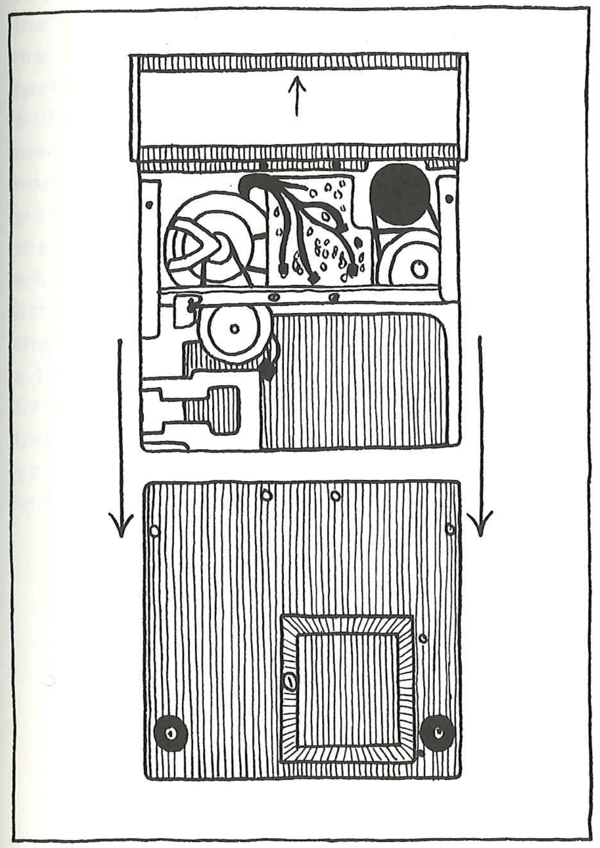
2. Lay the VTR flat on the table with the control levers facing you. Remove the two silver phillips head screws immediately behind the spot where the handle is connected to the VTR.

3. Turn the VTR around and remove the two large silver phillips head screws in the middle of the back.

4. Stand the AV 3400 on end so that you are looking at the bottom with the levers facing up. Be sure that the VTR is well supported. You can easily knock it over in this position. Remove the two bronze screws which are just below the slot where the handle rests. The last two screws which secure the case to the VTR are the ones which hold on the two upper feet (the black rubber discs). Remove these screws.

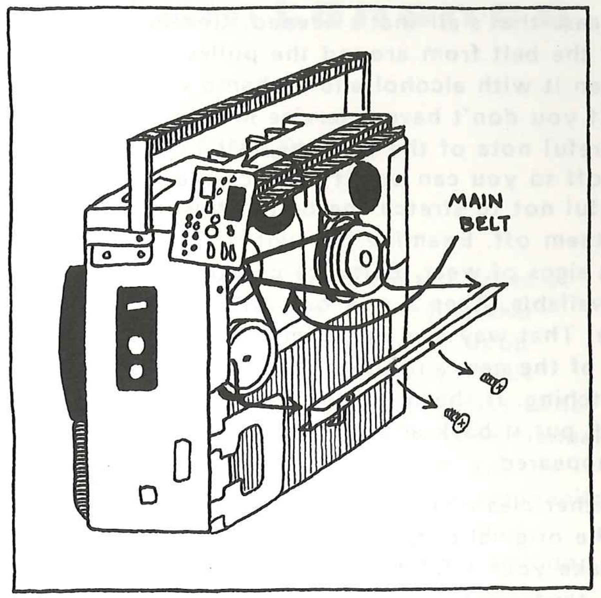


5. The case is now free. To separate the VTR from the case, pull the VTR up by the handle while holding down the case at the back.

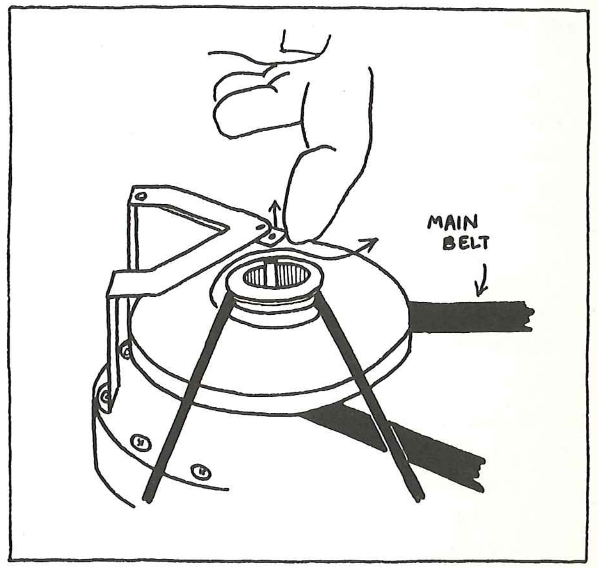


(Sometimes the case is a little tight and an extra set of hands might come in handy.) You can also turn the VTR upside down and pull the case off of it, depending on whichever seems easier.

6. Once it is open, you can see a metal bar spanning the center of the AV3400. Towards the center of the bar are two phillips head screws. When these screws are removed the bar will be loose and can be taken out. The screws and the bar secure a small printed circuit board to the pack. This board sits in slots and can be carefully slid out of the slots and out of the way. This fully exposes all of the belts in the VTR. The board, however, is still attached to the VTR by wires which, if you're gentle, will support the weight of the board, allowing it to hang out of the way.



To remove the main drive belt, slip it off the pulleys and guide it carefully between the end of the pulley axle and the piece of metal resting against the axle.



7. When you are ready to reassemble, just reverse the above procedure. Once the case has been removed, stand the VTR on end and secure it so that it won't fall over. Looking into the guts of the VTR, you will see one, two, or three belts, depending on the VTR (there are three in the AV 3400). They usually look like black rubber bands, and they are wrapped around pulleys on either end. By gently moving the belts in both directions, you should be able to produce movement in the pulleys. If any belt is so loose that it just slips easily over the pulleys, then it must be replaced. Belts are seldom that worn, so try cleaning the belts and pulleys –

just in case that's all that's needed. Gently remove the belt from around the pulley and clean it with alcohol and a chamois cloth. If you don't have a service manual, take careful note of the way the belt comes off so you can put it back correctly. Be careful not to stretch the belts while taking them off. Examine the belt for obvious signs of wear. Belts are cheap and fairly available. Keep a new one around if possible. That way you can compare the lengths of the new and used belts to check for stretching. If the old belt appears to be good, put it back and see if the problem has disappeared.

If neither cleaning nor replacing the belts solves the original problem, then you'd better take your VTR to a service center because tapes that don't track won't do you or anyone else any good.

Some Less Basic Maintenance

SERVICE MANUALS

This section is really just an introduction to a type of book . . . a service manual. VTR equipment service manuals are put out by the manufacturer and contain recommended maintenance procedures, the manufacturer's specifications and other information which will be discussed in this section. Service manuals are neither classified information nor need they be incomprehensible technical gibberish. And, while it's safe to assume that you shouldn't perform some operation which you don't understand, there's very little in any VTR hardware service manual that you can't understand if you are given a little orientation on how to approach it. Service manuals are high priced software, but if you are really serious about maintaining your own VTR equipment, they are indispensable.

There are a number of different types of information to be found in every service manual. Most manuals rely heavily upon graphic material in the form of symbolic diagrams, illustrations and photographs. What is necessary to understand in a service manual is a familiarity with the symbolism and its meaning, with the vocabulary of the manuals, and with the test equipment required to perform the service procedures. This section is only a general introduction to manuals and the information in them. There are a great number of books to supplement the information in this section, most of which can be found on the shelves of electronics stores. Those books can give you some of the more specific knowledge on the "hows" and "whys" of both the VTR equipment and the hardware necessary to maintain and repair it. If, after reading this section, you're unsure as to whether or not to tackle a service manual on your own, go to a local VTR service shop and ask to see the one for your VTR. If the manual frightens you, then forget it for a while. But, if it looks like fun (?), then why not jump right in; after all, what have you got to lose . . . ?

