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ABSTRACT

Designed and intended for persons with very little capital and minimal technical background who are just beginning to use television expressively or expand existing facilities, this paper discusses in detail the basic technical considerations that must be met before setting up a small television studio. It includes some operating and design principles, some adaptations of equipment with schematics, and short critiques of certain commercially available equipment. (Author/MC)

SUGGESTIONS TOWARD A SMALL VIDEO FACILITY.

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Suggestions Toward a Small Video Facility

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This paper is intended both for those with very little capital and minimal technical background who are just beginning to use television expressively, and those with a facility facing expansion. It includes some operating and design principles, some adaptations of equipment with schematics, and short critiques of certain commercially available equipment. It should be noted that the latter information reflects only the Center's experience and should be evaluated by the reader in that light. The Center's video mixing/processing facility, one of the most important components of its system, was described by its designer, Lawrence W. Templeton, in a paper included in the first Reports series. Audio equipment is not evaluated here; that is a paper in itself.

I. SYSTEMS APPROACH

If you anticipate expanding your facility at all in the future, it would be wise to think at the outset in terms of

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Richard Stephens was the Center's first maintenance video engineer. His background includes circuit designing and broadcast television equipment maintenance, most recently for the Munich Olympics. Don Hallock, a video artist, has a professional background in education and commercial television as a cameraman, producer and director and was the initial organizer of the Center's technical/production facility.

the entire technical system you plan to have. This does not require drawing up a detailed long-term purchasing plan, only realizing that any technical system -- especially with the small, non-broadcast equipment most experimenters use -- cannot simply be added to quantitatively. If you think only in terms of single products accumulated bit by bit, it may become difficult to integrate these products into a working system. Each new piece of equipment should be purchased not only in terms of what it can do for your present needs, but also for what it can do (or won't be able to do) in the system you'll evolve over time. What you buy now will affect what you will or won't have to buy later, and in some cases what appears economical in the short term may cause you to spend more money in the future. Several years ago at the Center, when there was no model for an experimental television facility and fewer products available, equipment was purchased with little thought to systematic expansion. The result was a mass of cables and wires and a system whose real basis was inadequate, most of which was torn down and the entire facility rebuilt. This is therefore being written in retrospect, to help others plan in a thoughtful way. If you take this approach, there are certain basic areas we suggest covering in the beginning.

1. <u>Sync Generator</u> (synchronizing pulse generator). If you would eventually like to have more than one camera, mix tapes, or mix more than one video source, you should have a synchronizing generator as a basic component to your

system. You will need this to keep parts of the system in step with each other. The generator provides pulses to drive the scanning system of cameras and monitors. You can think of it as the heart of the system (the pulses are the beats), feeding the beats through the whole system. Or, another way, as the drummer for your machine band. In the past, sync generators have been very expensive, but Sony has a color sync generator selling for approximately $1000. and Cohu has one for $750. We suggest you bypass black and white sync generators and, if you can, buy the color. You'll probably want color eventually, and if you start thinking in color terms now you'll avoid some problems later, only one of which is an outmoded black and white sync generator. A black and white generator cannot be used to make color video but a color generator will make black and white. If you know a design engineer familiar with integrated circuits you can buy a color sync generator on a chip (Fairchild SemiConductor; #3261DC2) for $47.00, and for several hundred dollars build in power supply, interface amplifiers, etc. and construct your own sync generator.

2. <u>Standards</u>. Certain consumer lines which are very inexpensive tend not to conform to any generally accepted electrical standards whatsoever. Purchasing equipment with matching standards is one of the most important keys to equipment integration for production. This means 1 volt

peak-to-peak signal systems with 75 ohm impedances, and color equipment with NTSC standard. There has been a problem in the past with half-inch videotape recorders where, owing to differences in the diameter of the video head drum and of the tape speeds, tapes recorded on one manufacturer's machine could not be played back on another manufacturer's machine. The Japanese have recently set a standard for ½" VTRs, called EIAJ Standard. All new half-inch machines conform, but if you purchase second-hand equipment and plan to use more than one ½" VTR in your system, this is something to check. We also recommend linking your system from the beginning with standard cables and connectors.

3. Cables. Video systems, like any systems, perform best under certain optimum "loading." In order to maintain high-performance throughout the system (a crisp picture, accurate colors, etc.) this has been standardized at 75 ohms, the ohm being the numerical unit of resistance in certain components to the electronic impulses flowing within the system. It is a unit of "impedance." It is very important to match impedance values as closely as possible throughout your system to avoid loss of frequency response, picture rejection, interference due to reflection (ringing-echoing in the picture), level losses, and worst of all, color shifting. There are all sorts of surplus markets that sell coaxial cable, but be sure when you

purchase it that it is 75 ohm impedance. One very large roll of cable, about 1000 feet, is a good beginning for a system. Specific recommendation: Belden 8281 cable. It is a bit more expensive than other 75 ohm cables, but it seems to be standard throughout the industry. The cost for 1000 feet of such cable will be $200-$250.

4. Connectors. Up to now UHF has been the standard video connector, and you will find many products considered broadcast quality that still have these connectors. However, it seems that industry is now changing to a connector known as BNC and we recommend starting your system with this type of connector. With the 8281 cable and BNC connectors you will be in a starting place where at least you have matched impedances and have a standard compatible with other equipment. Where there is equipment at hand with both kinds of connectors, adaptors should be kept handy for ready interconnection. By buying in lots you will get a definite price reduction. For example, in lots of 25 they cost 75¢ each; individually, $1.00. One hundred of these connectors and adaptors is probably a good initial purchase for a system. There are two ways to attach connectors: by soldering, or with a connector crimping tool. If you are planning a system of any size at all, we recommend the latter. The price of a crimping tool is $75 to $80; however, it is a one-time investment and makes a fast, good connection. If you have time, and like to give

your gear leisurely and loving attention, soldering is a mellow pastime, and if you are any good at it it is the least expensive way to attach connectors.

5. Patch Panel. Even if you have a very small system, you must have a way to get signals from one place to another. There are two ways to go about this. You can get a handful of BNC connectors and make up short lengths of cable with connectors on each end to connect one thing to another. But if the system is to become larger and have any complexity at all, it is almost necessary to have some sort of patch bay, a connector-board on which all inputs and outputs to all major pieces of equipment appear permanently. This is very simple to build. All you have to think about is outputs and inputs -- where you want outputs to be able to be patched and what inputs you want readily accessible. All these should appear on the front surface of a panel fitted with appropriate connectors on the panel which can be hooked together with a short bit of cable (a patch-cord). Professional video patching equipment is outrageously expensive, but the equipment is foolproof and easy to work with.

6. Used Equipment. There are some companies which specialize in second-hand equipment, and these can be scouted. Buying used video gear has the same pitfalls as buying second-hand cars, toasters or anything else: it may help you to have someone with expertise to advise you on the

purchase. Other places to check are local broadcast stations, both public and commercial. Often they have discarded equipment, patch bays (the Center's came this way), cable, all sorts of things. If you can rummage through their outmoded equipment you may find that what is outdated for them is quite appropriate to your needs. You can remind them it is a tax write-off, as well as a gift to be noted in FCC license renewal applications.

II. PHYSICAL FACILITY

The physical situation into which you put your equipment is obviously more than a space, and unless you are well endowed there are compromises that must be made. But if not chosen carefully, the physical space can become a burden, and you will spend part of each production session working around built-in, unsolvable problems rather than putting your energy creatively onto videotape in the form of images. You will also spend money. The Center has moved three times in its history. Here are some of the parameters we have found useful.

1. Power. Start with 200-300 amps of power. Initially the power requirement will be small, but this is an important place to consider the future; video products, particularly lights, require a great deal of power which adds up very fast, and if you begin with 100 amp service, it may be difficult to add more later.

2. Heat. If you can choose your building, get one with as high a ceiling as possible (12 feet or more). The

reason for this has less to do with space than the fact that lights produce an inordinate amount of heat, which becomes very uncomfortable for you and for your equipment. Evenness of temperature is very important; try to make your room temperature 60° to 80°. This is a much wider range than most broadcast stations maintain. They are controlled at about 70° to 75°, which is ideal. Watch overheating. Equipment tends to drift (change its behavior) quite a bit if it heats up, particularly the transistorized, solid-state equipment experimental facilities have.

3. <u>Dust</u>. Your room should be as dust-free as possible. We would not recommend a room that opens out onto the street. Dust is probably the most damaging element to videotape: it degrades quality rapidly and sends your raw stock costs skyrocketing. The mechanical systems in videotape recorders are also sensitive to dust. Electronic systems in general can short because of dust, and dust mixed with humidity produces alternate paths for electrons and can cause actual electrical breakdowns.

