THE PROFESSIONAL MAGAZINE FOR ELECTRONICS AND COMPUTER SERVICING

ELECTRONIC Servicing & Technology

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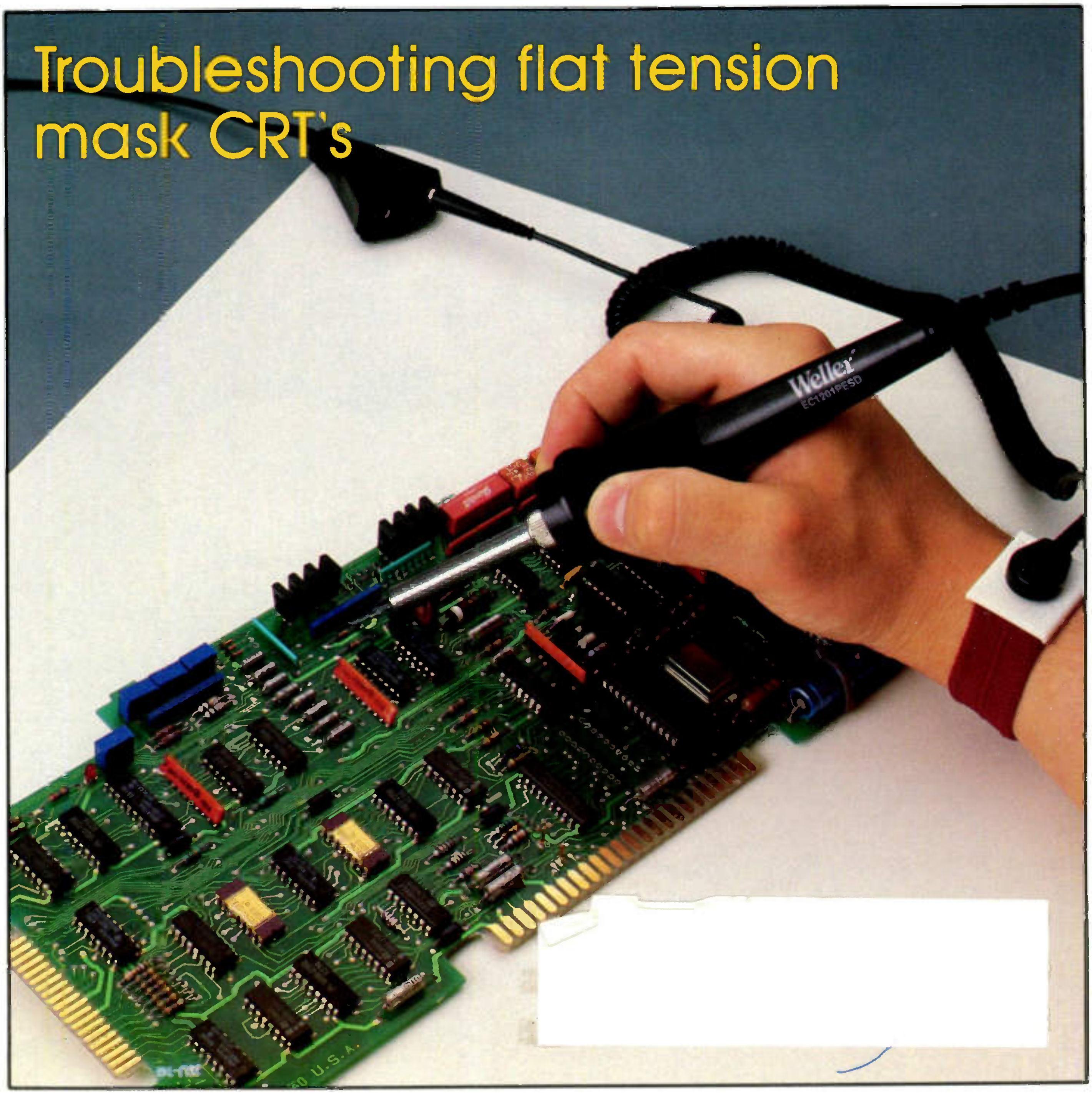
Annual Article/Profax Indexes

Basics of active filters

Troubleshooting flat tension mask CRT's



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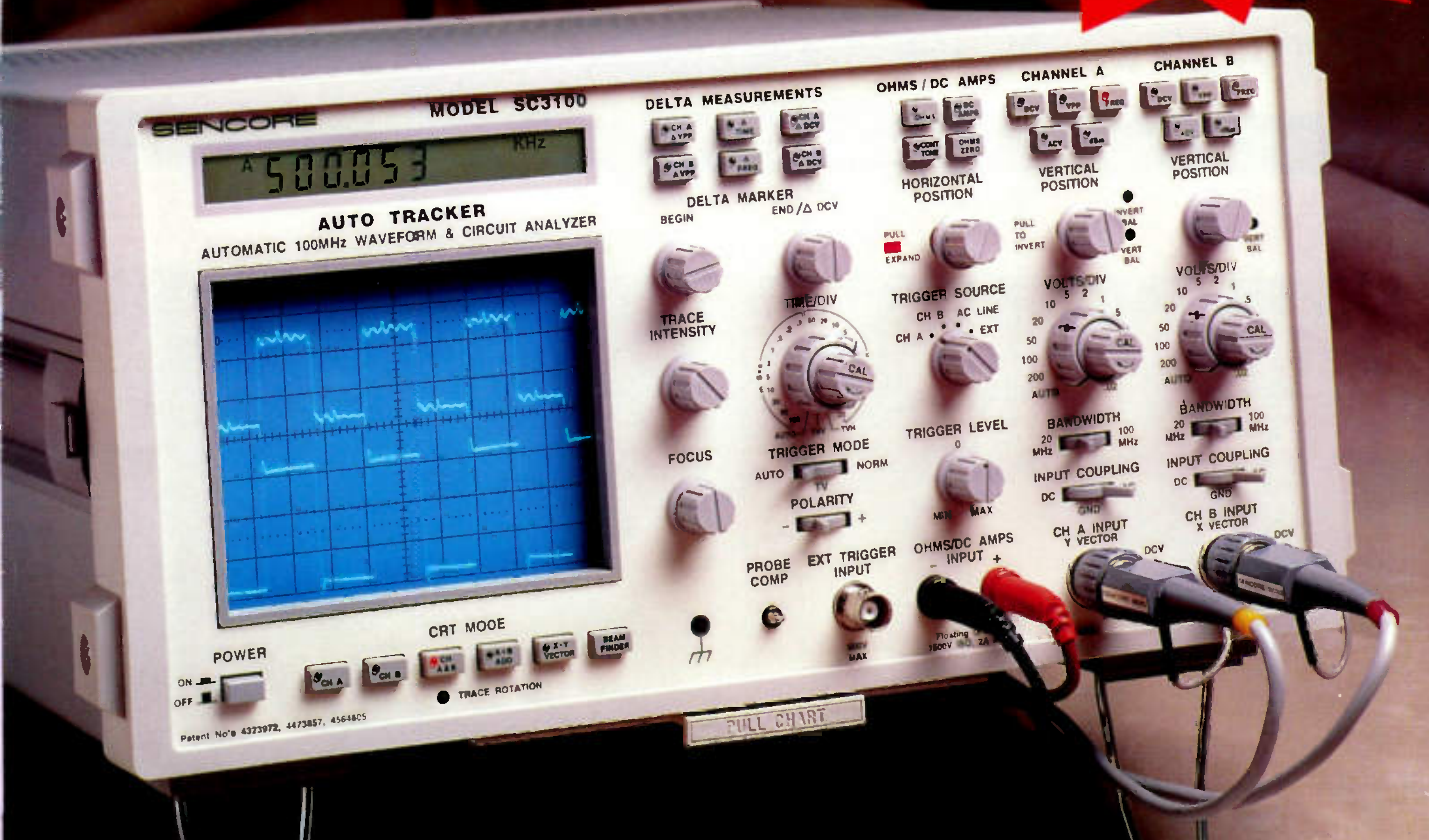

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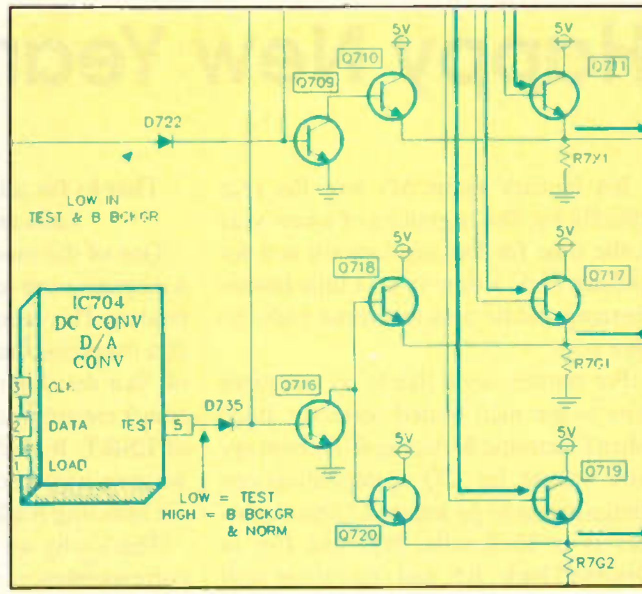

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ON THE COVER

Troubleshooting of video monitors requires that a technician follow procedures similar to the ones followed in servicing a TV set: observation of the monitor screen, voltage checks, resistance checks, observation and analysis of waveforms. Once the faulty circuit board has been isolated, care must be taken in removing/replacing components. *(Photo courtesy Contact East).*

THE PROFESSIONAL MAGAZINE FOR ELECTRONICS AND COMPUTER SERVICING
ELECTRONIC
Servicing & Technology

Happy New Year

It's January again. My how the year does fly by. The beginning of a new year is the time for looking forward and for looking back, a time to do a little housecleaning and tie up a few loose ends. So here goes.