The following types of information, in some form or another, are contained in the service manuals for all VTR equipment: schematic and block diagrams, circuit board layouts, explanation and theory of operation of all circuits and mechanical systems, maintenance procedures and the test equipment necessary to perform them, parts lists, and with most manuals, exploded diagrams of the piece of equipment. A consideration of each of these components of service manuals follows.

Parts lists need no explanation other than that for each part they include at least the manufacturer's number for the part, and that is what you need to replace it. They may also list its designation within its circuit or mechanical system and the electronic value of the component or a description of its function. The *exploded diagrams* show all the structural parts of the

Some, though not all, schematics list voltages at certain points within the circuit. These voltages can be measured with a multi-meter. Voltages, like waveforms, give an indication of whether or not a piece of equipment is properly functioning. When measuring voltages and checking waveforms, be very careful with your probes. The equipment must be on when these tests are made and it's extremely easy to cause an unintentional short circuit by misplacing or misusing the probes. You may end up causing a problem rather than solving one.

COMPONENTS

The procedures outlined in this manual are mechanical and don't require the specialized knowledge necessary to work with the electronics of video equipment. A familiarity with the symbols for and the shapes of the components which make up the various circuits is essential to a technician. This familiarity is also helpful to anyone who wants to feel more at ease when confronted with the guts of a VTR, camera or monitor.

Video technology started with tubes. Very basically, a tube is a sealed glass jar in which pieces of metal are imbeded and from which all the air has been removed. When a signal is passed through certain of these pieces simultaneously with the required voltage on others, the signal can be amplified or controlled or processed or shot at a photoelectric surface – or any one of a number of other things.

Tubes come in thousands of shapes and sizes. Some of the most common tubes used in video equipment are the vidicon, the monitor picture tube and the high voltage tube (found in most larger monitors).

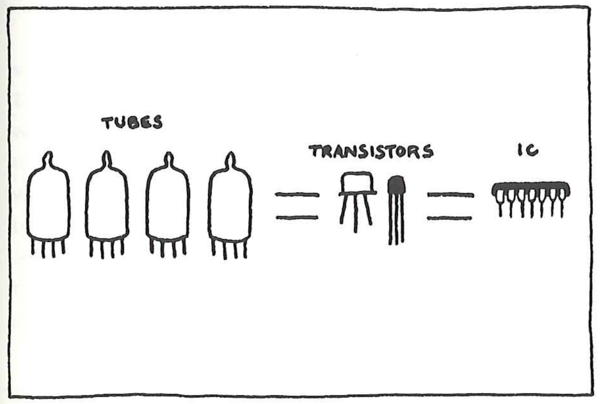
Tubes have certain drawbacks. First of all, they break relatively easily – which limits their portability. Second, they take time to warm up and, once they are warm, they produce a great deal of heat which is undesirable in many situations. Lastly, tubes tend to change their electronic characteristics with age.

This factor limits their reliability in some applications.

Soon there will be no tubes associated with video technology. All tubes including the picture and camera tubes, will be replaced by solid state devices of the same nature as transistors and integrated circuits.

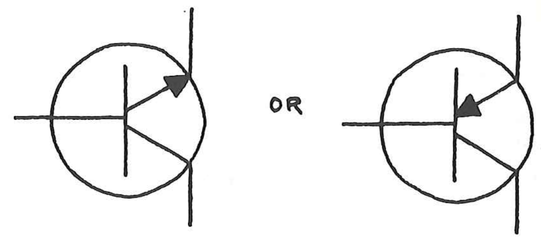
Transistors and integrated circuits (ICs) are small packages of semi-conductor metals arranged in very thin layers. When the proper amount of electrical current is supplied, these solid state devices perform the same functions to the signal as the equivalent tubes would.

A transistor, like a tube, performs an individual function in a circuit. An integrated circuit can perform a series or sequence of functions that would normally require several transistors and their associated components. Integrated circuits are not much larger than transistors and both types of components are considerably smaller than the tubes which they replace.

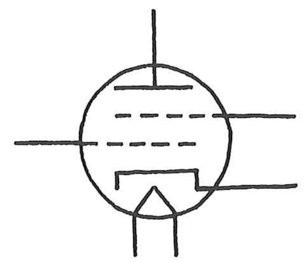


All tubes and solid state devices are specifically marked with letters and numbers. These markings are a reference code. Every component has certain operational specifications for voltage, current, etc., which determine what jobs each is capable of performing. The number and letter codes on each component can be looked up in reference books in order to determine whether or not a particular component is right for a particular job. Not all manufacturers use the same code for their solid state devices but most provide cross reference/substitution charts. For instance, if you have a Sony transistor which you want to replace, you can look up the Sony in a HEP (Motorola) or a General Electric substitution chart and find the proper HEP or GE replacement transistor.

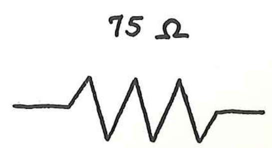
Transistors as well as integrated circuits and tubes also fall into general categories of function and physical appearance. Sony service manuals and all the transistor substitution catalogues have pictures of the various types of cases of the devices they use or are listing. However, the form of the case is no indication of the function of the device. That information becomes much clearer from the schematic diagram of the circuit in which the component is used (at least for someone who knows how to read a schematic). In schematic symbolism, a transistor is shown as a circle with a line in the center whose circumference is crossed by lines in three places.



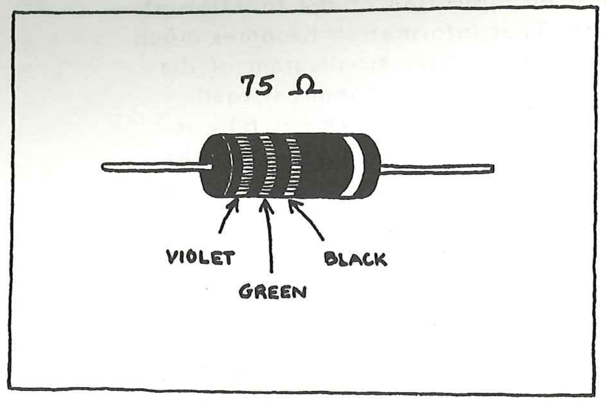
An integrated circuit is usually indicated by a box containing logic symbolism connected by lines. A tube is indicated by a circle containing the symbols for its various elements (grid, cathode, anode, etc.).



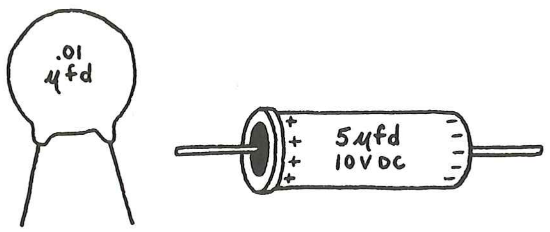
Most of the other components commonly used in electronic circuits are defined by their numeric values. Thus, resistors are shown in the schematic as jagged lines with a certain value of ohms written next to them.



On the circuit board itself, each cylindrical resistor is color-coded to reveal its exact value.



Capacitors aren't color-coded. Their values are printed on them in microFarads (μ Fd). The value for each capacitor is also listed next to it on the schematic.



There are, of course, many other types of components used in the circuitry of video equipment. But this manual can't possibly cover even the basics of electronic circuit design. These very sketchy explanations of the functions of some components are only aimed at making you feel a little less bewildered by the innards of your equipment.