4. <u>Physical Layout and Cabling</u>. Your production space should be large enough to house all your equipment plus all your fantasies. The size of this space varies with the kind of work you intend to do -- working with several freely moving dancers will obviously take more than a simple set up for electronic feedback. The more equipment you can put on wheels -- on rolling tables -- the more flexible

you'll be; you can put together unorthodox arrangements of equipment, which is a basic part of experimental work. If you have very little equipment, there's no need to do this at the beginning, but as your gear becomes more profuse, it saves you and your time (an Ampex 1" tape machine weighs approximately 90 lbs.) The patch panel is central here, having a main connection point so that you can patch signals around without physically having to reconnect all your equipment. When cabling your facility try to put the cable overhead or otherwise out of the way. Roughly divide the space so that you have your tape machines in one area, your mixer in another, your camera arrangement in another. They needn't be separated by a great deal of space. First, figure out how many lines you need, and give yourself a few extra ones. Allow 6-10 feet more cable than you think you'll need for monitor lines and such things. Invariably you'll need that few extra feet at some point. You can always make a few loops with the excess cable and hang it onto something. Label the wires, then decide on some means of ducting or bundling cables. If you have the time you can do trench work in the floor or ducting around the walls, or you can take the group of cables which is likely to come from the mixer and patch panel and run them overhead on a grid made out of pipe to the various tape machine camera and monitor areas. You thereby avoid masses of line on the floor, tripping over cables and toppling monitors, and the maintenance problems that come with injured cables. The grid can also be designed for lighting. Monitor Loops. If you have just a few monitors you can leave wires connected to them all the time. If you have a situation where you are going to want extreme flexibility and quite a few monitors and have a fairly large area to service, then it's wise to run monitor loops, two pieces of coaxial cable going to each place where there's likely to be a monitor or monitor area. One serves as an input line and the other as an output line and you can feed your signal into one monitor, out of it, back to the patch panel and then into another monitor and out of it and back to the patch panel, etc., stringing a group of monitors together without having to reconnect them physically, and terminating them in the patch panel. Systematic cabling is not only faciiitous and straightforward for production, but when something breaks down you have a set of "knowns," and can spot the trouble almost immediately without having to take a pitchfork to a pile of wires.

5. Logs. Keep a log of your technical system. Write down what connections were made. As each cable is connected, put a label on it stating where the cable has come from and where it is supposed to go. This will save no end of trouble when cable gets tangled. (Masking tape is not a good idea; it rips off easily and the writing gets worn off with use.) Number each cable in the house (you can

buy print[illegible] stick-on labels) and transfer that cable nu[illegible] a log. You then have a r[illegible]ord of your system which will help in troubleshooting and will also show you how and where to expand the system.

6. Floors, Walls, Worklights. Floors should be smooth, particularly if your kind of work involves dollying cameras. Cement floors are hard on the feet and legs for long stretches of work, but this can be somewhat alleviated by patches of carpeting in parts of the working area, such as the videotape editing area, where production tends to go on for hours. The floor should be solid, especially if you are sharing a building with any sort of industrial company and/or you're located on a street which has heavy truck traffic. If the building vibrates at all and you do any sort of semi-precise camera work, your production hours will be limited to the middle of the night, holidays and weekends. Often for financial reasons it is sensible to rent space in a warehouse or light industrial area. Try to choose a building where you can make noise, but not one which will subject you to a great deal of it. Walls and ceilings of the room which has cameras and lights should be painted black or some other very dark color. If not, you'll get bounce light splashing off the walls and ceilings and reflecting off the monitor which will not only prevent your truly seeing what you're putting on videotape, but also will actually alter feedback patterns on the

monitor as you move around the room. For this reason, flat overhead lighting is not good; each area should have its own carefully controllable illumination. Artists' video is basically dark room work; the light you deal with in your final work is light radiated off the monitor, your frame is black infinity.

III. CAMERAS

The following is an evaluation of the cameras the Center owns and some suggestions for broadening their abilities:

1. Sony AV-3400/AVC-3400 (Portapak). There are several good black and white cameras on the market for studio use, ranging from $700 - $1,300. However, for a first camera it is not necessary to spend that amount. Sony Corporation makes a product which they trade-name Portapak at $1,500. Portapak is a very small hand-held black and white camera with a 4 to 1 zoom lens, and a very small half-inch black and white videotape recorder. The two units are integral; that is, the VTR has in it its own battery pack, and it also has the option of being plugged into a small AC-to-DC converter. The camera plugs into the VTR and thus derives its power from the VTR. To use the Portapak camera alone as a studio camera, you can build yourself a small converter box that will supply power as well as standard television drive signals and reconvert those signals into drive pulses that will drive the camera to make scans. This will cost about $30 in electronic

components; the schematics (C) are attached at the end of this paper. You will then have one camera that will function almost as two; alone for studio use, or with the VTR as a portable remote camera.

Richard Stephens has also designed a very simple circuit that allows one to monitor the output of the Portapak VTR without looking into the Portapak camera viewfinder. As the Portapak system comes from Sony, the only way to monitor tapes is to look back into the camera viewfinder (about 1"x1½") and play back the tape. This is most unsatisfactory if you want to see what the picture will look like on a bigger monitor. For about $1.50 you can build a very simple circuit that allows the signal to appear on any monitor. This schematic (B) is also attached.

In addition, Sony makes a small television receiver (model 710U, $165.) that receives only air pictures, but again, for an investment of about 85¢ you can cable in through BNC connectors and access the video circuitry so that you can use this television receiver as a monitor, one that weighs only a few pounds and can become part of your remote Portapak unit.

For about $2.00 you can put a transistor circuit into Sony Portapak cameras which will allow the operator to have control over the video gain. This means that you can use that circuit to fade out video pictures to black, a much smoother transition than just turning the camera off. You can fade in from black and fade out to black as you shoot. Control of gain when doing video feedback is important, and you can increase the gain over the full range of video with his adaptation. (Schematic A, attached.)

2. Sony AVC-3200. This is a studio camera and costs about $700. If you do not need the Portapak VTR, the AVC-3200 is a more versatile camera than the Portapak camera. It is a simple instrument which has no level control, but it has a detachable viewfinder, a 4 to 1 zoom lens, selection of internal and external sync which means it can drive itself or be driven by other equipment in the system. (To drive more than one camera in sync a separate sync generator is necessary.) There is a coaxial cable output on the back of the camera which is separate from the camera cable. With the camera cable, you get back video which you can plug into your mixer or your tape machine. But you can also run a second output of video -- a composite video signal -- which you can take directly to monitors. There is a selector switch on the camera which switches that coaxial connector from a composite video signal (one which has sync pulses) to a radio frequency signal which will drive a regular TV set when connected to the antenna terminals.

3. Sony DXC-2000A. (no longer available). This is a good camera because it uses a 3/4" Vidicon rather than the newer 2/3" Vidicon. It gives higher resolution than the

Portapak or AVC-3200 and it is a slightly heavier camera. It also has a few more adjustments that sometimes make it more flexible. The 2000A has gain control, aperture correction and gamma correction. It also has pedestal levels, sync levels, video level, and they can all be adjusted very simply with a screwdriver. The Portapak camera, on the other hand, is a compact piece of equipment which is a bit difficult to get inside of to make any adjustments. All these cameras must be partially disassembled in order to make the more sophisticated adjustments.

4. Sony DXC-5000 color camera. This camera works quite well when in proper adjustment and comes with a color sync generator. It costs $10,000. Most of the current work done at the Center uses black and white images as sources to be processed through a color video mixer or video synthesizer. You might evaluate this mode of working from both an artistic and financial standpoint before you decide to invest in such a camera.

IV. VIDEOTAPE RECORDERS

Matters tend to become rather ambiguous in this area. There are quite a few VTRs on the market and no single machine answers all needs. If the budget allows, however, one should purchase a color machine. Color tape machines will record superior black and white images as well, and you will have the VTR available when you want to move your system into color. In addition, any tapes you have recorded previously can be played back on that machine and you can use your old black and white tapes as image bank material.

Half-inch quality on playback is probably as good as a home color television receiver. The other extreme is two-inch quadraplex tape which is broadcast standard and into the $100,000 range. One-inch is, in quality, about half the way between half-inch and two-inch. Another difference in quality is pointed up by how many generations of videotape you can go before the quality is unacceptable. By the time you get to third generation on half-inch -- the copy made off a copy of the original master tape -- the picture is quite degraded in quality. On one-inch machines you can usually go to the third generation and maybe have quality that equals the first generation of half-inch. And on 2" you can go many more. What follows is an evaluative rundown of the videotape machines the Center owns or has owned.