For starters, we'd like to try one more time to get mail routed correctly. Back when Electronic Servicing & Technology was bought by CQ Communications things began to go astray. CQ headquarters is in Hicksville, NY, and I'm in Overland Park , KS, and often times mail meant for one destination winds up being sent to the other. To add to the confusion, a great deal of mail is still being sent to the old Intertec address. And now that Intertec has physically moved its location within Overland Park, a further complication has been added.

All editorial correspondence, questions/comments on the editorial content for the magazine, requests for writer's guidelines, etc., should be directed to:

Conrad Persson
Editor
Electronic Servicing & Technology
PO Box 12487
Overland Park, KS 66282-2487
Phone/Fax: 913-492-4857

I can also be reached via MCI mail. My user name is CPERSSON.

All other correspondence: questions about the status of your subscription, complaints about missing issues, Reader's Exchange requests, requests for editorial calendars, or any other kind of administrative requests should be directed to the Hicksville office:

CQ Communications, Inc.
76 N. Broadway
Hicksville, NY 11801
Phone: 516-681-2922
Fax: 516-681-2926

Thanks for all your letters, phone calls and comments

One of the most important things that a magazine can receive is feedback from readers. This is especially true in the case of a magazine that is trying to keep track of fast developing things, such as consumer electronics technology, in the case of **ES&T.** It is absolutely essential that we remain aware of the developments that are affecting readers.

That's why we so appreciate all of the correspondence we receive from you. Unfortunately, because of the staffing level of the magazine, we don't have the time or the manpower to answer all of your letters. But we do appreciate your taking the time to send them.

Also, please keep in mind that if it is important to you that we send a reply, be sure to enclose a self addressed, stamped envelope. That makes it easier and we will try to answer those.

We would also like to thank those of you who fill out the comment box on the Reader Service cards. Every one of those cards is routed to me after they have been processed and I read them. Some of you have included some very thoughtful comments and suggestions. Along with the letters and telephone calls, these comments and suggestions help the editorial staff know what the informational needs of readers are, and help us plan for future articles.

Wanted: technical articles

The world of consumer electronics is vast and becoming larger. It is complex and steadily becoming more complex. Consumer electronics servicing technicians have a rapidly growing need for information on all aspects of this technology; from basic information on the construction and operation of the products to actual hands-on how to service it information.This magazine constantly strives to present this kind of information on this rapidly growing technology to its audience of consumer electronics servicing technicians and managers. The sheer rate of growth, however, constantly challenges us to do more.

If you have taken training classes in any of the new technologies, or if you have gained expertise in anything from TV service to servicing of the new CD-ROM or CDI products, you probably have information that would be of benefit to other readers of this magazine. We would like to have you writing one or more articles for us.

If the idea of sharing some of the hard won information you have developed with other technicians, and receiving a small payment for doing so intrigues you, write me or call me at the above address and I'll send you along a set of our writers' guidelines.

Tips

If you have some useful information but don't wish to write a lengthy article, perhaps you could provide us with a troubleshooting tip, or a Symcure; that is a brief description of how you corrected a specific problem in a specific product. You will note that there is a Troubleshooting Tip in this issue, and we plan to have such tips in future issues, so if you can write these, please let us know. You might request a set of our writers' guidelines as well, as the guidelines also include instructions on writing short pieces.

Have a good 1993

Even more important than housecleaning etc., the new year is a time of hope and a time to reach out to others. So we'd like to take this opportunity to wish each of our readers a Happy New Year, and promise that with your help we'll make **ES&T** an even better and more helpful magazine, better designed to deal with and cope with the changes that you see every day.

Nils Conrad Persson

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Literature

Static elimination catalog and handbook

A new 32 - page catalog and handbook explains how to identify the source of static problems and specify a cost-effective solution from Chapman's comprehensive line of static eliminators. New products such as the Silencer SE ionizing air gun and the Ionizer Tester are covered in detail. Industrial systems include meters, powerful "hot" and shockless bars, and volume static eliminators. Workbench and ESD applications are covered with self-balancing air guns, benchtop ionizers, and field meters sensitive to ±5V. Applications appropriate for light-duty passive static eliminators, including the manufacturer's inexpensive Passivator brush, are explained. The catalog features a section on customizing static eliminators for original equipment manufacturers. Everything needed to specify and order a static control system, including price is covered.

Circle (2) on Reply Card

Guide to power surges

Power surge causes, effects and solutions are detailed in the new 14-page resource guide, "Purge the Surge Scourge," from the Liebert Corporation. The easy-to-follow comprehensive brochure includes a glossary, charts on required ANSI/NFPA (National Fire Protection Association) applications and industry codes and standards (UL, ANSI, IEEE, etc.) for transient voltage surge suppressors (TVSS). Diagrams give examples of industrial and residential circuits, and TVSS industrial, hospital and commercial applications.

Circle (3) on Reply Card

Chemicals catalog

Chemtronics Inc. has issued a 44-page, full-color catalog that features the company's broad line of specialty chemicals and products for the electronics industry. The catalog incorporates numerous elements designed to help specialty chemical users quickly and easily locate the right products for their applications. Color-coded icons clearly identify product categories, such as precision cleaning agents, circuit refrigerants and desoldering braid. Helpful product application tips are also designated by an icon.

Detailed application, compatibility charts and Mil Spec charts help OEM and service chemical users more closely match specific needs with the right products. Complete packaging information is also included.

The catalog provides environmental impact data to help specialty chemical users better understand the potential impact these products may have on the environment. A detailed chart lists each product's content of chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), chlorinated solvents (cl.. solvs.) volatile organic compounds (VOCs) and hydrofluorocarbons (HFCs), as well as its ozone depletion potential (ODP).

Circle (4) on Reply Card

Test equipment catalog

B&K Precision has released a new 64-page catalog, BK-93, covering the company's line of electronics test instruments, including oscilloscopes, IC testers, spectrum analyzers, digital multimeters, signal and function generators, power supplies, component testers, video test instruments, probes and accessories.

The catalog provides complete specifications in detailed listings and easy-to-use comparison charts. Key product features are summarized, along with selected products. The catalog also describes a complete line of instrument accessories to enhance the functionality of many different instruments.

Instruments featured address applications such as engineering, maintenance and repair, field service, education, production line testing, quality control programs and research and development.

An important resource in the catalog is a glossary of terms for each product category. This guide assists in specifying the right instrument for a given task as well as providing an educational training aid.

Circle (5) on Reply Card

Tips on optics pocket guide

The Broadcast and Communications Products Division of Fujinon, Inc., has released the "Tips on Optics Pocket Guide," a reference piece that provides a simple overview and general description of various optical subjects.

The booklet provides information on 17 different areas, ranging from basic terms to more complex optical issues. Subjects such as T-number, F-number, modulation transfer function, optical coatings, and depth of field are covered. The information is concise, but completely thorough in giving the reader an understanding of the various lens terminology.

The information provided in Tips on Optics also gives the reader an understanding of why a lens performs the way it does and what to look for when purchasing a lens.

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THE PROFESSIONAL MAGAZINE FOR ELECTRONICS AND COMPUTER SERVICING

ELECTRONIC
Servicing & Technology

Electronic Servicing & Technology is edited for servicing professionals who service consumer electronics equipment. This includes service technicians, field service personnel and avid servicing enthusiasts who repair and maintain audio, video, computer and other consumer electronics equipment.

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SDA changes convention plans

The Satellite Dealers Association (SDA) has confirmed its 1993 national satellite show and convention plans. A single show will be conducted in the Quad City area, IL, August 25-28.

The SDA Satellite Trade Show dates are August 27 and 28, a Friday and Saturday. Location is the Airport Holiday Inn Convention Center. The Quad City area is composed of Davenport and Bettendorf, IA, and Rock Island and Moline, IL.

According to Gary Moller, Chairman of SDA and owner of Satellite System Sales in Hot Springs, SD, the Quad city area was selected as the 1993 site because it is in the center of heavy population centers (Des Moines, Minneapolis, Chicago, Kansas City and St. Louis), and offers a national show to some dealers who have had to travel great distances to attend in the past.

ETA (Electronics Technicians Association, Int'l) will join SDA for the second year, ETA will produce the pre-convention Business Management School for dealers, the well-known SAM (Satellite-Antenna-MATV) school and Electronics Technology and Servicing schools for installer and technicians). These business and technical seminars will occur on Wednesday and Thursday prior to the trade show.The Satellite Equipment SATFEST, or swapmeet, will again be included in the convention activities, due to its success in New Orleans in '92. SDA expects the SATFEST to draw larger numbers of dealers and to be open to the public. It will occur on a day other than that of the Satellite Trade Show.