SOME LESS BASIC MAINTENANCE PROCEDURES

The remaining information found in service manuals is the step-by-step procedures for testing, aligning, and repairing video equipment. These service procedures are necessary to maintain VTR equipment and diagnose problems, but they are most often not specific remedies for anything but standard misalignment problems. The procedures are designed to indicate how a particular circuit or system is functioning. They are not designed to reveal if a specific component has gone bad. All this means is that while you may be able to perform many of the maintenance procedures outlined in a manual, you may still be unable to locate or solve a specific problem. Don't be discouraged; you're not alone . . . your friendly local VTR serviceman is often in the same boat. This is not meant to play down the importance of the service manual maintenance procedures in any way. It is just an attempt to put service manuals and their procedures in some sort of perspective.

Maintenance and alignment information in service manuals is arranged by system and by sequence. Each system of a VTR usually has its own section – video, audio, sync (servo), tape transport, etc. Within those sections, the maintenance procedures are sequenced in an order that hopefully avoids confusion and duplication of labors. For each sequence in every maintenance procedure there are four things you have to know: 1) what equipment is needed; 2) how that equipment should be adjusted; 3) what is being tested and adjusted, and; 4) what component to work with. All of this information is provided in the service manual.

The two most essential pieces of test equipment are a good multi-meter and a proper oscilloscope. The cheap multi-meter of the basic tool kit will suffice for some of the test procedures, but battery operated multi-meters often do not have the accuracy to make the measurements required in many of the procedures. There are two alternatives to the low cost multi-meter: 1) a vacuum tube volt meter (VTVM) or, 2) one of the multitude of solid state (transistor or integrated circuit) multi-meters which are often referred to as digital volt meters (DVMs) or digital multi-meters (DMMs). Both types are usually AC-operated. The Heath Company makes a "do-it-yourself" VTVM kit that is quite adequate for video work, but there are many other AC multi-meters which will do the job. Any multi-meter for use with the maintenance procedures in the service manuals should measure both AC and DC voltages on scales ranging from at least 1 volt DC to 10 kilovolts (10,000 volts) DC with at least two scales in between, should measure ohms in at least three multiples of 10 and should have the capability to measure small amounts of current in milli-ampers. Most meters with these facilities also have a decibel scale marked dB.

One problem with VTVMs, as with all vacuum tube equipment, is the warm-up time the tubes need before they are ready to work. This is an important consideration with VTVMs, since any measurement made while the tube or tubes are not warmed up may be inaccurate. For this reason, each VTVM has two adjustments which must be made before accurate readings from the meter can be had.

The first adjustment to make is marked "Ohms Adjust." This adjustment sets the needle on the meter at exactly the spot marked Infinite Ohms on the resistance scale. All you need to do to make this setting is to put the meter on one of the ohms scales and set the needle to read properly. The second adjustment is marked "O (zero) Adjust." This adjustment sets the needle on the meter to read at the exact zero point on all the scales. Make the "O" adjustment by leaving the meter on ohms scale and connecting the two probes together. Now set the "O" adjustment knob so that the needle sits directly over the "O" end (left) of all of the scales. The last thing to do is to go back and check both settings again in order to insure that the "O" adjustment didn't throw off the ohms and vice versa.

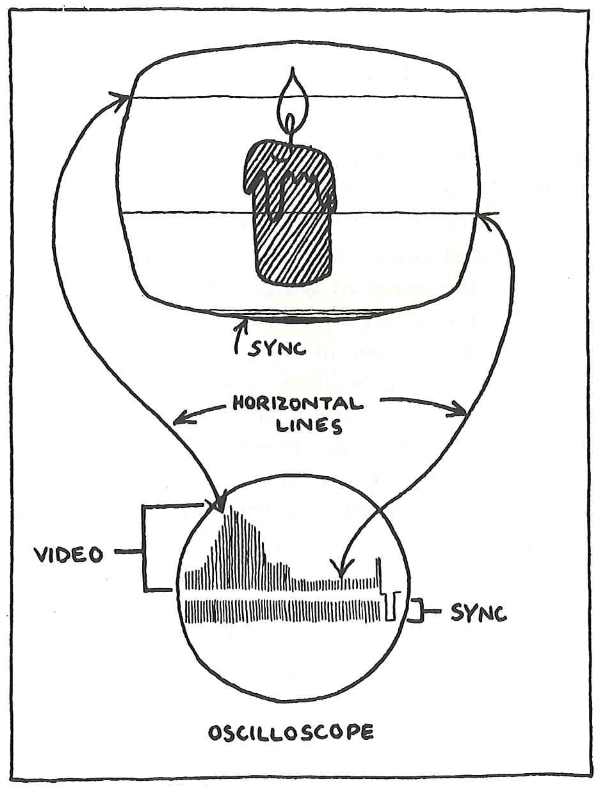
One last hint is that most AC operated multi-meters have switched probes. One side of the switch measures DC volts and the other measures AC + Ohms. Keep this in mind and you'll save yourself a lot of

inaccurate measurements. Many probes have these switches right on the probe itself, while others have a switch on the meter.

The most modern multi-meters (DVMs, DMMs) use components which light up with the digits of the measurement you are making. These digital meters seldom have any external adjustments.

An oscilloscope is very much like a video monitor. It graphically registers the changes of the video signal by means of an electron gun. The gun "shoots" the video signal at a photo-electrically sensitive screen. The two differences between a monitor and an oscilloscope are the ways in which they scan their screens and the ways in which they represent the changes in the video signal. The raster of the monitor covers the entire surface of the screen all the time. The oscilloscope electron gun moves in only one line – from right to left. When a video signal is fed into a monitor, the monitor registers changes in the video signal as changes in contrast and brightness on the monitor screen. Contrast and brightness would go unnoticed on the screen of the oscilloscope since the contrast and brightness change of one line of video would fall directly on top of these changes in the preceding and following lines. Therefore, the oscilloscope registers changes in the video signal by causing the electron beam to jump off its scan line in direct proportion to the changes in the video signal. A completely black video picture would cause no jumps and the oscilloscope would register a straight horizontal line. Most video pictures have varying areas of contrast, which, if there is movement, rapidly change in position. The sync signal shows up as a regular series of lines below the video. This is because sync is a negative voltage and doesn't (or at least shouldn't) vary in voltage like the video signal.

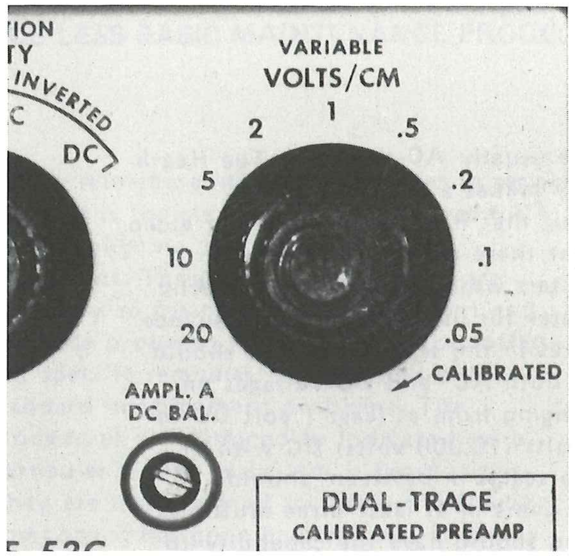
Because of retention of vision, your eye sees not a series of jumps but a jagged line from one side of the screen to the other. If there is no movement in front of the camera (on the tape) then the jagged lines remain unchanged.