A note on color. Ampex one-inch color electronics are extremely good. One can put down flat fields of color or fields of really doubtful kinds of color that tend to confuse a machine's circuitry because they are neither fish nor fowl. As in painting, artists mix colors in video, and the machines must somehow reconcile all of the bits of different color used to make up each single "color." Videotape recorders are made generally to record "broadcast" color, which is very thin, with little contrast or saturation. While Ampex machines are best able to reproduce the sorts of color artists mix, they have difficulty when the saturation level is high, as any videotape machine does. Sony electronics are less able to reconcile these color-mixes well without breaking up into noise which is made up of the separate components of that color. Saturated purple, for example, which is difficult enough for a 2" broadcast machine, is almost unusable for a video artist working with smaller Sony machines because it turns out as red and blue noise. Sony machines have other redeeming features, however, and all of these factors must be considered before purchasing one to suit your particular needs.

1. Sony 5000 and 5000A. These are half-inch color machines which Sony no longer manufactures. The letter "A" signifies that the machine has a noise reduction circuit that processes the color signal to produce a sharper picture. In our experience at the Center Sony has offered the most in half-inch machines, although the newer Panasonic machines are reportedly even better. The 5000 and 5000A have given little trouble in terms of maintenance, and they get a great deal of use. The 5000A is a very good workhorse. It is a machine that will not give you 2" picture quality but it will, more often than not, give you a picture.

Sony uses two video heads, instead of one which gives a somewhat better picture quality.

The circuitry does tend to drift over time, so the machine needs regular calibration, and every so-many-hours it is necessary to sit down and go through the maintenance procedures and tune up the machine. Sony's service manuals are very good.

The audio circuitry on the 5000 and 5000A is poor. The frequency response is only adequate and the gain or level of the recorded signal is automatically controlled. This means you have no control over levels unless you rebuild the circuitry. The Automatic Gain Control, or AGC, is intended to make recording efficient, but instead it reduces the dynamic loudness range of your sound track and increases the always-present buzzing so that there will be noise in quiet sound passages.

2. Sony 320F. The 320 is Sony's one-inch machine. Some people rave about the 320. It lives up to the Sony's workhorse reputation and has been able to take a great deal of abuse along with a great deal of use. Unlike Ampex 1" machines, there are no mechanical problems, but it does have many difficulties in its color recording. It is better than the half-inch, of course, but compared to the Ampex 1", for instance, has more color noise and poorer resolution. The audio is satisfactory except for one thing -- it is made to record broadcast standard level audio. This means that home hi-fi gear, which is what most of our audio system is composed of, will not drive that record circuit properly. In other words, if your input level is the consumer product level of -10db, it will play back

a very weak recording. Broadcast level is +4 or +8db, and that is what Sony's 320 is actually made to record. If you cannot drive things that high, you'll have trouble with weak recordings. What the Center did with its 320 was to change the input attenuation so that it became compatible with home gear. The Center has sold its 320; there was a moire pattern in the video recording which no one, including Sony engineers, seemed to be able to eliminate.

Ampex 1" VTRs. Ampex machines make high quality video signals but require careful and steady maintenance. If you have a person to do this, you will get the best quality with Ampex machines. Ampex has a single-head system, one video head on the machine, where Sony has two. However, the writing (record-scanning) speed is very high -- 1,000 inches per second -- thus giving high resolution, low noise recording in both black and white and color. Ampex also has a high-band carrier frequency system which produces very high quality color pictures.

3. Ampex 7000. This is the Center's first VTR, a black and white machine. It receives little use now, and therefore has given few problems.

4. Ampex 7500. This is a color one-inch machine. It is used regularly and breaks down regularly. One of the problems the Center has experienced, however, is that the demands on a maintenance engineer's time are so great that

a regular schedule of two to three hours a week of adjustment procedures per machine cannot be followed. The Center's 7500 is a model that fits down into a case and as a result, the circuitry is not accessible unless you unbolt it from the case and lift it out. We suggest with this model cutting off the front of the case to slip the front part of the machine down. This accesses the most important circuit boards which are the servo board and the mod/demod circuit.

5. Ampex 5800. The Center bought this machine for good editing capability. The Sony 320 does edit but the edit circuitry was not high quality and often would produce flashing and glitches at the edit point. The Sony system uses a flying erase head that erases a video track and lays down a new one; sometimes the edit erase will not go in at the proper point. The Ampex 5800 has another good feature, an external sync input; that is, you can take synchronizing signals from your generator, put them into a VTR and by doing so, any edits that you make are started and completed only during the vertical blanking interval, and this makes the edit clean.

6. Ampex 7800. This is a one-inch machine that is almost a two-inch machine. That is, it has all of the features that two-inch machines have -- sync inputs and sync outputs, blanking inputs and blanking outputs, editing, accessible circuit boards that pull out and can be put on

extenders; and logic controlled tape handling: fast rewind, fast forward, start, stop and slow motion circuits. Tape handling is practically foolproof. For example, if you are in fast forward and hit the rewind button accidentally, rather than ripping up your tape (as the 5800 and earlier Ampex models will do), the machine reads your command and decides whether it's in a mode that's sensible for answering that command. Since its range of choices is really very small, it can decide easily whether what you've just told it to do will destroy the tape. And if it comes up with the answer, "yes, it will destroy the tape," then it simply comes to a discreet stop and waits for you. In addition, the 7800 has a remote control box which you can put on your mixing console so that you can start your recording, edit, and stop the machine from there as you're making your images, rather than having to get up, go across the room and come back to your mixing area. The video quality is excellent.

7. Sony Videocassette. This is basically a consumer product and as such has limited usefulness as a professional or semiprofessional tool. The 3/4" tape is completely enclosed within the plastic box, and there is no access to it except to break the plastic box, which then makes it impossible to play the tape. When you press the start button, it takes 5 to 7 seconds before it actually shows a picture because the tape has to be physically pulled out

of the cassette by a little finger and drawn around the drumhead, which is inside the machine. The inaccessibility of the tape means it can't be physically spliced. The tapes themselves are limited to half-hour and hour format, and you can't shorten a reel. The cassettes are easy to handle physically since they are self-threading in the machine; interchangeability of playback machines seems to pose no problem. The cassettes are most useful for playing back extended segments of one minute or more. Cueing is difficult because of the complicated mechanical processes involved, and because the linear tape speed is much slower -- 3 3/4 inches per second -- and fast forward and rewind are therefore very fast. We do not consider it to be a mastering machine. The picture quality is good, as is the color (that is, nearly as good as IVC 1", better than Sony 1", but nowhere near Ampex 1".) Because it is intended for home use, the audio circuitry in general and the audio AGC in particular, create real problems for the video experimenter; the Sony reel-to-reel machines such as the 5000 are intended for the inexperienced but somewhat knowledgeable amateur who is making his own tapes. The cassette machine, on the other hand, is made for the consumer with no technical knowledge who wants a machine that will work dependably and well with the least amount of effort on his part. The level control circuitry in the cassette machines must therefore cover and control a wider range of level fluctuations; in experimental use, however, the machine tends to control you, rather than the reverse. For example, it is impossible to record and play back silence on a 3/4" machine. The audio AGC has an incredible gain factor so that if you have twenty seconds of silence on your tape, by the end of that time all your line-hum and tape hiss will be amplified to a literal roar. Obviously this cuts down your production freedom. The AGC also tends to destroy the dynamic range of your sound track: a soft, quiet passage of sound in your piece gets pulled up to full level; and if you decide to really lay it on thunderously, the machine will simply turn you down smoothly so that your cresendo becomes the same loudness level as all the rest of your score. If you plan to use the Videocassette in most production situations, you will have to go into it and remake the audio circuitry.

V. MONITORS

In the beginning stages of a system, the less expensive monitors are adequate. You can always rent a good monitor to display work made with good tools, but if your basic video system -- cameras and videotape recorders, particularly -- are of unsatisfactory quality, your picture will look poor even on the best monitor available. The least expensive display surface is a television set with an RF converter that allows you to plug in your 75 ohm video picture and receive back something you can connect to the antenna terminals of the set and so see the picture through it. The converter is a tiny television broadcasting station in a box which you connect to the set's antenna terminals because a regular set will not read a video signal fed into its antenna. For that you need a carrier frequency. The box gives you a television picture with that carrier frequency. The problem with these "jeeped" monitors is that they do not have the circuitry to produce a true black field (zero luminance); their "black" is medium grey. Any picture that uses subtleties of light and dark compositionally will therefore lose its nuances on such a monitor.

A step better than this is a manufactured monitor such as Panasonic's or the Sony Trinitron. These are semi-professional monitors which include monitoring circuits built on the basic chassis of a television set. The Trinitrons are excellent. Broadcast stations use them in parts of their facility where Conracs, the best monitors available, are not required. The monitor also receives transmitted broadcast signals so you can record off the air. It is integrated with the Sony half-inch VTR gear so that you can feed directly into the tape machine what's coming into it from a broadcast station, or you can feed directly out of the VTR into the monitor for a compact playback set-up. A 14" Trinitron color monitor is about $400; it will render excellent black and white pictures, and seems to us to be the best multi-purpose means of display available now.