ETA and SDA seminars eligible for college credit

Satellite installers and electronics technicians who attend any future regional or national technical or business management seminars produced jointly by the two national associations, SDA and ETA-I, will receive college credit for successful completion.

George Savage, Chairman of ETA, and Director of Education for the thirteen-year-old professional organization had been working towards the culmination of this project for over a year. Nebraska's Central Community College, with campuses in Lexington, Kearny, Columbus, Hastings and Grand Island, has signed an agreement with ETA to allow one semester hour of credit for each 2-day seminar as produced by ETA and SDA. Savage says "This agreement recognizes the importance of continuing education. The SAM, BMS, and ET seminars (as produced in the past by ETA in cooperation with CCC and similar technical colleges) is unique in that professional electronics, instructors, practicing technicians and business owners, as well as electronics manufacturers combine to bring the latest techniques and information to those who operate or are employed by electronics sales and service businesses as well as industrial firms."

Cable Re-regulation bill passes

The Electronic Industries Association's Consumer Electronics Group (EIA/CEG) applauds the passage of the Cable Television Consumer Protection and Competition Act of 1992 as a victory for consumers. Included in the bill is the assurance of cable compatibility with consumer electronic equipment features of televisions and VCRs, and competitive pricing on remote controls and converter boxes.

"This bill will not only save consumers money, but it creates new opportunities for consumers, retailers and manufacturers," said Gary Shapiro, group vice president, EIA/CEG. "By requiring the commercial availability of converter boxes and remote controls, this law breaks the cable monopoly and allows consumers to shop for competitive pricing on these products from sources other than their cable operator."

"Consumers who have invested in advanced television and VCR features will be able to enjoy those features without fear of interference by their cable service," says Shapiro. "Features such as picture-in-picture, will be fully usable when the Federal Communications Commission issues rules that cable companies must comply with under the act." The Cable re-regulation bill passed the Senate in October with a vote of 74 to 25 and the House with a vote of 308 to 114, effectively overriding a veto from President Bush.

Basics of active filtering

By Dale C. Shackelford

From low-cost personal stereos to the most sophisticated computer systems used aboard the space shuttles, electronic filtering networks play an important role in the proper operation of many electronic devices. The most modern and versatile of these filtering networks are known collectively as *active filters*.

Unlike traditional filters which consist entirely of passive components such as inductors, resistors and/or capacitors, active filters utilize such linear devices as operational amplifiers (op amps) to enhance their overall performance. In addition to attenuating the undesired frequencies, active filters may amplify the passed bands, resulting in a sharper cut-off (fc) slope, and less insertion loss. While the active components used in these circuits are important, the proper placement/use of the traditional passive components in conjunction with the active components is critical.

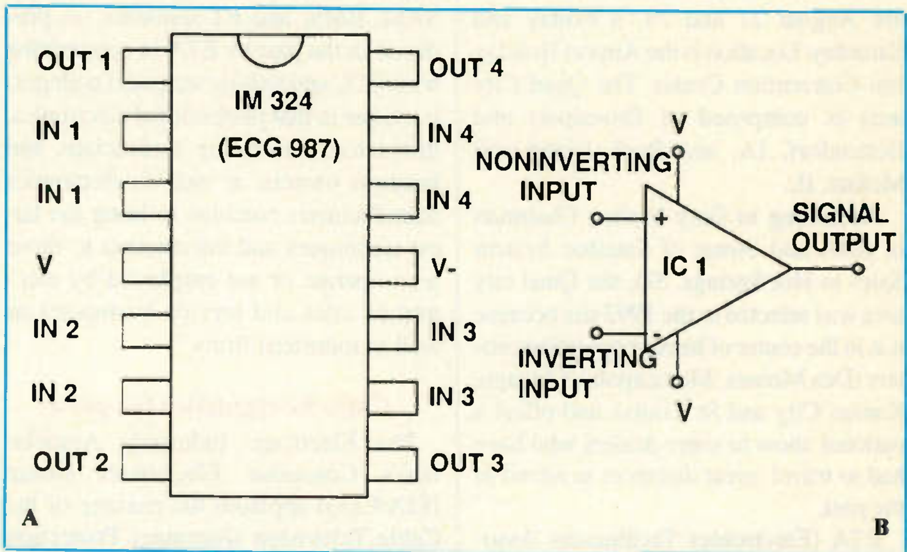


Figure 1. The pinout diagram of a popular 14-pin DIP (IM324/ECG987), a quad op amp, is illustrated at left. At right is a generic schematic representation of an operational amplifier, whether it is a single op amp in an IC package of four, or is the sole op amp in the package (as is the ECG976).

The op amp package

In Figure 1A, the pinout diagram of a popular 14-pin DIP is illustrated (IM324/ECG987). Notice that this component requires a negative as well as a positive-power source, as opposed to the more traditional positive-chassis ground connections. While the voltage/current requirements may vary between components and/or manufacturers, the voltage applied to op amps should be equal, though opposite with respect to chassis ground.

Figure 1B is a generic schematic representation of an operational amplifier, whether it is a single op amp in an IC package of four (as in Figure 1A),

Shackelford is an independent electronic servicing technician.

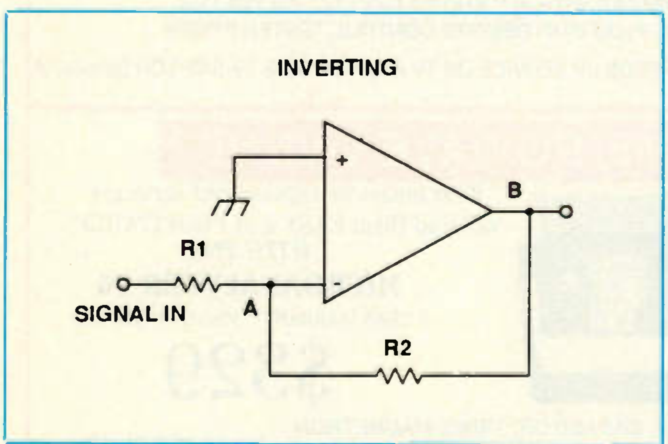


Figure 2. A basic signal inverting amplification circuit. The output signal (Point B) is 180 degrees out of phase with the input. While the op amp (IC1) would invert the signal in this configuration) without R1 or R2 in the circuit, the resistors are being used to form a feedback loop.

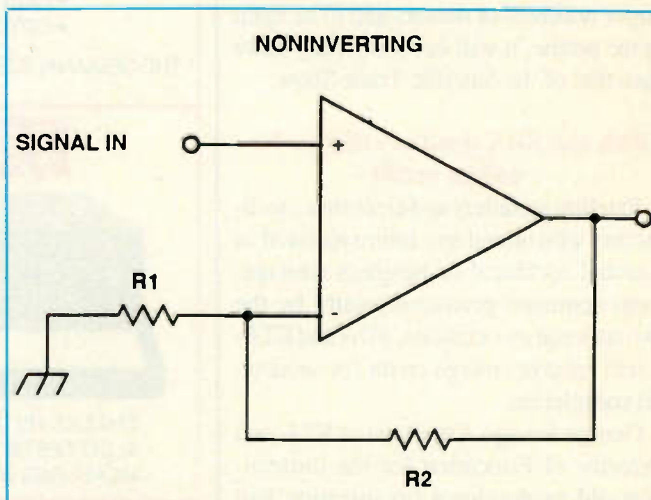


Figure 3. In this application, the same op amp shown in Figure 2 is used as a non inverting amplifier.

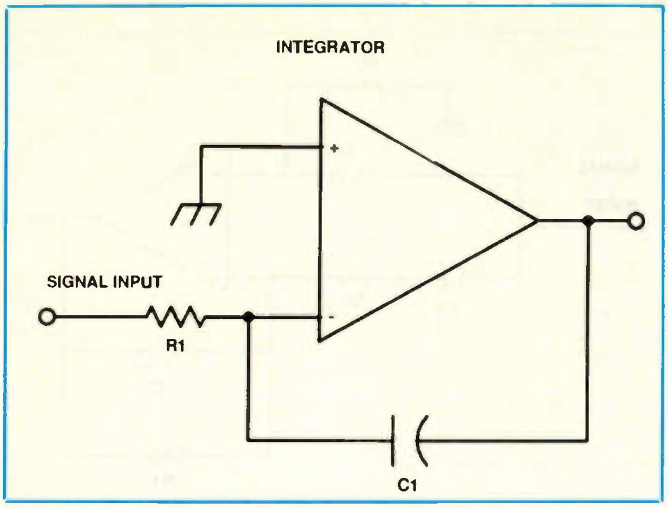


Figure 4. This filtering circuit, commonly known as an integrator, consists of an op amp, an input signal resistor and a capacitor (rather than a resistor) in the feedback path.