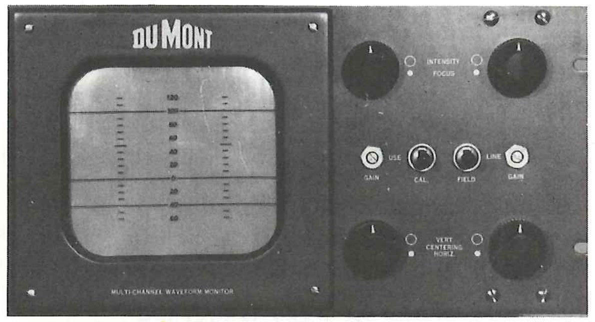
When movement occurs, these lines of the video signal ripple as a result of the changing light and dark areas (voltages) seen by the camera.

Not all oscilloscopes are capable of displaying video and sync. The main requirement of a scope for video work is that it be capable of displaying the range of frequencies necessary to make the required measurements. This includes not only composite video, but also some of the RF signals of the video recorder. This frequency sensitivity range is called the *Band Width* of the scope. The band width necessary for working with video equipment should be somewhere around *10MHz. Hz* is the abbreviation for Hertz and means cycles per second. The *M* stands for the prefix *Mega* which means 1,000,000.

There is also a minimum voltage to which scopes should be sensitive. This is referred to as the *sensitivity* of the scope. A scope used in video maintenance and repair work should have a variable sensitivity scale between at least 0.1 volts and 10 volts.

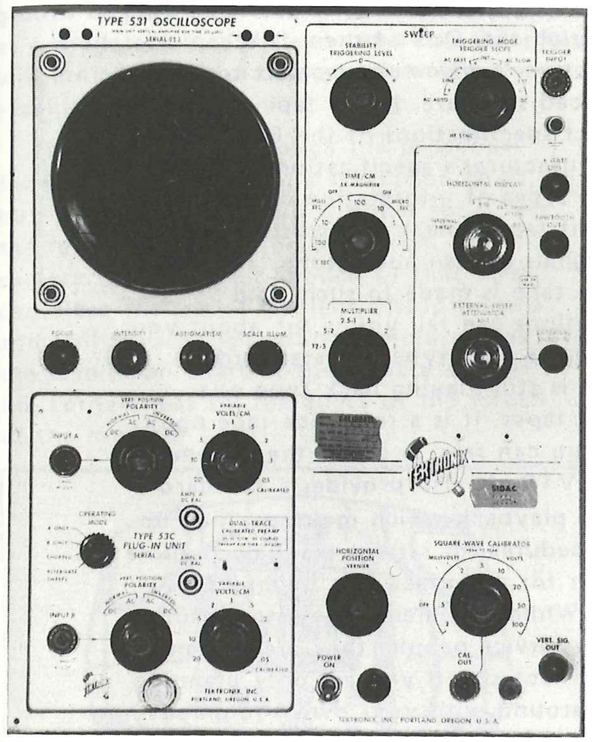


A *video wave form monitor* is simply a specialized scope.

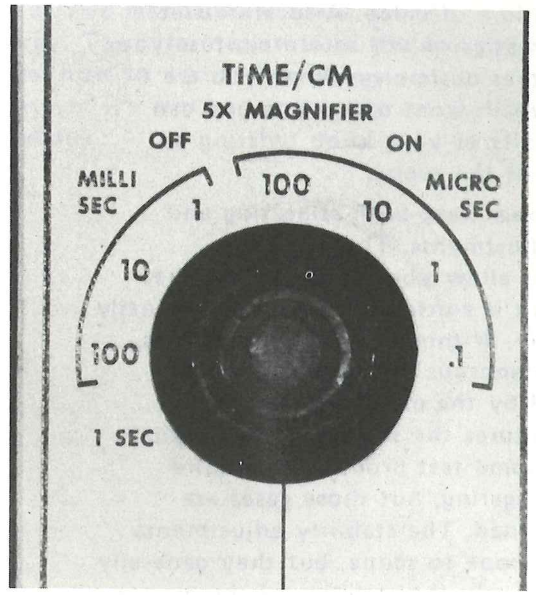


It is set up to display composite video by field, frame, and line. It can give valuable information in production and editing systems but is limited in repair work because wave form monitors often have neither the sensitivity nor the band width required to perform all the maintenance procedures.

Oscilloscopes come in all shapes, sizes, and levels of complexity.



However, all of them have certain things in common. First, you can set the sensitivity scale to utilize the desired amount of the surface of the scope screen. You can also set any scope up to display the desired amount of information across its screen. To do this you have to select an amount of time for each complete sweep of the scope's electron gun across the face of the screen. By selecting an amount of time within which the desired portion of a signal is fully completed, (like 1/30 of a second for a frame of video), you can see the amount of information you desire. For this selection, there is a time selection knob.



This knob is usually indicated by the label *Seconds* or *Time per Centimeter* and is gradated in *milli-* and *microseconds* (1/1,000 and 1/1,000,000 of a second respectively). Most scope screens have a grid of thin lines over the face of the screen. The boxes of this grid are 1cm. x 1cm. They are of great aid when you are measuring signals for both strength and duration.

For example — if you want to look at one frame of video at a time. Most video signals are about one volt or more. The sensitivity of the scope should therefore be set at less than 1 volt/cm in order to use most of the screen. The time setting is a matter of logic. Each full frame takes 1/30 of a second or 0.03 seconds. This means that the entire sweep of the electron gun must take at least 0.03 seconds. Therefore, you should set up the scope on the time scale closest to 0.03 seconds. The time scales on the scope are set for micro- or milliseconds *per Centimeter.* The grid on the face of the scope shows that the scope screen is more than one centimeter long — the grids on many oscilloscopes are ten centimeters long. Putting all this together, if you set the scope on the 500 microsecond per centimeter scale and there are ten centimeters on the face of the scope, then the total time for each sweep of the electron gun is 5,000 microseconds. To convert microseconds to seconds, multiply by 1/100,000. The result is 0.05 seconds, or just a little bit more than the time necessary to display a full frame of video at a time. The same procedure is applicable to setting up the scope to display both a field and a line of video. Also, don't let the mathematics of this set-up confuse you. It all becomes quite clear when you are sitting down in front of a scope and can see the results of your knob twisting on the screen of the scope.

Most scopes have both triggering and stability adjustments. The triggering adjustments allow you to select how the electron gun is controlled — either externally or internally. Within those two categories, there are numerous categories which are determined by the manufacturer. For most procedures the scope can be internally triggered. Some test procedures require external triggering, but those cases are clearly outlined. The stability adjustments vary from scope to scope, but they generally control not only the stability of the gun as it sweeps across the screen, but also whether or not the screen is swept at all.

Many of the knobs on scopes are stacked, that is, there is an outer knob and an inner one, each performing a different function. These knobs are clearly labeled if you are aware of them. This labeling is most often done by having the label and the specific section of the knob the same color. Scopes also have horizontal and vertical positioning controls with which you can place the sweep of the electron gun.

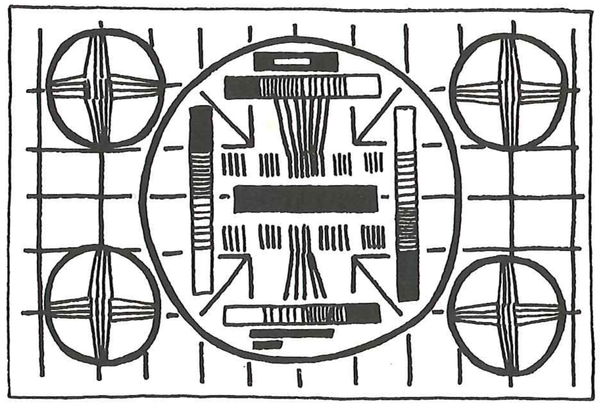
For every individual service procedure in a service manual where a scope is required, the manual lists the sensitivity, the time per centimeter, and the test point at which the scope must be used. If not otherwise stated, the scope can be internally triggered. Also, the waveforms on the schematic or block diagrams give both sensitivity and time settings.