VI. ACCOUTREMENTS: LIGHTS, LENSES, TRIPODS, VIDEOTAPE

Obviously, the kind of lights you need depend on the sort of work you do. The work at the Center involves precisely controlled amounts of light on very small areas; for this photographic and theater lights and spots are used; Fresnells, Lekos (ellipsoidac reflector spots) quartz-lights, etc. If you can manage to find three of four 1000 watt Variacs or 5000 watt Variacs you can have dimmers and good control. You will probably have little use for film floodlighting such as the old Colortran products.

Your choice of lenses, too, depends on your aesthetic. Basically, you have a choice between fixed lenses and zoomar lenses. Most Sony cameras come with a 4:1 zoom lens, not a great range, but adequate. In this day and age of zooming, fixed lenses are greatly undervalued. The zoom lens is actually a master's tool, deceptively easy, which to be at all successful as a lens must be used with a great amount of sophiscation. You can also get fixed lenses in wider and longer focal lengths than most zooms are capable of producing. For video, any decent quality 16 mm lens is acceptable; 16 mm film is capable of much higher resolution than video cameras, so anything that works well for a 16 mm film camera will be fine for a C-mount television camera. The television screen does not intrinsically require that human scale be a referant for size, and a set of close-up lenses and extension tubes may be a very sound purchase for your work. The best zoom lens available and the most expensive is the Angenieux 10:1 zoom, $900. Others can be acquired for less. Surplus dealers often have used optics.

Good tripods are not inexpensive. You should be able to pan and tilt your cameras smoothly, and even roll them over on their sides. Still camera tripods are intended to be set up and locked in place and no not have smooth tilting mechanisms. There are panhead tripods which are countersprung to offset the weight of the camera and ones with smooth action, some of them viscous damped with a silicone substance, some of them geared, so that you can pan and tilt them with great smoothness. The old-fashioned wooden tripods have a geeat deal to recommend them, but their legs are not easily extendable and retractable. Those with a column that cranks up and down in the center are good; the cheap aluminum tripods with turn collars on the legs give a great deal of trouble.

With respect to brands of videotape, we cannot recommend one over another. They are all exhorbitantly expensive. The new carbon-backed tape such as the Memorex Chroma 80 an Ampex 162 is good except that it is difficult to mark on the back with a magic marker for edit cueing. There is a new high energy tape that requires special settings of the machine, but the recordings tend to fade (loose strength) after a while. One can buy used tape from companies like DAK in Los Angeles; it is probably used computer tape, half the price of new videotape stock; it can be used to make sketches for your final work.

This has been a brief and cursory appraisal intended for readers with little technical knowledge. A more precise paper would run many times this length, and an evaluation of all the products available and adaptable to experimental use would be a small book, one rendered almost immediately obsolete by the rapidly changing and very complex electronics industry. One entire area upon which the quality of any system depends -- the proper maintenance of electronic equipment -- has been omitted because it is nearly impossible and probably impractical to translate for non-technical readers. We would be glad, however, to answer any questions, expand on any areas, or detail any points covered in this paper by letter. A final word: an electronic system is not just a means to produce images or a vehicle for ideas; it is a very beautiful, complicated, simple, and illuminating balance of power and energy. You, and in a very real sense, the image possibilities you have, are enriched if you understand its flow, its substance and its connections.

APPENDIX

The following are descriptions of some basic and very simple modifications that can be made to the Sony Portapak (camera & VTR).

(A) First is a description of a video gain control that can be easily added in a few hours and at a cost of $3-$4. With such control, one can adjust the amount of video from zero to full output while allowing the sync signal to remain constant and therefore allowing a stable output at any of the ranges.

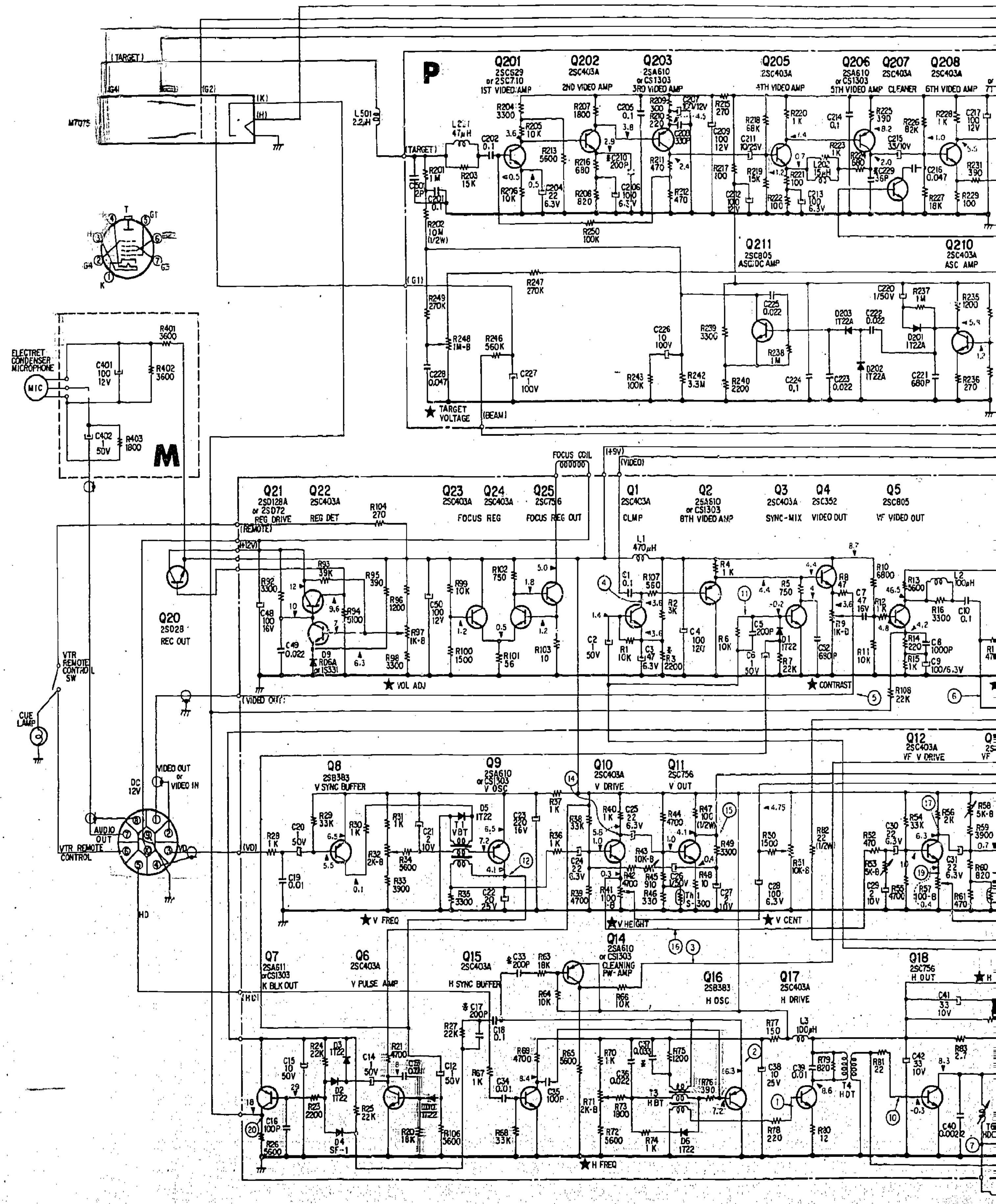
(B) The second modification is the addition of a monitor output to the Portapak VTR. This will allow one to hook any standard monitor onto the VTR for previewing recordings and playback of pre-recorded tapes. This circuit modification will cost another $3-$4 but is far less expensive than the rf monitor option that Sony sells for the VTR.