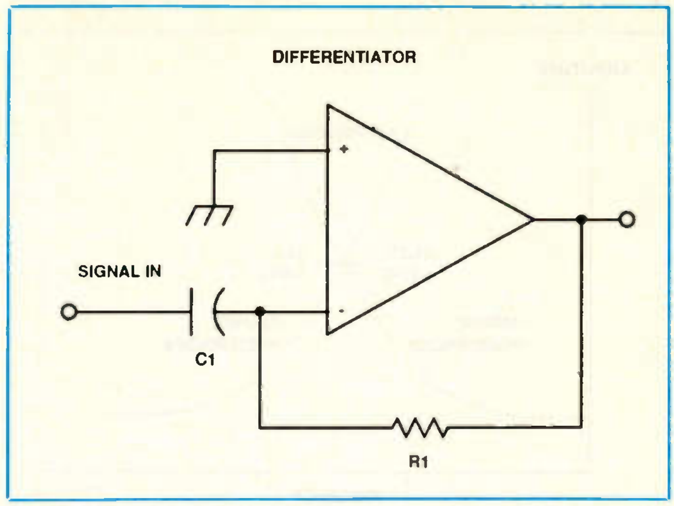


Figure 5. For high-pass filtering, an op amp differentiator circuit is often employed to provide active, low-frequency attentuation.

or is the sole op amp in the package (as is the ECG976).

One of the most useful characteristics of any op amp in a filtering circuit is its ability to invert, or not invert, the output signal 180 degrees out of phase with the input signal. Although the op amp is not in and of itself considered a filter, these linear devices, and the qualities they possess make the filtering of electronic signals much more effective, at greatly reduced cost.

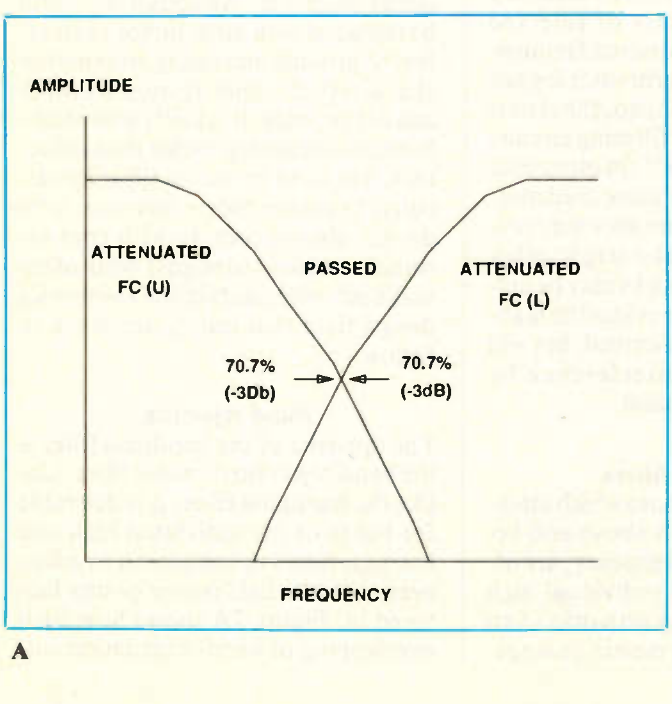
Figure 2 is a basic signal inverting amplification circuit with the output signal (Point B) 180 degrees out of phase with the input. While the op amp (IC1) would invert the signal (in this configuration) without R1 or R2 in the circuit, the resistors are being used to form a feedback loop.

Because the input signal is connected to the inverting input of IC1 (the - symbol represents inversion rather than polarity when depicting signal inputs) the signal output, through R2 is being used to decrease the input signal. Because the output is 180 degrees out of phase with the input, the negative feedback will cancel out a portion of the input signal before it can reach the op amp. Ri not only restricts the amount of original signal reaching IC1, but will also prevent any of the out of phase signal from decreasing any of the signal which may be destined for other circuits.

R2 allows the amount of negative feedback flowing from Point B to Point A to be regulated. Additionally, the ratio of R1 to R2 will determine the gain (G) of the op amp based circuit, as $G = R2/R1$. Regardless of the gain, however, the output signal, in this configuration, will be 180 degrees out of phase with the input signal.

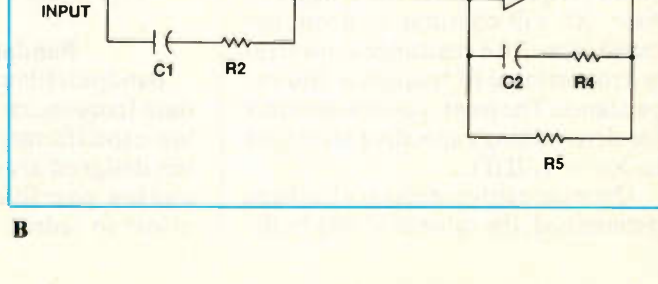
The non-inverting connection

In another application, the same op amp is used as a non inverting amplifier (Figure 3). Note that the input signal enters IC1 at the +, or noninverting,



A

Figure 6. To obtain the most effective bandpass circuit, the fc of the individual filters should overlap somewhat, but only after the half power points (70.7%, or -3dB) have been factored in. Figure 6B illustrates a practical bandpass circuit based on the operational amplifier.



B

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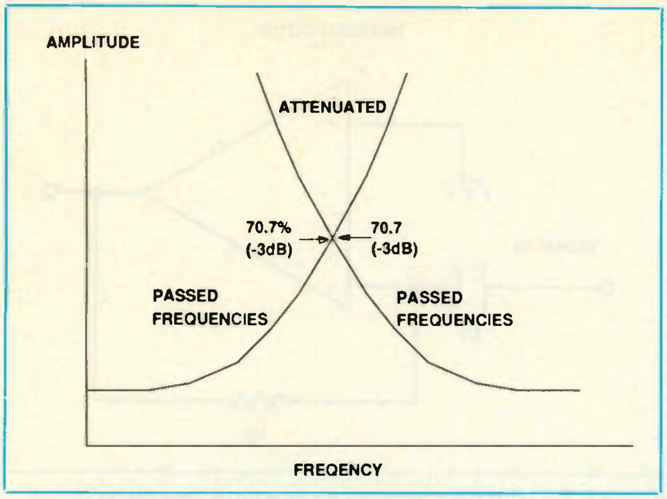


B

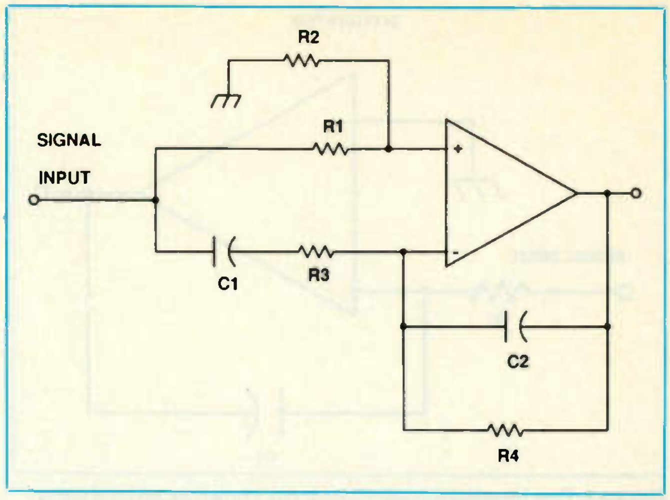


Figure 7. In the band-rejection, or notch filter, it is desirable for the fc of the individual high and low pass filters to completely overlap, even with the half-power points factored in. Figure 7A shows the overlapping of band-attentuation cut-off points. Figure 7B is a typical notch filter.

position, but that the feedback path flows to the –, or inverting, position. This because the feedback must be out of phase with the input in order to decrease it.

If the noninverted output were to be fed back into the original input signal path, theory has it that the gain would reach infinity (and beyond) as the in-phase signal would be multiplied exponentially (though the limits of the device to amplify the signal would be quickly reached). Therefore, the feedback signal (in these applications) must be out of phase with the original input, regardless of whether the desired output signal to be used in later stages is inverted, or not inverted.

The integrator

Figure 4 depicts a filtering circuit commonly known as an *integrator*, consisting of an op amp, an input signal resistor and a capacitor (rather than a resistor) in the feedback path. This configuration allows the circuit to be used as a low- pass filter as the capacitive reactance (Xc) of C1 will increase or decrease as the feedback signal varies in frequency.

At high frequencies, Xc is low, thereby passing lower RF and higher audio frequencies. As the frequency rises, Xc will continue to drop, because capacitive reactance is inversely proportional to frequency and capacitance. The most common formula for determining capacitive reactance is: $Xc = 1/2\Pi FC$.

Once capacitive reactance has been determined, the value of G may be determined as $G = Xc/R1$. In practical applications, gain may be determined by dividing the output voltage by the input voltage, and converting the result to decibels.

The differentiator

For high-pass filtering, a *differentiator* circuit is often employed to provide active, low-frequency attenuation (Figure 5). While extremely low frequencies (including dc) will be attenuated or blocked by C1 alone, the higher frequencies will be passed, with the actual frequencies being determined by the value of C1.

One of the undesired characteristics of the high-pass circuit is its tendency to pass the harmonics of rejected bands as well as the desired frequencies. Because these harmonics are not only passed, but amplified, the claims that active high-pass filtering circuits are somewhat "noisy" (in electronic terms) must be given some credence.

In cases where harmonics may present a problem with later stages, other types of filtering networks may be utilized which not only provides the high-pass characteristics described, but will reduce harmonic interference by "capping" the passband.