An oscilloscope is a sophisticated piece of electronic hardware. Scopes can measure anything from heartbeats to signals from the stars. What has been presented in the preceding few paragraphs are some of the things that the scopes used in video work have in common. Oscilloscopes are not spacecraft; they are tools used in the everyday repair and maintenance of video equipment, but they take some getting used to. One way to do that is to find someone who has, and knows how to use, an oscilloscope and spend some time practicing with him. If that's either impractical or impossible, check the book shelves of an electronics store for paperbacks on how to use an oscilloscope.

There are three other pieces of test equipment about which you will probably hear if you get involved with servicing your own equipment. One of them is the *manufacturer's alignment tape.* It too is high priced software. It is a tape made to the exact specifications of the EIAJ (or the manufacturer's specifications). There are four types of information on most alignment tapes (black and white) — three video signals and an audio tone. The fact that this tape is made to such rigid specifications can tell you a lot about your VTR, i.e., if your type one standard machine is still playing back type one standard tapes. It is a reference tape upon which you can rely to check the alignment of your VTR. It also provides a standard signal in playback which makes writing up test procedures for service manuals a whole lot easier for manufacturers' technical writers. While alignment tapes are useful to full time service people, they are not an absolute necessity if you are only planning to fool around with your own equipment now and then. A tape that was recorded without apparent technical foul-ups (tracking errors, crinkled tape, etc.) under good lighting and with audio when the VTR was *NEW* is just about as good as a test tape for most minor technical set-ups.

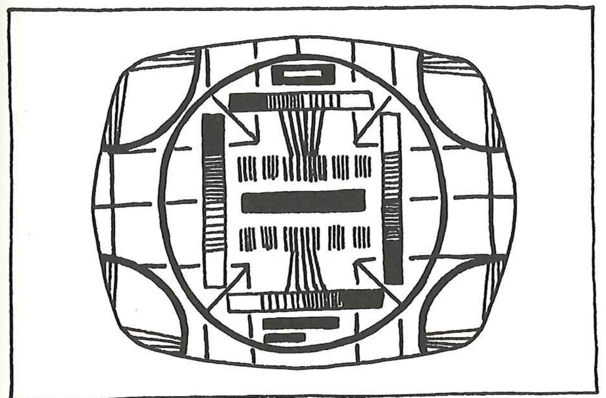
Another piece of test equipment you may hear about is a *frequency meter or counter.* Frequency meters measure the frequency of whatever signal is being fed to them. Most modern meters give digital readouts like the multi-meters mentioned earlier. The service manuals tell you when a frequency meter is needed and where and what to measure.

The last common piece of test equipment is the *camera resolution chart.*



A good resolution chart actually has provisions for measuring not only picture resolution or definition of the camera, but also contrast and linearity. Resolution is measured by groups of vertical lines which are spaced at a predetermined distance apart so that they will indicate various degrees of camera resolution.

The manuals go through the procedure for camera set-up using a resolution chart, but it won't hurt to run it down again. Set the resolution chart (5-15 ft) from the camera. Light it well enough so that you can close the iris of the lens a stop or two and still have a high contrast picture. Next, frame the resolution chart in the camera so that the corners just fill the edges of the screen of the monitor.



Focus the camera as well as optically possible, then adjust the electronic focus if the picture still isn't as clear as you'd like it to be. The group of lines closest together but still distinguishable is the measurement of the camera resolution. Portable cameras should resolve about 350 lines on a good monitor. Next, use the target and beam adjustments to set the contrast of the camera output to the grey scale on the chart. The service manuals will probably provide you with exact voltages for these settings but as often as not your eye can tell you as much as your multi-meter. Be sure that the monitor you are using is also properly adjusted or you will be running around in circles. The last part of the camera set-up using the resolution chart is the linearity check. If the circle at the center of the chart or any of those at the corners are distorted (eliptical rather than round), then you can correct that distortion by diddling with the horizontal and vertical linearity and center controls. There are some resolution charts which don't provide linearity tests, so if you are in the market for a test chart make sure you get one with resolution, gray scale and linearity.

Repeating all the information that's in the service manuals would be a waste of energy. The information is all there if you know how to use it. And that, for whatever it's worth, is what this manual is all about.

Broadcasting and Cablecasting Half-Inch Tapes

It is technically possible to cable- or broadcast any 1/2" tape. The obstacles currently limiting 1/2" video producers from using cable and the airwaves are primarily due to policy decisions of management and unions involved. The technical drawbacks of 1/2" tapes are often presented as the stumbling block in order to cloud the real issues involved. So, it is important to have a working knowledge of the options available for the interface of 1/2" equipment with cable and broadcast hardware if you want to show tapes and do live origination on those media. Much of the hardware and many of the processes have already been covered in other sections. This section reviews that information and adds some new ideas in order to focus on the specific requirements of cable and broadcast interface.

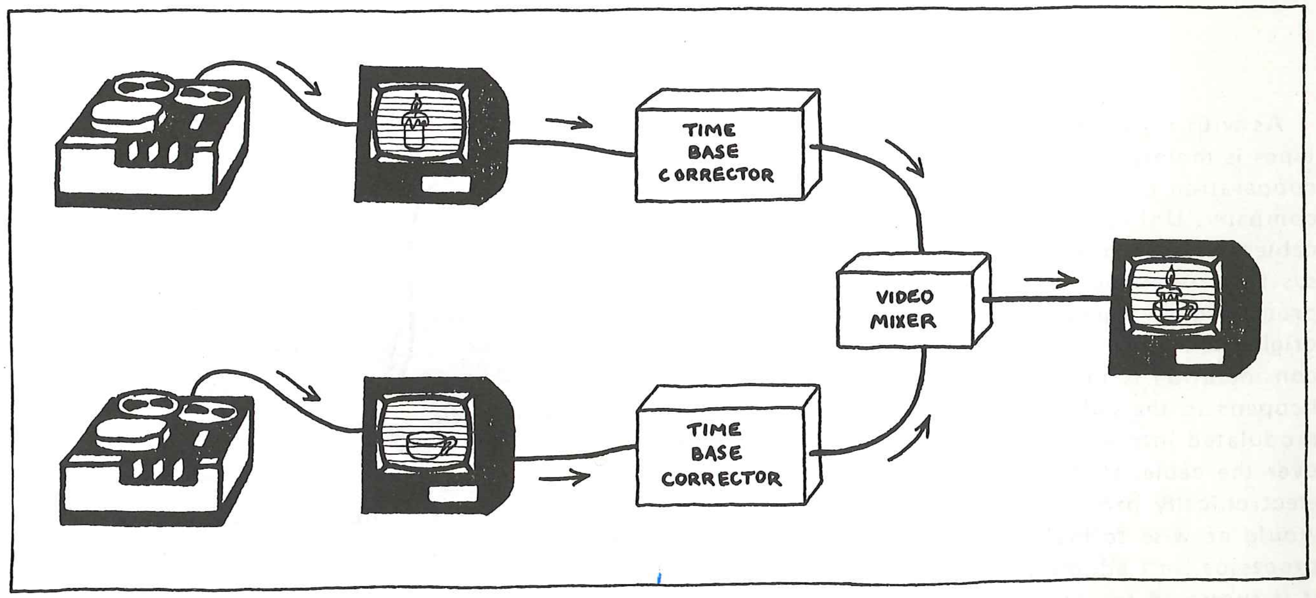
The Federal Communications Commission sets rigid technical standards to which every licensed station must adhere. These standards govern, among other things, the stability of each station's signal. There is no 1/2" VTR presently being made that can meet the FCC stability regulations. The problem, then, is to transfer the 1/2" signal to some format which meets FCC requirements. The most common method of performing this transfer is scan conversion. This usually involves pointing a camera from the TV station at a monitor on which the tape to be transferred is being played back. The audio can be transferred directly from the line level output of the VTR. Once this system has been set up, the signal from the camera can be recorded on a 2" quadruplex (quad) broadcast quality VTR (or onto any one-inch VTR which meets FCC standards). It can be sent directly out over the air.