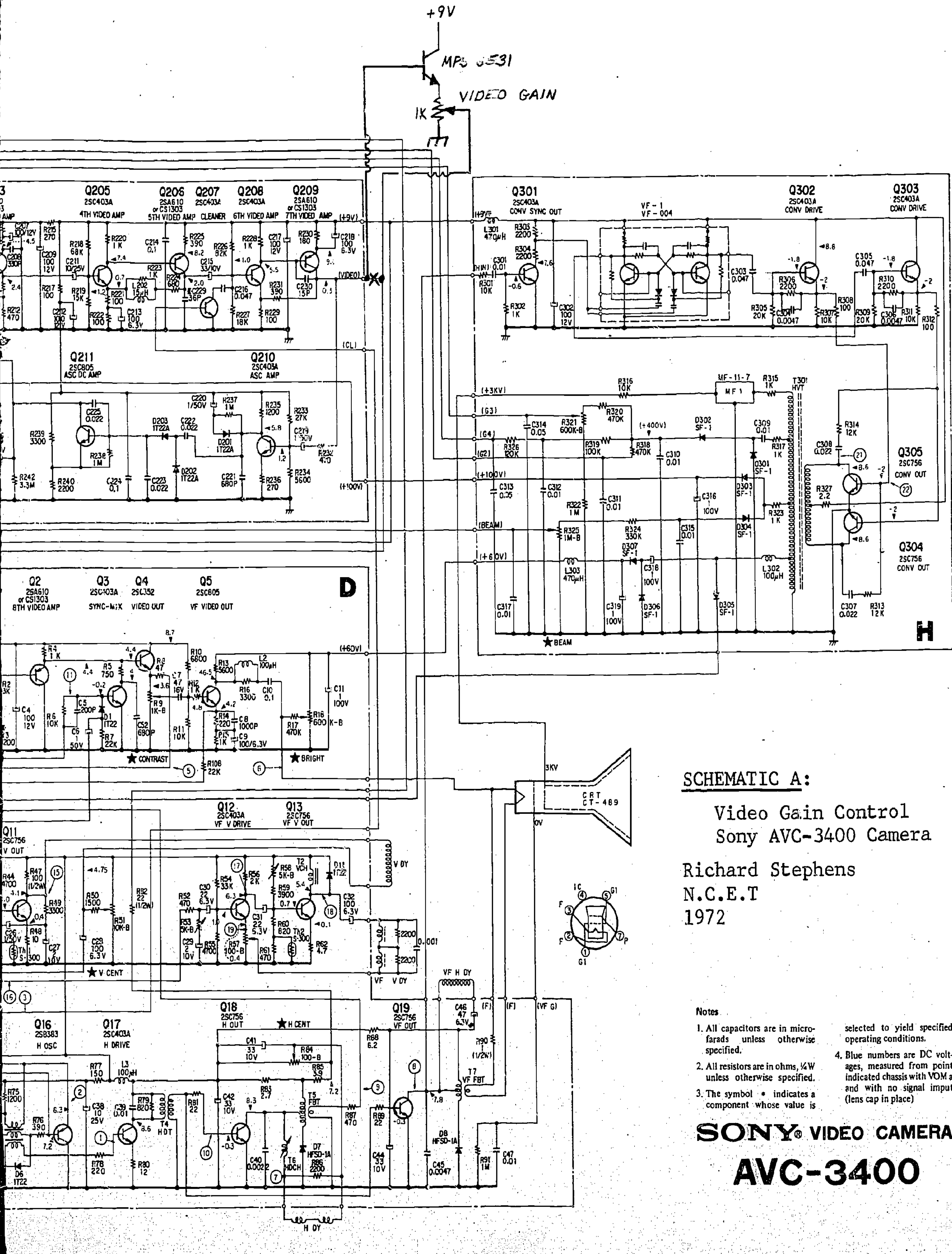
(C) The last modification is one that will allow the Portapak camera to be divorced from the VTR so one can then use the camera just as any other studio camera would be used. The "interface" box includes drive conversion, (this modification precludes the addition of a standard sync generator to your TV system.) video processing and a power supply. By far this is the most expensive modules $25-$30, but is very much worth doing if one would like to use the camera in a studio situation.

If there are any questions concerning these modifications, please feel free to contact NCET.

Richard Stephens

4-5 SCHEMATIC DIAGRAM





SCHEMATIC A:

Video Gain Control
Sony AVC-3400 Camera

Richard Stephens
N.C.E.T
1972

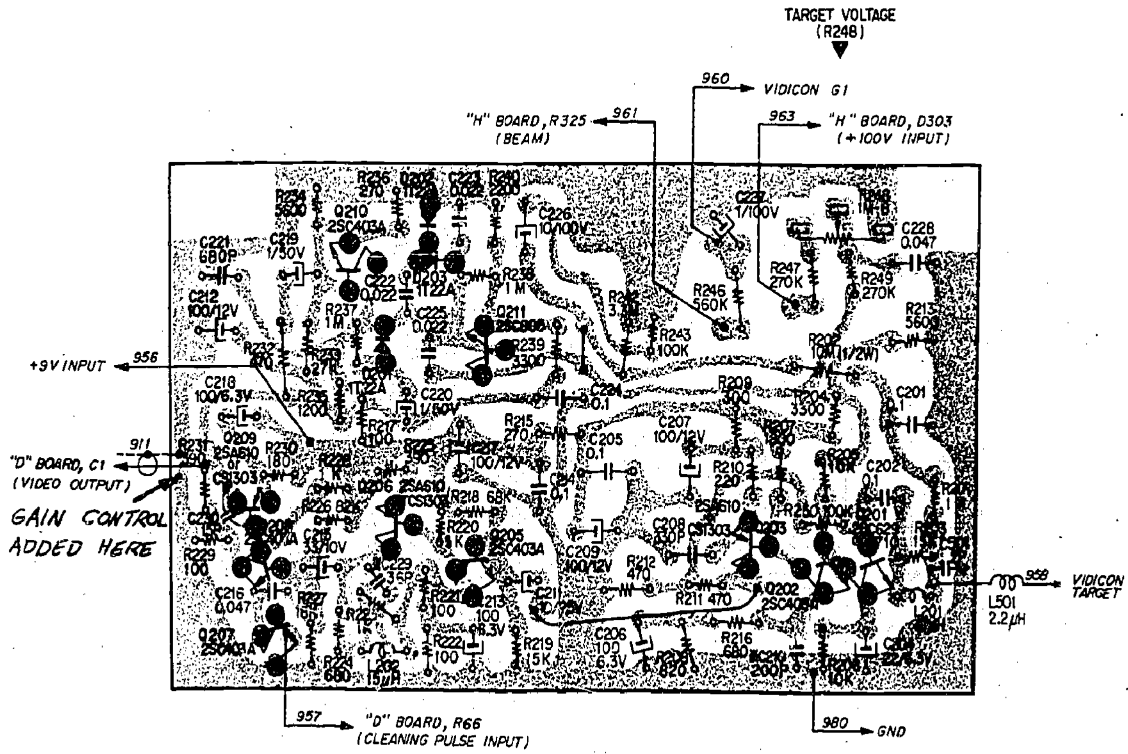
Notes

1. All capacitors are in microfarads unless otherwise specified.
2. All resistors are in ohms, ¼W unless otherwise specified.
3. The symbol • indicates a component whose value is selected to yield specified operating conditions.
4. Blue numbers are DC voltages, measured from point indicated chassis with VOM a and with no signal imput (lens cap in place)

SONY® VIDEO CAMERA

AVC-3400

"P" VIDEO PRINTED CIRCUIT BOARD —— CONDUCTOR SIDE



SCHEMATIC A:

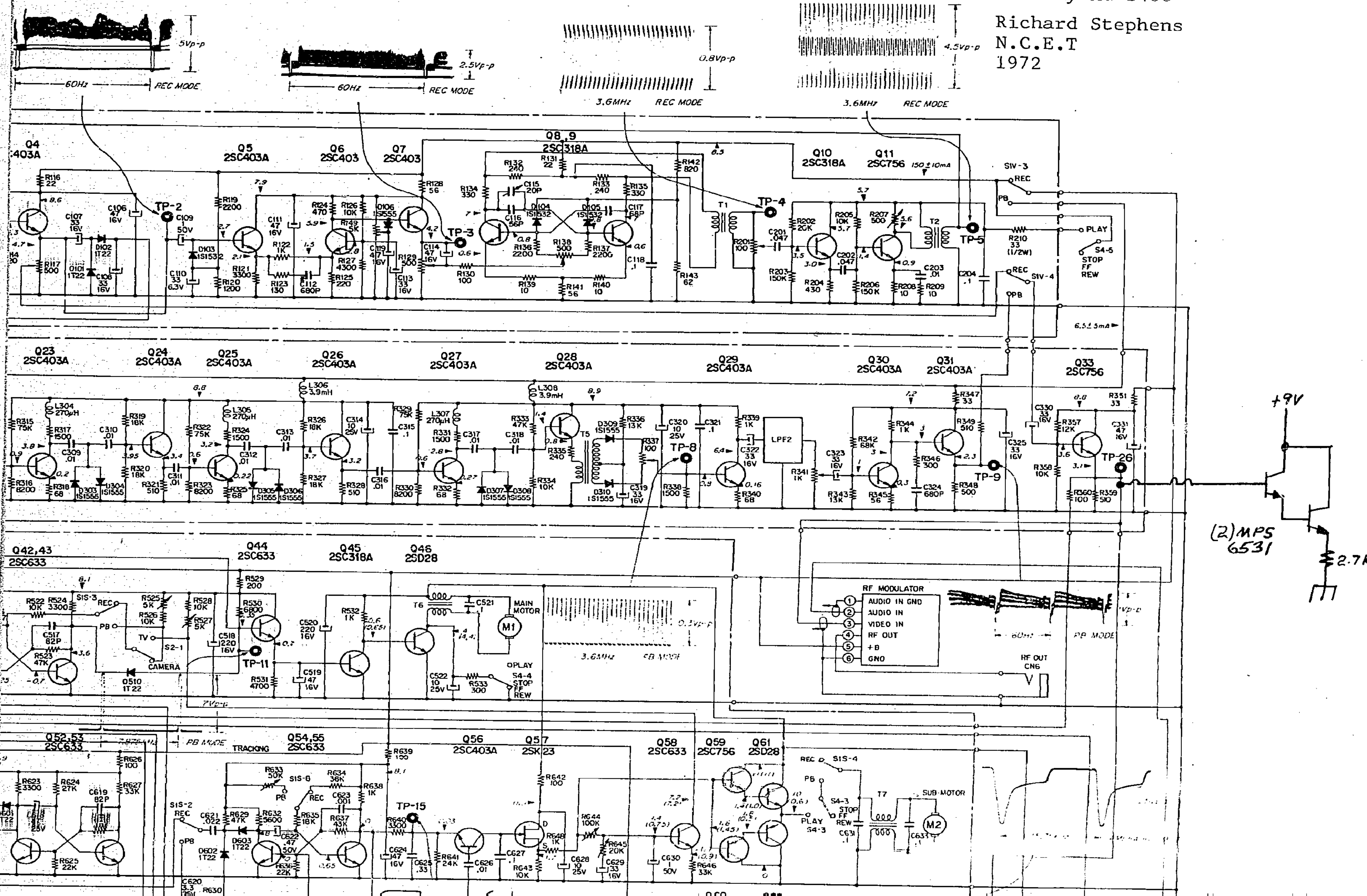
Video Gain Control
Sony AVC-3400 Camera

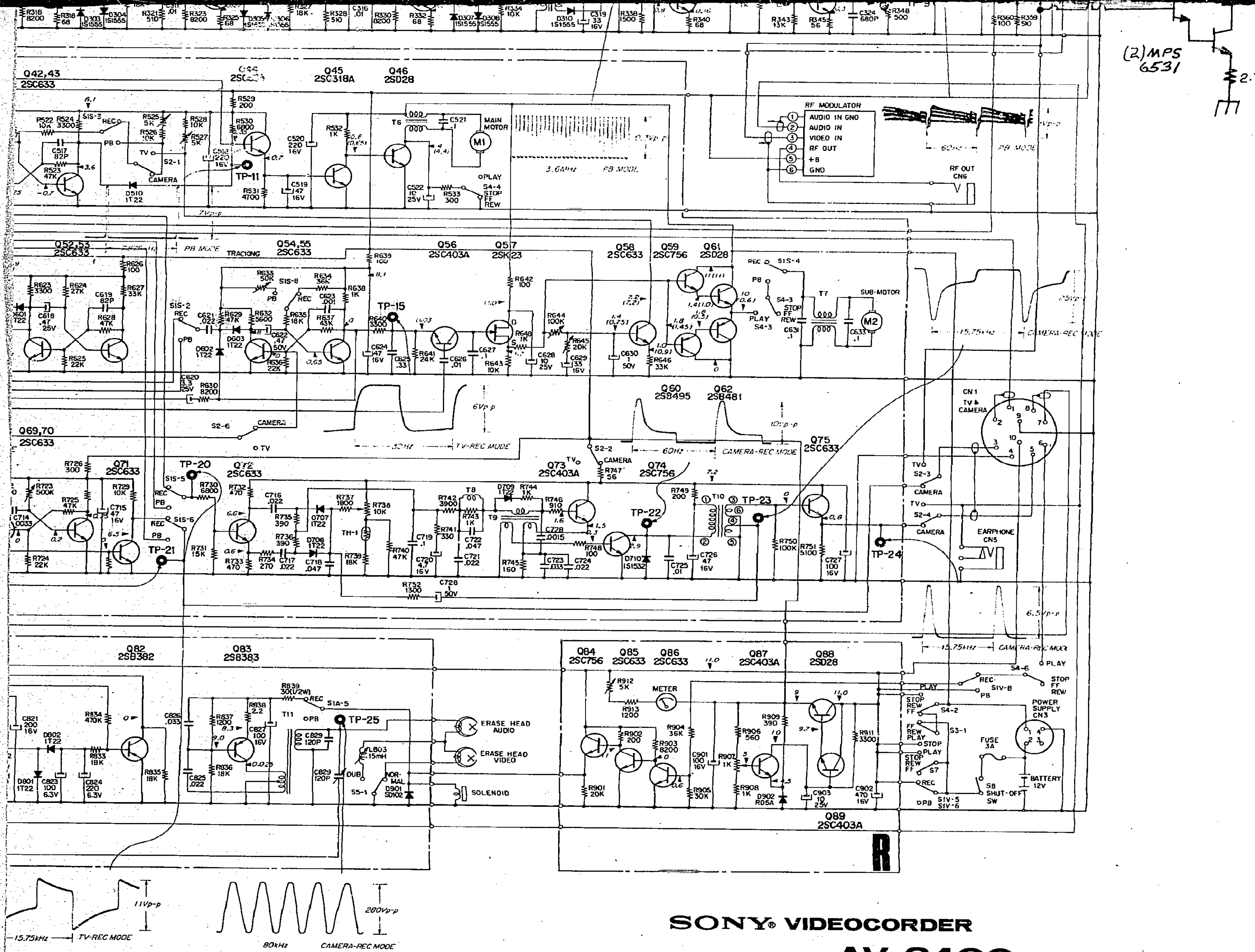
Richard Stephens
N.C.E.T
1972

SCHEMATIC B:

Monitoring Conversion Circuit
Sony AV-3400

Richard Stephens
N.C.E.T
1972

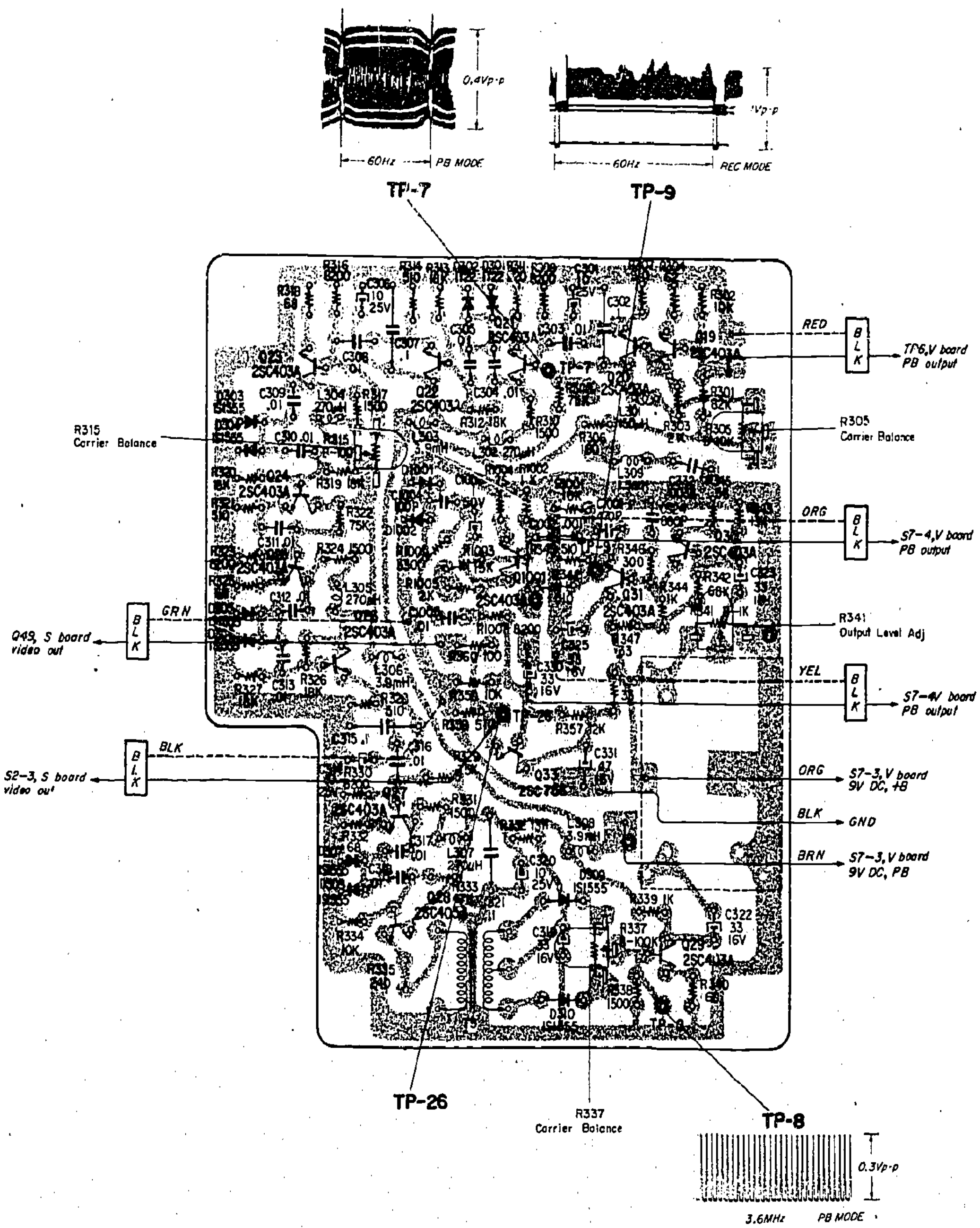




SONY® VIDEOCORDER

SCHEMATIC DIAGRAM AV-3400

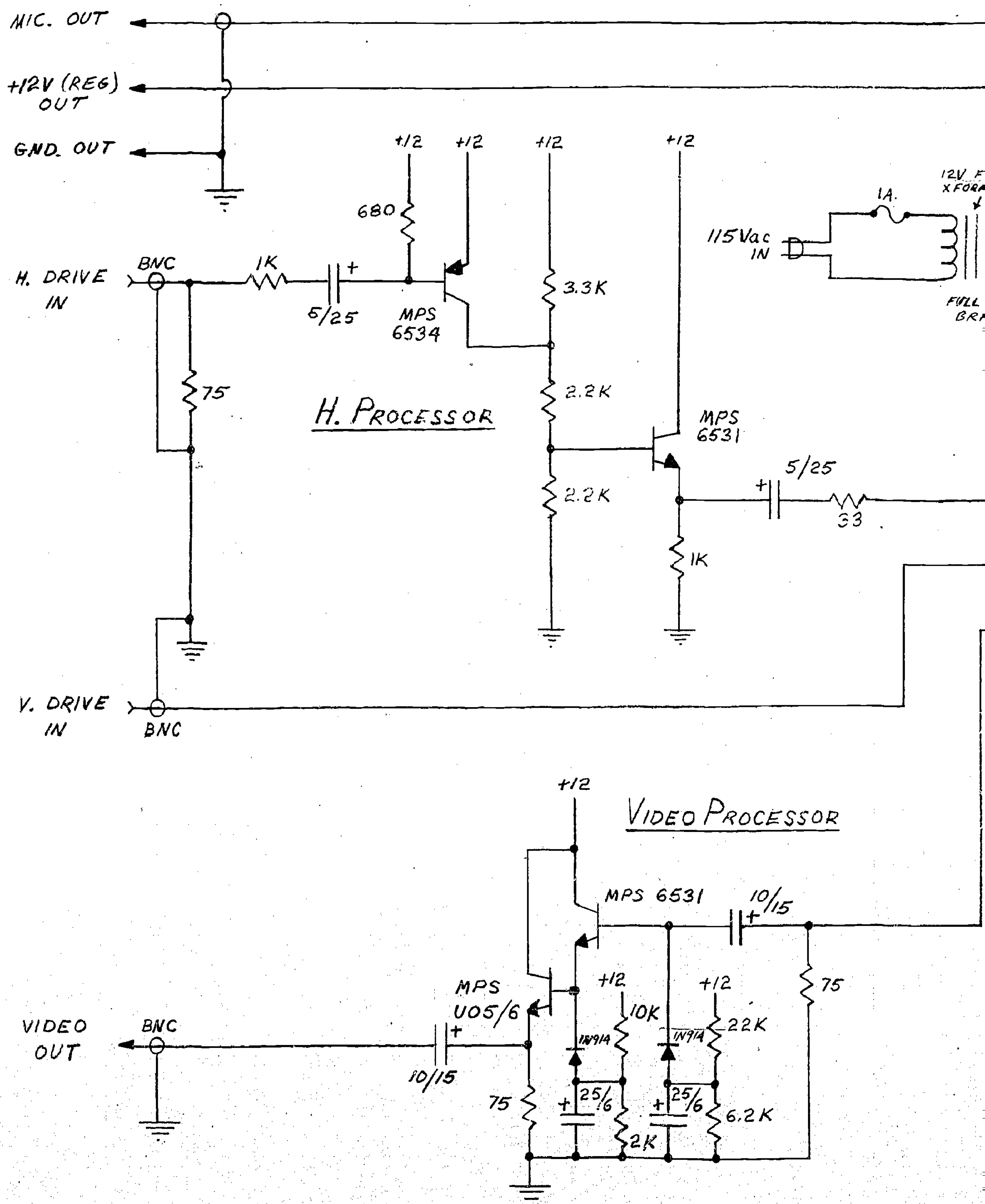
(DEMODULATOR) PRINTED CIRCUIT BOARD



<u>SCHEMATIC B</u>:

Monitoring Conversion Circuit
Sony AV-3400

Richard Stephens
N.C.E.T.
1972



MIC. OUT
+12V (REG) OUT
GND. OUT
+12
680
H. DRIVE IN
BNC
1K
5/25
MPS 6534
3.3K
2.2K
2.2K
75
H. PROCESSOR
MPS 6531
5/25
33
1K
12V
X FORM
1A.
115Vac IN
V. DRIVE IN
BNC
+12
VIDEO PROCESSOR
MPS 6531
10/15
75
MPS U05/6
VIDEO OUT
BNC
10/15
10K
22K
1N914
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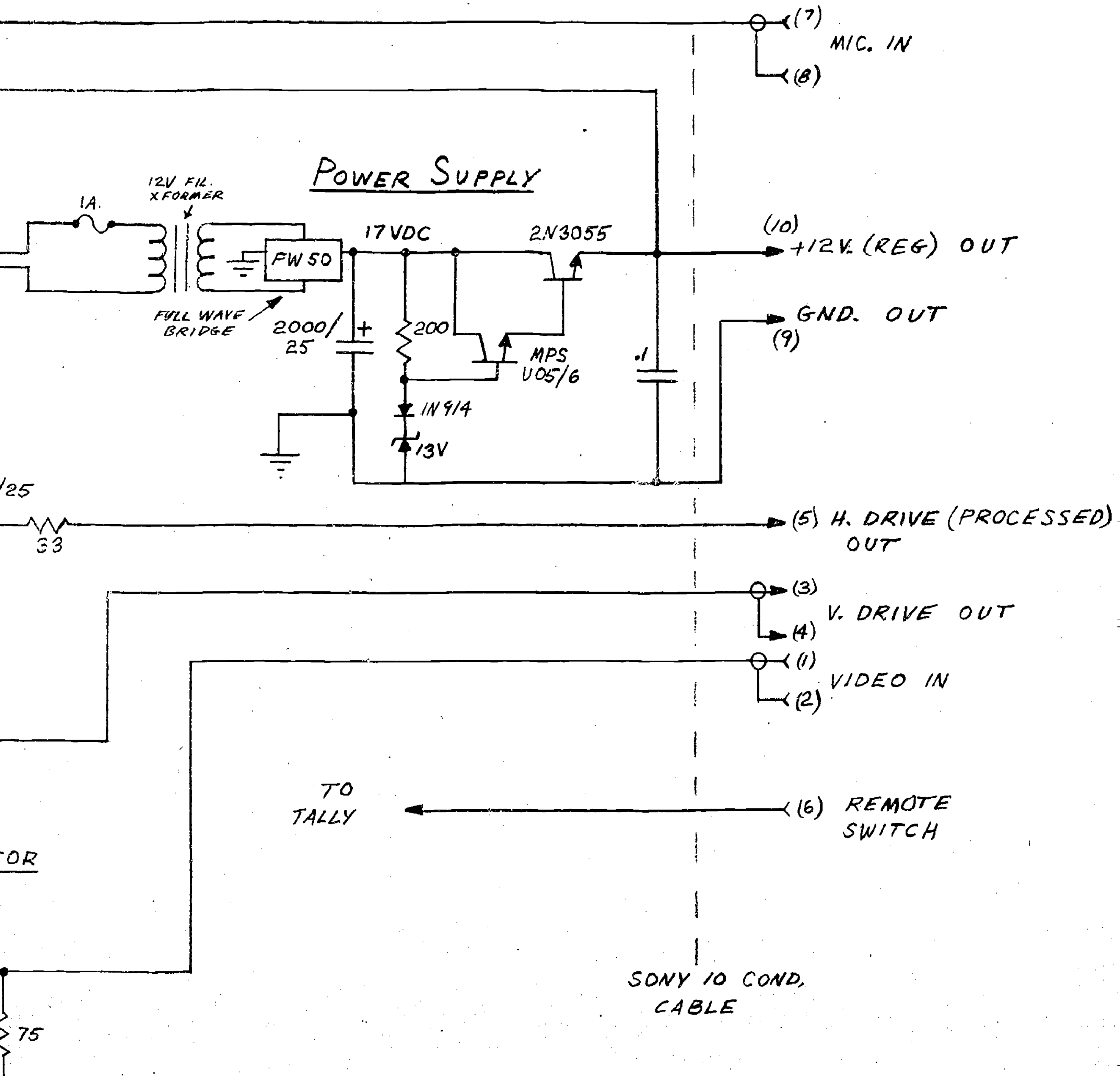
2K
6.2K
75



SONY PORTAPAK CAM INTERFACE

SCHEMATIC C

Richard Stephens
N.C.E.T.
1972

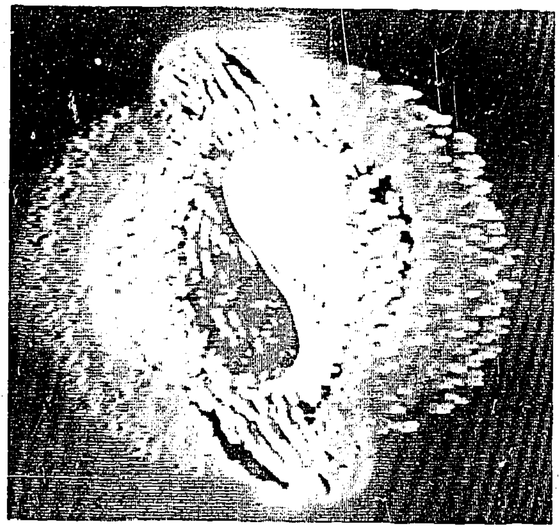


Figure 1 Synthesized Image.