Bandpass filters

Bandpass filters, those which attenuate frequencies both above and below a specific target frequency, are often designed around individual high and low-pass filtering networks in an effort to reduce harmonic passage, and to provide later stages with a cleaner, more defined signal.

In bandpass applications, the upper and lower fc of the individual high and low-pass filters should not be allowed to overlap, as the result (in theory) would be the complete elimination of output signals. To obtain the most effective bandpass circuit, the fc of the individual filters should overlap somewhat, but only after the half power points (70.7%, or -3dB) have been factored in (Figure 6A). This will allow a tighter bandpass filter to be constructed, without extraneous signals being passed.

Figure 6B illustrates a practical bandpass circuit based on the operational amplifier. Although R1 could be replaced with an inductor in an effort to provide increasing attenuation characteristics that resistors simply can not provide, it is fairly well established that resistors, rather than inductors, are used in active filtering circuits. There are those, however, who do not always comply with conventional wisdoms (designs) who often make advancements in the electronics design field that others are quick to follow.

Band rejection

The opposite of the bandpass filter is the band-rejection or *notch* filter. Unlike the bandpass filter, it is desirable for the fc of the individual high and low pass filters to completely overlap, even with the half-power points factored in. Figure 7A shows how such overlapping of band-attenuation cut-

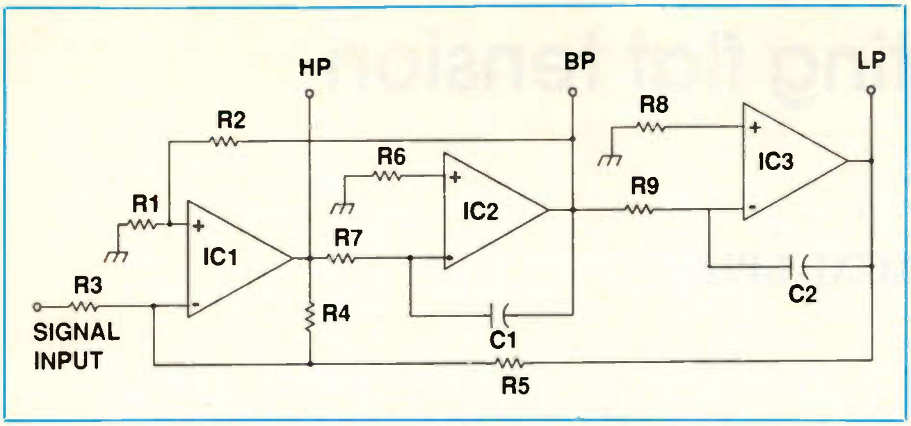


Figure 8. The state variable filter (SVF) consists of individual high, low and bandpass filters which are hooked together and "tapped" at various points (outputs) along the signal path. Some SVFs contain more that the three individual filters as depicted on the illustration, while other use only two.

off points will provide double the attenuation to a targeted frequency band than could be attained with a single high or low- pass filter that included the targeted frequency within its stop- band.

Figure 7B is a typical notch filter. Again, note that the components used in the notch filter are the same as those used in the construction of the band-pass filtering circuit, but have simply been rearranged to attenuate, rather than pass the center frequency.

Although the bandpass and notch filtering circuits depicted may be used in practical applications, they are shown here for illustrative purposes only. These circuits are very basic and will not provide quality performance. For real world applications, second, third and even fourth order filtering networks, using high, low, bandpass and band rejection techniques will provide high quality (Q) at the expense of adding more components (including op amps) to the circuit.

Additionally, formulas used in the determination of cutoff frequencies, center frequencies, bandwith and Quality are available through a number of sources, but are too complex to go into in this article. Generally speaking, however, the calculations used with passive filtering circuits will apply to active circuits, although gain (G), as well as the effects of feedback will have to be taken into consideration in all mathematical calculations.

The state variable filter

Next, and probably the most versatile of the active filtering circuits is the *state variable filter*. As is obvious in Figure 8, the SVF is nothing more than individual high, low and bandpass filters which are hooked together and "tapped" at various points (outputs) along the signal path. Some SVFs contain more than the three individual filters as depicted in the illustration, while others use only two.

State variable filters are often constructed around the IM324 op amp IC package detailed in Figure 1A in an effort to conserve limited (physical) space on the circuit board. Because almost all of the passive components used in this type of circuit are the same value, they are easily constructed, and due to their simplicity, may be altered slightly to fill a variety of needs, especially where a number of filtering applications within a particular device are required.

Although active filtering circuits which employ op amps have been lightly covered in this article, many filters which are considered "active", but do not contain op amps, are just, if not more important than the op amp based systems.

Some other filters in use today

Surface acoustical wave (SAW) filters are now being used to eliminate the need for i-f alignment (therefore the bulky coils) in television receivers. Comb filters are being used to separate color and luminance information in color televisions, resulting in sharper detail at higher brightness/color settings. Switching capacitor filters sample input signals, reinforcing those which fall within specific parameters, while averaging out to zero reinforcement when sampling undesired frequencies.

Microprocessors which convert analog signals (frequencies) into digital (binary) strings will enhance the desired data, while virtually eliminating others. This is very popular in the compact disc technology where the enhanced digital signal is (re)converted to analog.

Needless to say, active filtering circuits are here to stay, at least until something better comes along. Learning the basics of op amp based filters will provide useful insight into the inner workings of linear filtering needs of modern consumer electronics products, and other electronic devices and circuits. ■

Troubleshooting flat tension mask CRTs

Video circuitry in the ZCM-1492

By John A. Ross

The preceding article in this series, published in the October issue, discussed the design technology of the series of Zenith flat-screen monitors. This article will move away from design theory and historical backgrounding to a discussion of circuit operation and troubleshooting. Because the monitor design adds a few new wrinkles that may be applied to other video technologies, this article may prove especially valuable.

As the last article illustrates, the Zenith ZCM-1492 consists of the same essential

Ross is a technical writer and microcomputer consultant for Ft. Hays State University, Hays, KS.