The problem with this system is the same as with any scan conversion system, i.e., a noticeable loss of quality on the transfer. Also, problems may arise when certain tapes are played back on the TV studio monitors. These monitors have excellent overall picture quality but are sensitive to any instabilities. Any technical problems with the 1/2" tape may cause rollovers and other undesirable interference that might not appear on monitors designed to display 1/2" tapes. The decision as to which monitor to use should be made after testing both types of monitors.

Most scan conversion transfers have a type of interference which shows up as light and dark bands or flickering running through the picture. This interference is caused by the conflicting scan rates of the playback VTR and the recording camera in the studio. The 1/2" VTR tends to vary a bit around its base frequency, while the studio camera remains absolutely stable.

Some studios have extremely sophisticated scan conversion equipment. This equipment eliminates most of the frequency difference interference by using electro-optical processes which minimize the picture loss due to the transfer. But any scan conversion transfer leaves a lot to be desired.

The best way to broadcast 1/2" tapes would be to correct the problems in their basic stability and re-record them on quad VTRs (or feed the corrected signal directly into the transmitter modulator). This has just become possible although the equipment to accomplish it is neither cheap nor readily available. Presently, the most common way to do this is to use a quad VTR made by Ampex called the AVR-1. The AVR-I will accept the direct video and audio signals from many 1/2" tapes. Processing circuits in the AVR-I make the transfer possible. There is no guarantee that the transfer can be made every time with every tape. The results are varied. The AVR-I will generally accept 1st generation 1/2" tapes played back on properly aligned 1/2" studio VTRs. It will also transfer many 1/2" tapes edited on 1" editing VTRs. Edited 1/2" tapes have had mixed results depending mostly on the quality of the original tapes and the condition of the 1/2" editor.



Quad VTRs on the 525 line system are standardized. If you have a tape successfully recorded on an AVR-1 you will be able to play it on any other Ampex or RCA quad VTR. RCA, the other major manufacturer of quad VTRs, will probably come out with an equivalent of the AVR-1 in the near future.

Only recently some companies have started to introduce equipment which equals or betters the processing elements of the AVR-1. This piece of hardware is called a time-base corrector. The time-base of a VTR is a measure of the speed at which the VTR can compensate for the mechanical and electronic variables which arise in playback and record. The time base of a VTR is one very good measurement of its stability. With the exception of a few very expensive 1" VTRs, only 2" quad VTRs used to have a time-base quick enough to allow them to meet the FCC stability requirements. The first time-base correctors produced were designed to work for the relatively slight time base errors of the more sophisticated 1" VTRs. These time-base correctors wouldn't work with 1/2" VTRs. Now one company is demonstrating a time-base corrector that will work for many 1/2" tapes. Once the time-base of a 1/2" VTR's output video signal has been corrected, there is no obstacle to transferring that output to a quad VTR or, for that matter, to mixing that output with another time-base corrected 1/2" signal in a special effects board just as if the output of each 1/2" VTR were a camera.

Back here on earth, time-base correctors are still largely untested with 1/2" equipment but they will undoubtedly play an important part in the future of low-cost video technology.

The final factor in the transfer of 1/2" tapes to quad VTRs is the cost. Two inch tape costs 5 to 10 times as much as 1/2" tape. An Ampex AVR-1 costs well over $100,000 and broadcast studio time is in line with these hardware costs. Also, most but not all TV studios have contracts with the various technical unions. The unions make certain demands on the management in order to protect what they feel are their best interests. In many cases this union involvement excludes 1/2" video producers from taking any active part in the transfer of the tape (this includes threading the 1/2" VTR). This is in spite of (or because of) the fact that many of the broadcast technicians may never have seen 1/2" equipment and might not have the slightest idea of how to use it. The unions may also prohibit the station from showing any non-union produced programming except when it falls into certain financially determined categories.

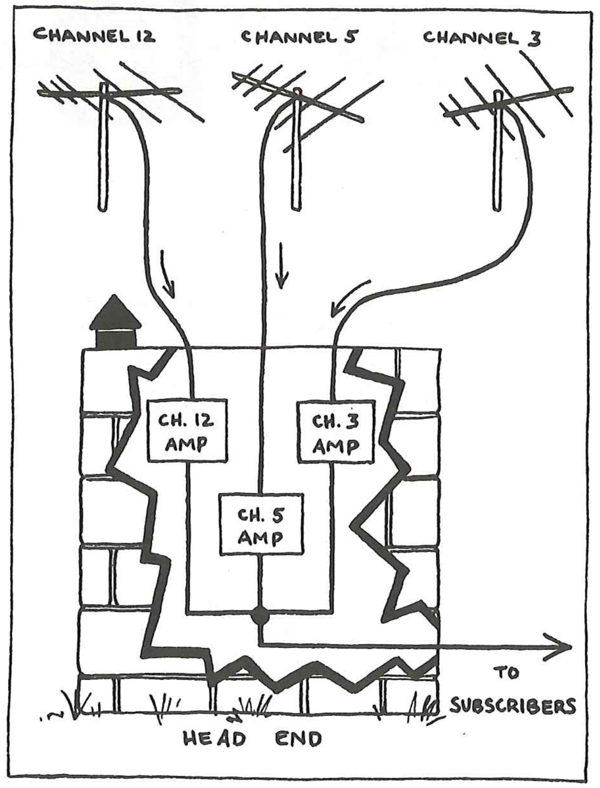
At this point relatively few people have had any experience in broadcasting 1/2" tapes. As a result there is very little practical information on the subject. There are also very few pieces of equipment specifically designed for the interface of 1/2" to quad VTRs. But this situation is rapidly changing and within the next few years 1/2" tape will be regularly used in the broadcast industry.

As with broadcasting, cablecasting 1/2" tapes is mainly a matter of gaining the cooperation of the management of the cable company. Unlike broadcasting, the costs of cablecasting are relatively low. Many cable systems are already originating their own programming. Plugging into an existing origination point is simple. The only consideration is that you should know what happens to the video signal before it is modulated into an RF signal and sent out over the cable. If the video is being electronically processed in any way it would be wise to make sure that the processor isn't adding more problems than it is supposed to correct. Many cable stations use 1" equipment and their proc amps are adequate for their own hardware. But many proc amps designed for 1" hardware will not work for 1/2" tapes. A visual check of the video signal just before it reaches the modulator will tell you whether or not there are any problems (watch for excessive jittering or tearing in the picture). If there are problems, then whatever auxiliary video hardware is in the line between the VTR and the modulator should be eliminated.