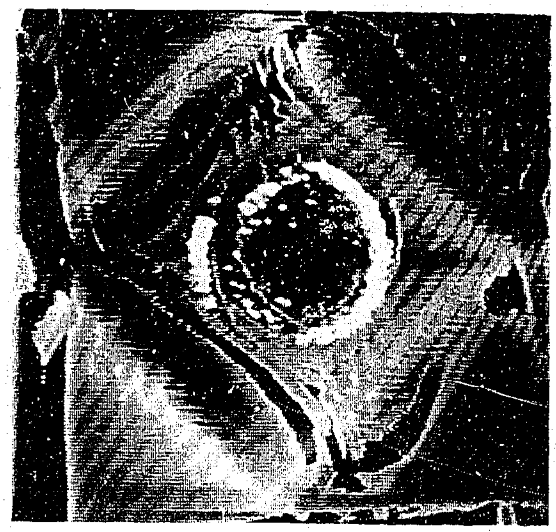


Figure 2 Synthesized Image.

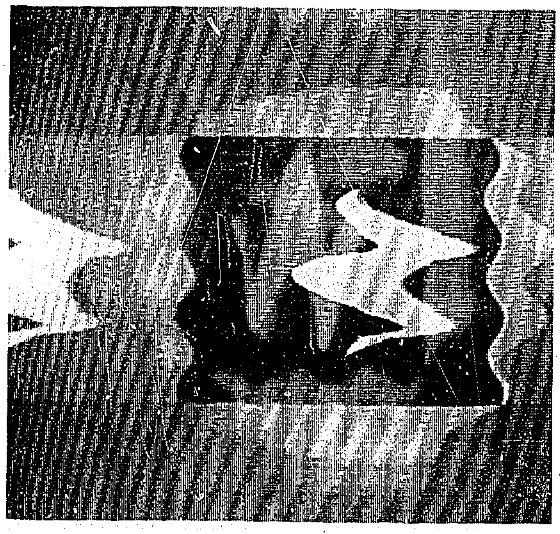


Figure 3 Synthesized Image.

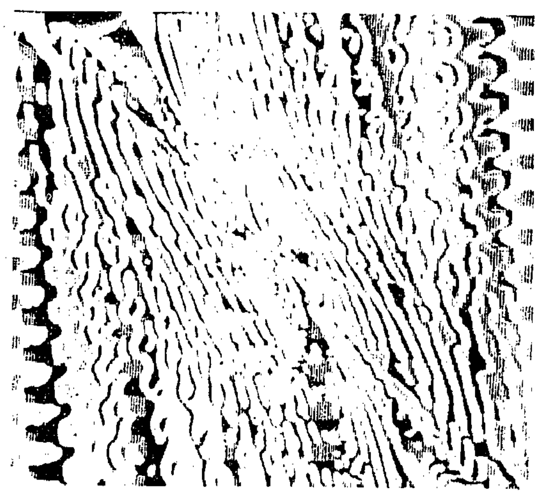


Figure 4 Synthesized Image with camera source.

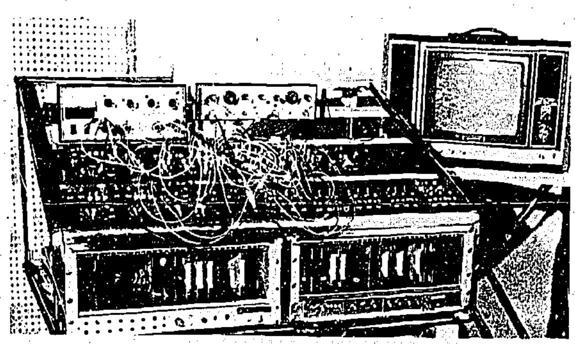


Figure 5 Prototype Direct Video Synthesizer.

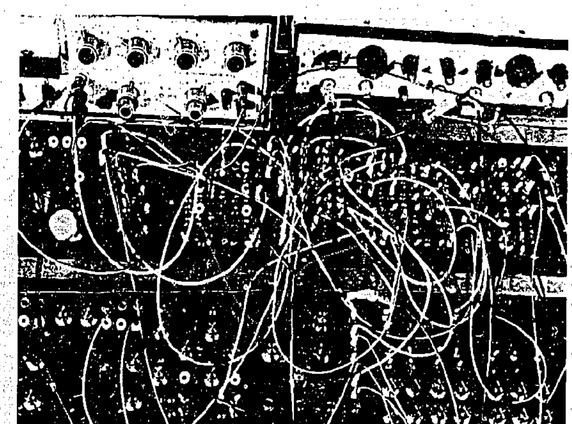


Figure 6 View of Control Panel.

Photo credit: M. d'Hamer.

Direct Video: An Electronic Artform for Color TV

S. C. Beck
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Introduction

Within mankind's tools are latent properties which often remain unutilized. Television is no exception. As an electronic system its range of impact and complexity are astonishing, more so than its usual content indicates. It is possible, however, to go one step further than television might seem to permit and remove the TV camera, replacing it with electronic circuits which can be manipulated to effect the formation of an image on a video monitor. This is direct video synthesis, an electronic means of evoking images from within the television system. It presents the videographer with a method of using television as a medium of personal expression. (Fig. 1 to 4)

Genesis of the Direct Video Synthesizer

I was led to color television in the search for a precise, electronic means for expressively controlling light. Many graphic displays which are available seemed costly and neglected a common piece of display hardware -- the color television set. Hence arose the notion of a visual synthesizer, designed to display directly in a color video format. It remained, however, to formulate an aesthetic model upon which to base the engineering of image-forming circuit modules which would constitute the synthesizer.

Aesthetic Model

The synthesized image is built up of parallel (in time) layers of image information. An image is modeled to consist of elements of form, motion, texture, and color. (A mathematical development of form as points, lines, planes, and perspective illusions serves as a preconditioner for electronically realising this element in two dimensions.) The temporal change of geometrical relationships between elements of form gives rise to motion. Texture arises in several manners; for example, as brightness gradients over elements of form, or as aggregates of microforms, and also dynamically. The spectral distribution of reflected and radiant energy of forms evokes color from our perceptions.

Implementing the Model: Outline of the Synthesizer

Mapping from the aesthetic model into real electronic control of video images is summarized here:

1) sequences of pulse-width modulated signals are developed which define two dimensional contours of form over the monitor surface;

2) waveshaping and amplitude modulation of these signals allows control of the brightness gradient, yielding texture;

3) proportional distribution of these signals as excitation for the primary pigments of emitted light, red, green, and blue, produces a gamut of colors with hue, saturation and luminance specified precisely.

I have constructed a prototype synthesizer (see Figure 5) utilizing this process which consists of circuit and control modules that function directly on a scanned raster basis. A controlled-voltage parameter approach has been employed to direct the image element producing modules. Thus, a computer can be used to generate control voltages, but, more importantly, the videographer has intimate control of the image through various physical-to-control voltage transducers. (I hope to include bioelectronic transducers also.)

Operation

By patching desired modules together at the control panel of the synthesizer, as in Figure 6, and supplying appropriate control voltages to control ports a given passage of images may be executed. Some modules generate and manipulate forms, while other modules impart differing textures to forms, or independently control the various layers of the total image. Camera signals may be processed through the synthesizer also. (Fig. 4)

The synthesizer accepts video sync and drive pulses as "Backdoor" inputs and delivers parallel RGBY (red, green, blue, luminance) outputs to the video encoder. This makes it possible to use the synthesizer with various video formats by substituting sync generators and encoders, an important element of flexibility. The present version produces NTSC compatible color video.