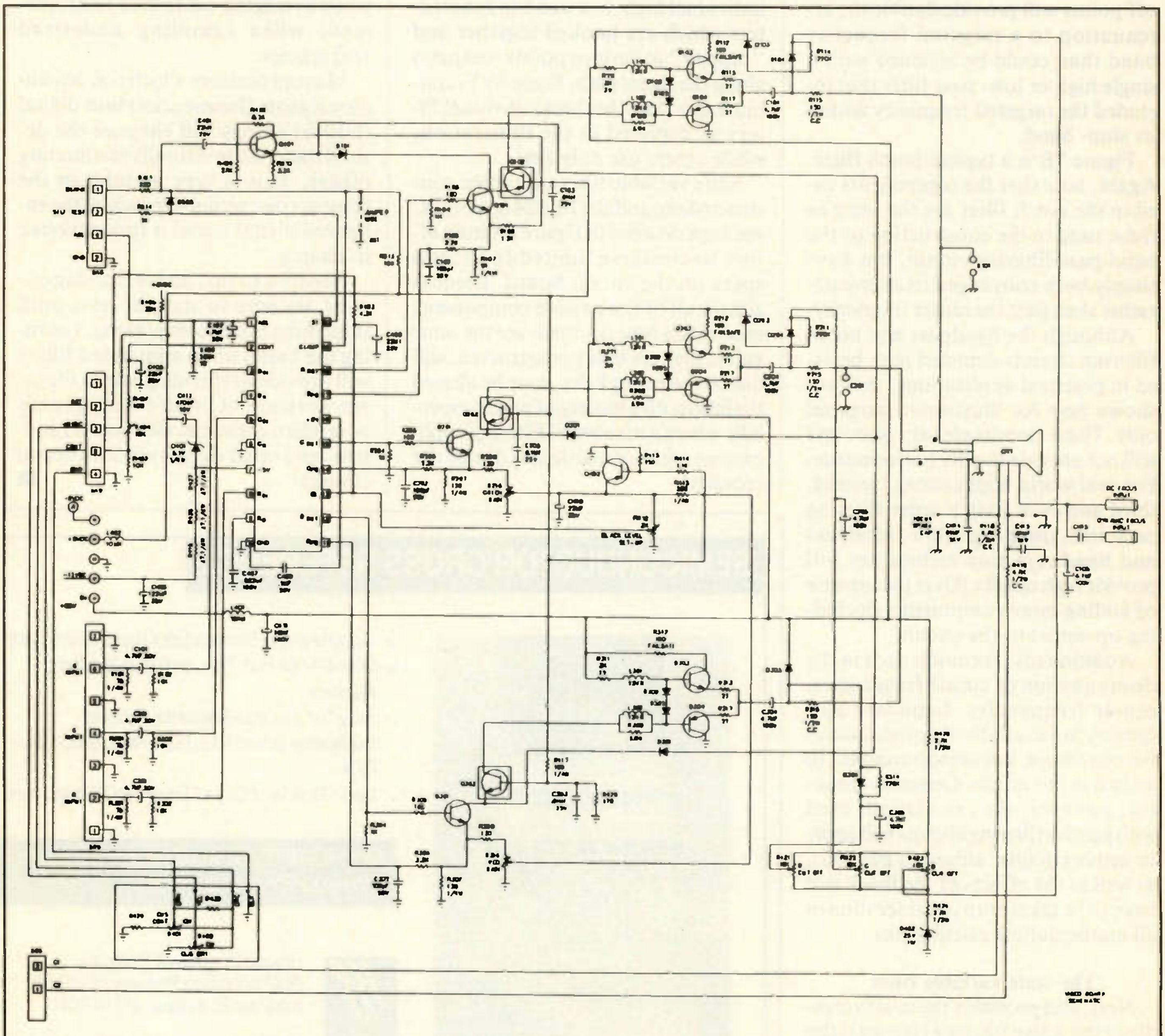


Figure 1. Video Module Schematic

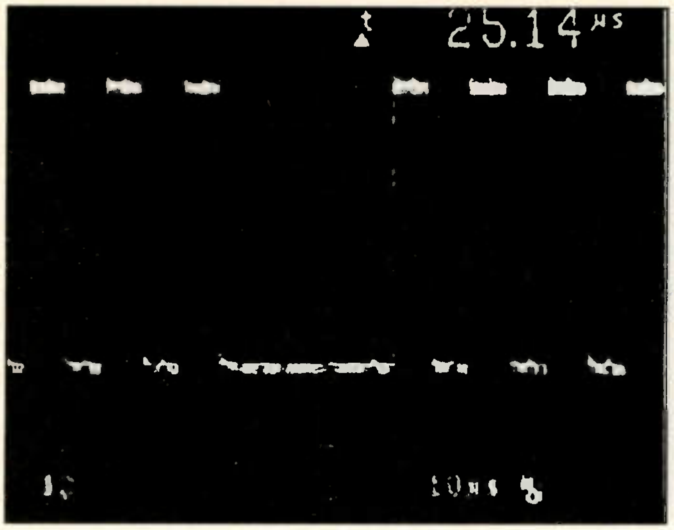


Figure 2. Waveform seen at pins 3,5,8 of IC401

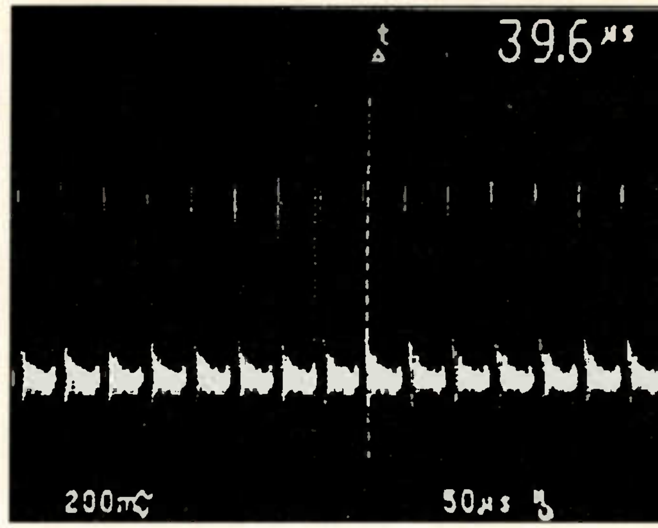


Figure 3. A,B,C, — CRT waveforms

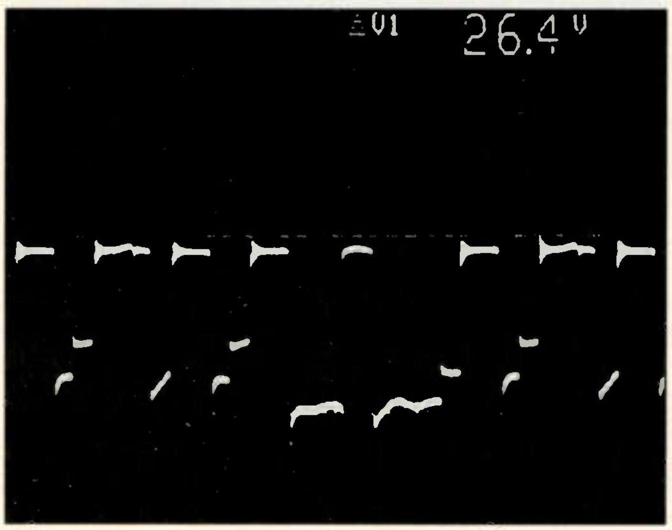


Figure 3B

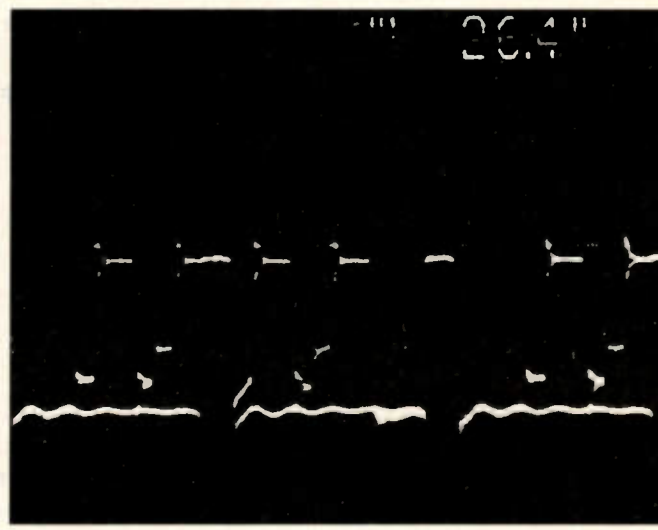


Figure 3C

pieces that normally make up other color video technologies: the video module, the deflection module, the high voltage area, the pincushion correction area and the CRT.

Video circuitry in the ZCM-1492

Figure 1 is a schematic diagram of the video output module. Video input signals enter the board through connector 5R9. On the module, capacitors C301, C201 and C101 ac-couple the red, blue and green analog color signals to the video inputs of IC401, a video amplifier. The signal outputs at IC401 are pin 12 for red, pin 15 for green and pin 18 for blue. Action in the video amplifier circuit controls most of the video signal processes.

After the video amplifier circuit processes the input signals, three different stages—the video drivers, a dc restoration circuit and a cascode output amplifier—further amplify and add to the signals. Three resistors attenuate each color signal before it couples to its respective video driver. Then, each signal becomes applied to a cascode output amplifier that allows high gain and a wider bandwidth.

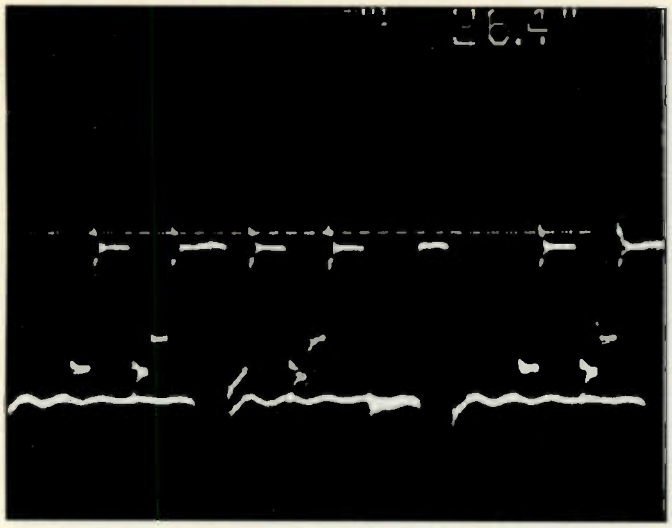
Contrast and brightness

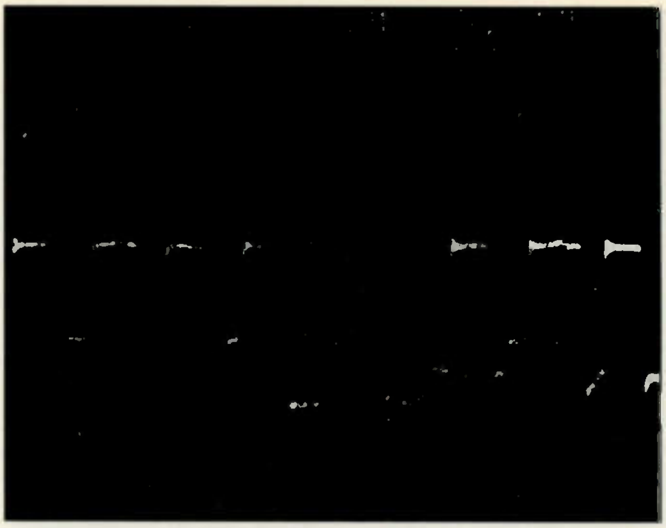
Moving back to the integrated circuit for a moment, a variable dc voltage at pin 2 of the IC, supplied through the contrast control, controls the gain of the three video signals. The voltage varies from +8Vdc at maximum contrast to 0V at minimum contrast. The contrast control, R401 (in a box at the lower left of the schematic diagram), along with R404, R432 and R407, form a voltage divider that smooths any contrast action. R112 and C111 make up an integrator that smooths the action of the control so that the variable voltage stays within three percent of its designed range.

An automatic brightness limiter circuit within IC401 also controls the gain of the video signals. In this case, the circuit causes the video signal to decrease if the average anode current goes past 450µA. The anode current is sampled at the secondary of the flyback transformer, averaged by R5111 and C5119 and then applied to pin 1 of IC401. Negative feedback produced by the ABL circuit forces the average anode current back to the 450µA level.