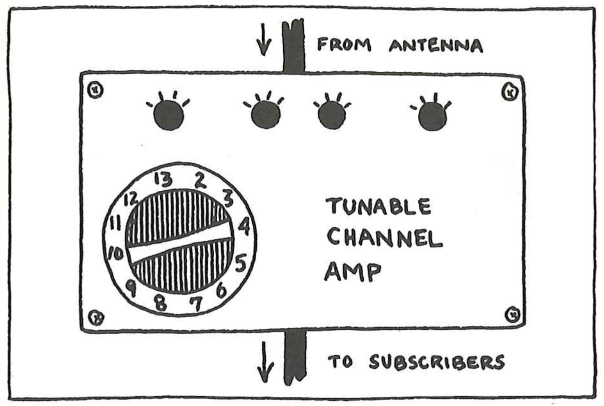
Many cable systems have only a weather scan (thermometer, barometer, etc.) or a message wheel for their origination. The audio is usually from a local radio station. The video and audio are modulated to the frequency of one of the cable system's unused channels and sent to all the subscribers on that channel. That video and audio can just as easily be the output of a 1/2" VTR either in playback or in E to E mode (for live origination).

Most cable systems do no local origination. However it is extremely easy to hook any VTR into any cable system with a few minutes of help from the person who maintains the system. Most systems not originating programming won't have access to a video/audio modulator. So the only other piece of equipment needed is the RF unit that can be gotten for any EIAJ 1/2" VTR.

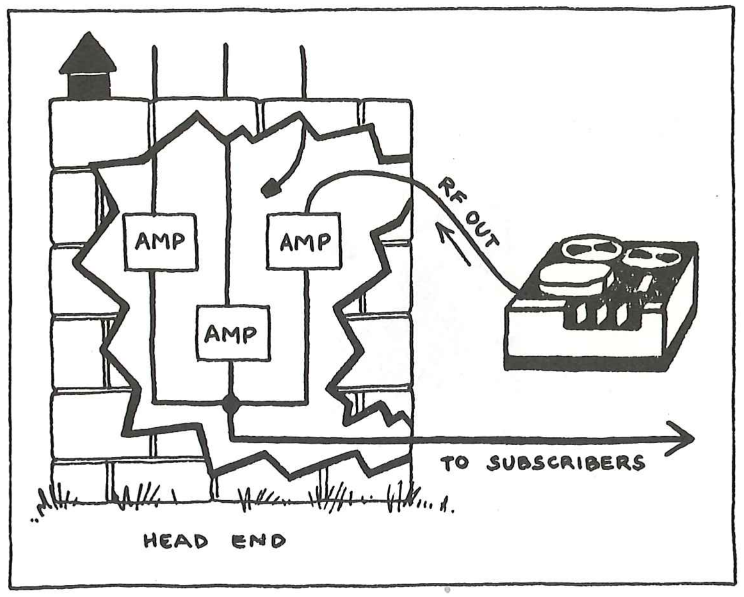
Broadcast TV signals are received at the cable system's antennas. These signals are sent to the nearby headend, usually a small pillbox type of structure. In the headend are individual channel amplifiers, one amp for every channel supplied on the cable.



After each of the incoming TV signals is amplified, they are all mixed and sent out over the cable to subscribers' homes. In many cable systems, the individual channel amps have tuners just like the ones found on any regular TV set. The tuner is used to select the channel that the amp will amplify. Usually the tuner can select any of the VHF TV channels (2-13). The output of each amp is set at the factory to a specific channel.



To connect a 1/2" VTR into a cable system with tunable amplifiers, simply disconnect the input to one of the amps and connect the output of your RF unit to the amp. Then, tune the amplifier to the channel at which your RF unit is set. Once this is done, the signal from the VTR via the RF unit should be on the cable on the channel at which the amp's output is set.



A lot of small systems don't use tunable amps. To hook into this type of system you need an RF unit that corresponds to one of the channel amps at the headend. The process for hooking into the system is the same. Just disconnect the existing input and substitute the output of the VTR's RF modulator for that input.

Most cable systems carry network duplicates. This means that often two channels on the cable have the exact same programs. This duplication time is ideal for disconnecting one duplicate and plugging in local programming.

Someone who is familiar with the technical set-up of the system is necessary in order to see that the output of the origination amp is balanced in relation to strength of the other signals on the cable. This is done by using a Field Strength Meter which measures the RF signal strength on each channel. A cable technician can also help out with the match-up of cables to adapt the output of the RF unit to the input on the amp. Once the cables are made and the RF levels set, there shouldn't be any other problems with cablecasting — provided the tape and live signals are of reasonable quality (no tracking errors, audio buzzes, etc.).

The above systems presume that the origination and headend points are the same. This need not be the case. Almost all cable systems now being built and many of those already in operation have provisions for two-way systems. Very few of those systems are actively engaged in two-way communications over the cable even though they have the capability. One of the reasons for this is that the amplifiers in the cable runs are only capable of passing signals in either direction when a special module is plugged into each amplifier. And the cable companies haven't bought these modules because there is little or no demand for two-way service. With the addition of these modules and with the proper RF modulation gear, anyone connected to the cable can also originate programming to any and all other cable hookups.

Cable origination is an accepted fact. And, while there are always individual questions to be answered for each separate system, the fact that a cable system exists means that it is capable of delivering locally originated programming.

Epilogue

THE PRESENT

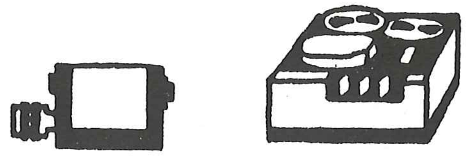
Every VTR manufacturer is "planning" to introduce new equipment . . . all the time. But there is a long wait between the plans and the reality. Models and machines don't change too often. Rather, they undergo some subtle changes which incorporate whatever technological advances are necessary to meet the competition but which avoid costly retooling programs.

Through competitive pressures (and to a lesser degree, user demands) new pieces of equipment eventually reach the market. However, bringing out a new piece of hardware almost always means that the company involved discontinues an old one. Such was the fate of the Sony AV-5000. The same thing will happen soon to the Sony AV-3400 and to many other VTRs of other manufacturers. The problem is that, to avoid what they see as a panic among current and prospective customers, the manufacturers keep this type of information top secret. It's hard to find out about a particular model after it has been discontinued.

A Partial List of Currently Available VTRs

All of this is an introduction to this list of some currently available VTR equipment. Obviously, given the above situation, this list cannot be entirely valid for too long. Also, this list should not be construed as a recommendation of what to buy. The comments accompanying the pictures are simply reflections of the experiences (albeit limited in some cases) which we've had with what's listed.

Sony AV/AVC-3400



Perhaps the most revolutionary piece of video (electronic?) equipment ever developed. What makes it work and not work is, by now, pretty well known. Supposedly it will be supplanted in the Fall of 1973 by the AV-8400 – a color capable portable. The AVC 3400 is the most rugged portable camera ever built for general consumption. It hasn't been through any basic changes since 1968. The AVC 3400 will be sold with the AV 8400 until the advent of a low-cost portable color camera.

Panasonic NV/WV 3082

Panasonic's answer to the Sony portapak. Still largely untested. Sony has had three more years of experience but Panasonic has more sophisticated engineering. The Panasonic portable VTR and camera have plastic cases. Because of this they are lighter than the Sony but the ruggedness of the plastic is still a question. The tape path is very easy to thread and the controls are accessible and easy to operate. With the addition of an outboard AC operated box the VTR will record color. The camera is black and white but the viewfinder monitor is larger than Sony's. The first user reports are mostly satisfactory.

Sony AV 3600

Lightest AC operated record/playback machine available (33 lbs.). All newer models have built-in selector for AGC or manual audio level control. It's very rugged. Black and white only.

Panasonic NV 3120

The first 1/2" standard color VTR with a built-in dropout compensator. It's proven to be fairly reliable and rugged. Panasonic VTRs all seem to have a slightly worse S/N than Sony, at least in black and white. 3120 has manual and AGC for both video and audio levels.