Video drive

The three video signals exit the video input IC and become dc coupled to the video driver transistors Q101, Q201 and Q301. For the red and green channels, resistive networks combine with a variable resistor in each circuit to control the





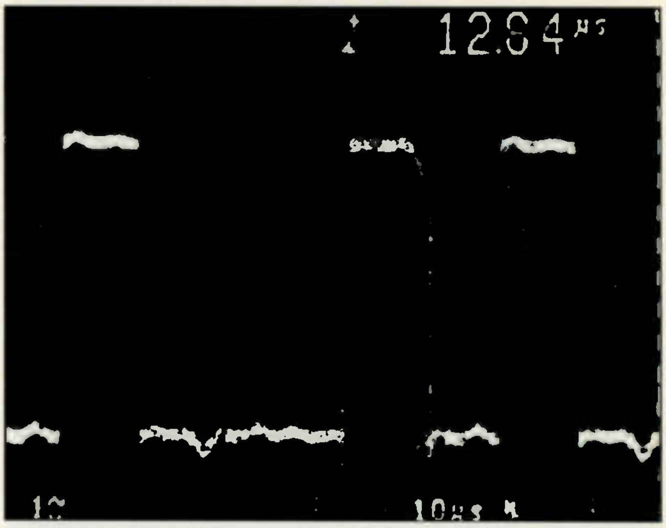


Figure 4. (Upper Left) Waveform seen at the emitters of Q103, Q203 and Q303

Figure 5. (Upper right) Waveform seen at the collector of Q 102, Q202 and Q302

Figure 6. (Lower Right) Waveform seen at pins 12, 15 and 18 of IC40F1

video gain. The gain of the blue channel is fixed.

A dc voltage produced by transistor Q402 appears at the variable resistor and at the black level reference input, pin 13 of IC401. Rotating the gain tracking control changes the amplitude of the video signal without affecting the dc bias of the video amplifier.

Because of the original ac-coupling of the video input signals to the video amplifier circuit, the dc portion of the signal is restored by a combination of transistors, integrated circuits and passive components.

An RC network in each video circuit samples the voltage at the emitter of each amplifier during the retrace interval. The sample voltages feed to pins 11, 14 and 17 of IC401. There, a comparator compares the sample voltages with a reference voltage at pin 13 of the IC. Depending on the size and polarity of the difference voltages, the comparator either charges or discharges hold capacitor C405.

Voltage developed across C405 controls the dc bias of the signal at pin 15 of IC401. During clamping, the condition of the dc restoration loop allows the black level emitter voltages of Q101, Q201 and Q301 to equal the reference voltage at pin 13 of the IC.

When clamping stops and video begins, the dc restoration loop turns off and the hold capacitor supplies the dc bias. The action of the dc restoration loop and hold capacitor provides a stable dc bias for the cascode output amplifier.

Video amplification

While transistors Q101 and Q102 function as a cascode amplifier for the blue signal, Q201 and Q202 make up the cascode amplifier for the green video signal. Transistors Q301 and 302 amplify the red video signal. The respective amplified video signals appear at the emitters of transistors Q103, Q104, Q203, Q204, Q303 and Q304 and also shows across the load resistors.

For the red, blue and green video signals, the load resistors are R314, R211 and R114. Also, at the output of each amplifier, two diodes—D102, D105, D202, D205, D302 and D305—cause each pair of transistors to operate in the class AB mode.

Additionally, the output stage isolates the collector of Q202 from the cathode capacitance of the CRT. Zenith uses the isolation to reduce the effect that excess capacitive reactance may have on the bandwidth of the amplifier.

As you know, capacitive reactance is inversely proportional to frequency and can decrease the amount of load impedance seen by the amplifier. Capacitors C104, C204 and C304 ac-couple the output from the cascode amplifier to the CRT cathode.

Troubleshooting the video circuitry

Problems that occur with the video board involve the loss or distortion of the color signals. All ZDS microcomputers include a built-in set of diagnostic aids accessible through the ROM. By simultaneously pressing the Ctrl, Alt and Ins