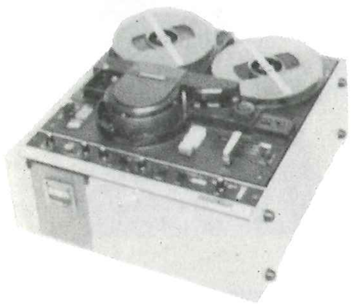
Sony AV 8600

First of the 8000 series by Sony. Standard (as are the Panasonics) with other 1/2" VTRs now being made (the Sony AV 5000 color disaster wasn't standard with anything). Manual/AGC control for audio only.

Sony AV 3650

The first 1/2" VTR that was widely available for editing 1/2" tapes. It's had a lot of false starts and bugs. It's greatly improved since the first models but still leaves a lot to be desired. Frame to frame editing. Black and white only.

Panasonic NV 3130



Color and black and white frame to frame editor. In keeping with the general Sony/ Panasonic rule, the Panasonic 3130 has more sophisticated electronics but a slightly worse S/N than the Sony AV 3650. Edits seem to be generally cleaner on the 3130 than on the 3650. 3130 also has insert editing and dropout compensator. Some early models had overheating problems. Seems to have been reasonably de-bugged by this time although some users still dissatisfied with audio problems (same with Sony 3650).

Sony VO 1600
Panasonic NV 2125
and others

3/4" cassette. Sony started it. Everybody markets it. It represents the worst in regressive, counter-productive technology. A new format is not necessary (Sony is already responsible for six different ones — none of them standard with the others). It eats tape. You can't edit with it. It's bulky and foolish. Sony's marketing power might make it prevail over the forces of reason.

Panasonic NV 5125

Largely untested cartridge machine. The claim is that you can put any half-hour 1/2" type one standard tape in the cartridge, add a special leader to the tape and this VTR will thread itself automatically each time thereafter. There is a dial access mechanism for cuing up any spot on the tape. This could be a very convenient way to record, play and store tape. It's a very good idea anyway.

There are other manufacturers of 1/2" video equipment besides Sony and Panasonic. Shibaden and JVC (Japanese Victor Corp.) are just two. But these other companies have neither the marketing nor the service structure of Sony or Panasonic. Therefore, their equipment is much less widespread and information about them is much harder to come by. Also, there are a number of companies which market but don't manufacture 1/2" video equipment. Ampex and Concord are two of these. Akai makes 1/4" VTRs — including a color portable. The resolution on 1/4" is however much lower than on 1/2". Both Panasonic and Sony make 1" VTRs as do IVC (International Video Corp.), Ampex and others.

Addresses of Some VTR Manufacturers

The following is a list of the central offices for some of the companies making and/or marketing VTR equipment. Many of these companies also have regional offices.

Sony Corp.
47-47 Van Dam St.
Long Island City, New York 11101

Panasonic
(Matsushita Electric Corp.)
200 Park Ave.
N.Y., N.Y. 10017

Shibaden
58-25 Brooklyn-Queens Expressway
Woodside, N.Y. 11103

JVC America
58-75 Queens Midtown Expressway
N.Y., N.Y. 11378

Akai
6 Kilmer Rd.
Edison, N.J. 08817

Audiotronics
7428 Bellaire Ave.
North Hollywood, Calif. 91605

IVC
675 Almanor Ave.
Sunnyvale, Calif. 94086

Ampex
401 Broadway Ave.
Redwood City, Calif. 94086

Concord
470 Park Ave. South
N.Y., N.Y. 10016

Javalin
63-57 Arizona Circle
L.A., Calif. 90045

Suggested Reading List

1. *The Physics of Television*
by Donald G. Fink and David M. Lutyens
Anchor books, Doubleday & Company, Garden City, New York, 1960

2. *The Television Signal*
by Robert Pfannkuch
Audio Video Industries, Inc. 217 Westport Ave., Norwalk, Conn., 1968

3. *The Radio Amateur's Handbook* and the *A.R.R.L. Antennna Book*
by the American Radio Relay League, Newington, Conn., 06111 (published yearly)

4. *Popular Electronics*
Ziff-Davis Publishing Company, 1 Park Ave., New York, N.Y. 10016
(subscription office – P.O. Box 2774, Boulder, Colo., 80302)
(published monthly)

5. Sony Service Manuals – Videocorders (VTRs), video cameras and Videocorder accessories, *Sony Service Bulletins* and *Sony Technical Digest*
Technical Publications Dept., Sony Corp. Of America, 47-47 Van Dam St., Long Island City, New York, 11101
(*Service Bulletins* and *Technical Digest* published monthly)

6. Panasonic Service Manuals
Matsushita Electric Corp. of America, VTR Sales Dept., Special Products Division, 23-05 44th Road, Long Island City, N.Y.,11101

7. *Introducing the Single Camera System*
by Grayson Mattingly and Welby Smith
S&M Productions Ltd., Box 31095, Washington D.C. 20031, 1971

8. *Closed Circuit Television Handbook*
by Leon A. Wortman
Howard Sams & Co., The Bobbs Merrill Co., Inc., Indianapolis, Indiana 46206, 1964 and 1969

9. *Electro-Voice Microphone Primer*
available from: Electro-Voice Inc., Buchanan, Mich. 49107

10. *Video Tools*
published by CTL Electronics, 86 West B'way, New York, N.Y. 10007.

THE FUTURE

This manual is incomplete. It may also be somewhat out of date by the time it goes to press. Both of these facts simply reflect reality and are not necessarily drawbacks. The industries which produce low-cost video equipment, having come to at least some temporary agreements on standardization, are now in a healthy state of flux (competition might be a better word). The best piece of video equipment today may be practically obsolete next week. This is a frustrating situation but it is also an exciting one because it is becoming increasingly clear that this technology is only limited by the demands of its users.

TV will soon be a tubeless technology. But defining the future of TV as tubeless is like talking about the car as "horseless" – what it won't be instead of what it will. So what it will be is very simple, very rugged, very colorful and very, very different. Predicting specifics would be foolish. The technology is moving too fast. It is possible to survey the present capabilities of the technology. And because practical applications are always far behind the latest discoveries and and developments, these capabilities represent a curious mixture of the present and the future.

Solid state cameras the size of a transistor radio are already in production. They are full color and can be made much less expensively than most tube cameras (black and white or color). They will soon be available for use with VTRs (the only problem right now is a limited resolution). They will work in light levels from practically dark to direct sunlight. Flat screen, solid state monitors can also be made and will be comparable to the cameras.

A VTR with a fixed head has already been demonstrated. For the moment, magnetic tape still seems to be the most viable form for the storage of video and audio information. Eventually, most VTRs will use some sort of cassette. Video discs will probably be the most popular form of home playback equipment – if such a market exists.

All signal interchanges among camera, monitor and VTR can be done through the airwaves (10-pin cables will make nice clothes lines). The sight of skies polluted with cables could disappear. Cable TV systems, antennas and all, can be made to fit into a suitcase. Small, inexpensive TV and radio broadcast stations can provide local programming to electronically isolated areas.

Service will eventually be a matter of throwing away the defective camera, monitor or VTR and buying a new one. Thus a new form of pollution would be created greater perhaps than the spaghetti jungle that now exists. And there is still a greater danger. This is the same wonderful technology that brought you bombs guided by video cameras, wiretaps and other forms of covert surveillance. It brings you broadcast TV and Muzak. It collects your money. It has your name, address, telephone number and now your picture and voice.

This technology has provided us with tools that are at the same time exciting and frightening. If we are to use these tools it is essential that we understand their very nature.

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