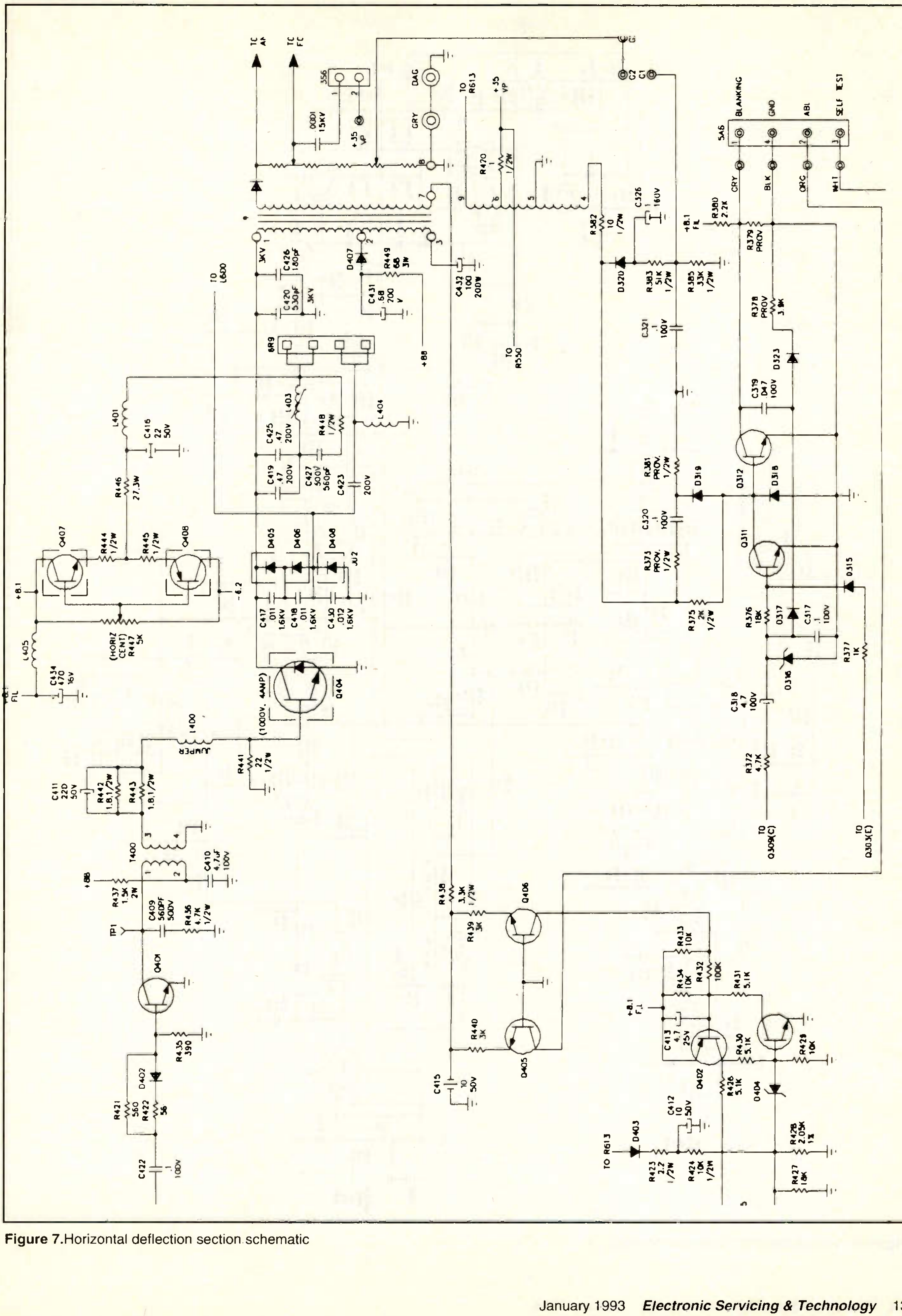


Figure 7. Horizontal deflection section schematic

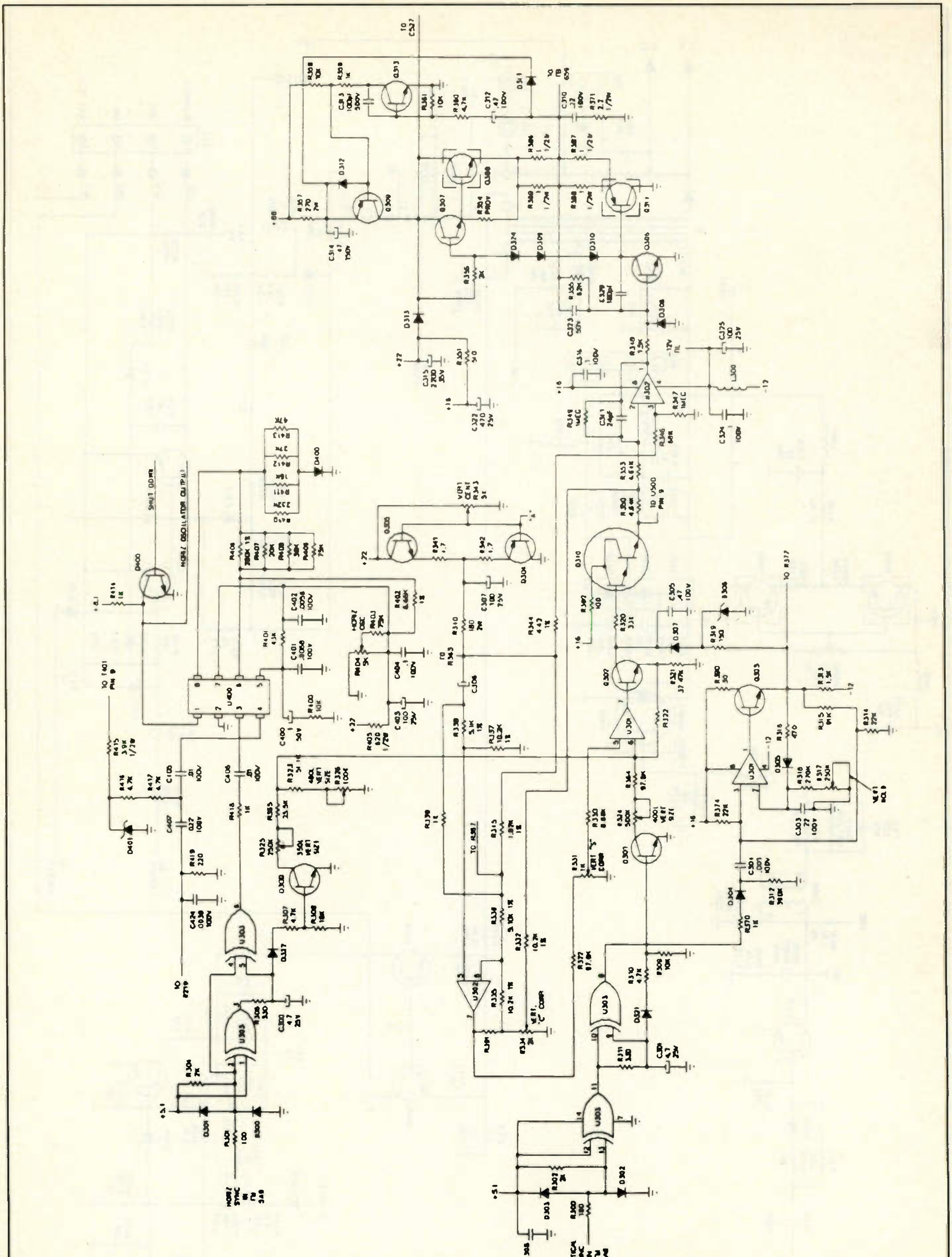


Figure 8. Vertical deflection section schematic

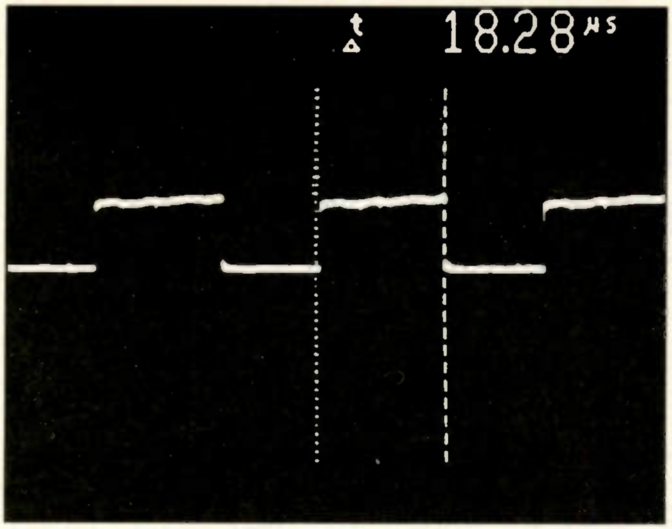


Figure 9. Waveform seen at pin 1 of U400

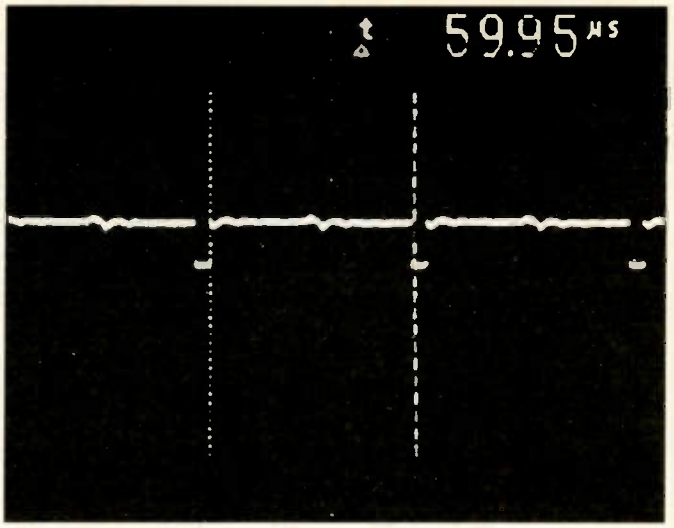


Figure 10. Wavefrom seen at pin 3 of U400

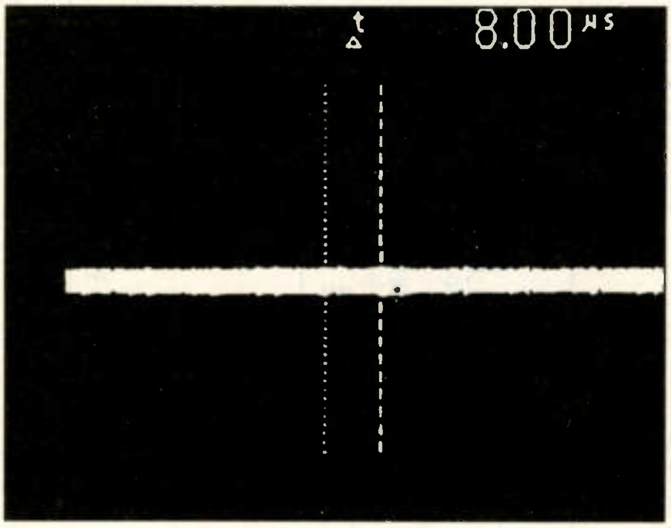


Figure 11. Waveform seen at pin 6 U303

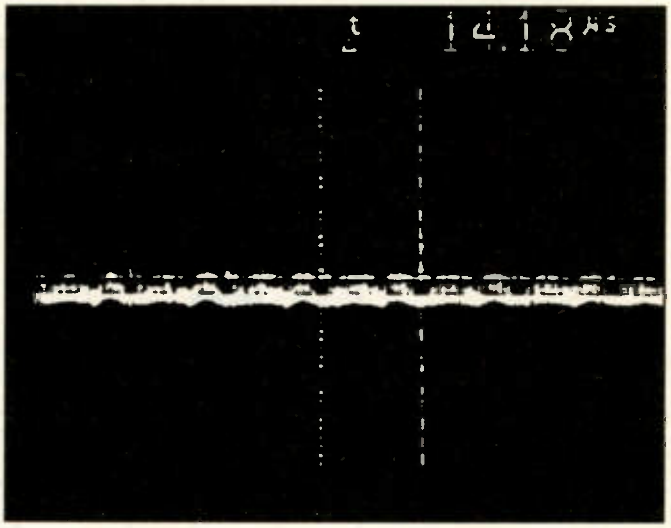


Figure 12. Waveform seen at pin 11 of U303

keys, you can gain access to those diagnostics. The use of those keys should display a prompt and the version of the system read-only memory.

In case of suspected video board problems, simple testing involves the use of color bars. At the displayed prompt, simply type C for a color bar display. If the color bars are present and appear normal, check the video gain and cut off adjustments. If the color bars are not present or are distorted, the symptoms can lead you to several different areas.

First, check the video input cable leading from the monitor to the processor. With the bulky 15-pin cable, wiring inside the cable can break due to extreme flexing or bending. To confirm a possible problem with the cable, check the waveforms at pins 3, 5 and 8 of IC401. An example of the correct waveform is shown in Figure 2. Distortion in these waveforms usually indicates problems with the cable.

If the cable does not have any flaws, check the CRT waveforms seen in Figures 3A, 3B, and 3C. Distortion within those waveforms may indicate a defective CRT. Good waveforms at the CRT tell us to begin troubleshooting the video module.

The waveform of Figure 4 should be observed at the emitters of Q103, Q203 and Q303. Any problems with this waveform may indicate defects within transistors Q101, Q102, Q201, Q202, Q301 and Q302. If the waveforms seem okay, suspect the video amplifier IC. At the collectors of Q102, Q202 and Q302, you should find waveforms such as the one shown in Figure 5. In addition, check the video output waveforms at pins 12, 15 and 18 of IC401. Figure 6 is an example of those waveforms.

If the waveforms at those points compare favorably with the figure, you can narrow your diagnosis to the circuits involving transistors Q101, Q201 and Q301. Distortion in any of those waveforms indicates problems with IC401, the video amplifier IC. Good waveforms at pins 3, 5 and 8 of the IC also are an indicator of problems within the chip.

Horizontal and vertical deflection circuitry in the ZCM-1492

The deflection module incorporates the horizontal deflection, vertical deflection and high voltage circuitry. Figure 7 is a schematic for the horizontal deflection and high voltage circuitry.

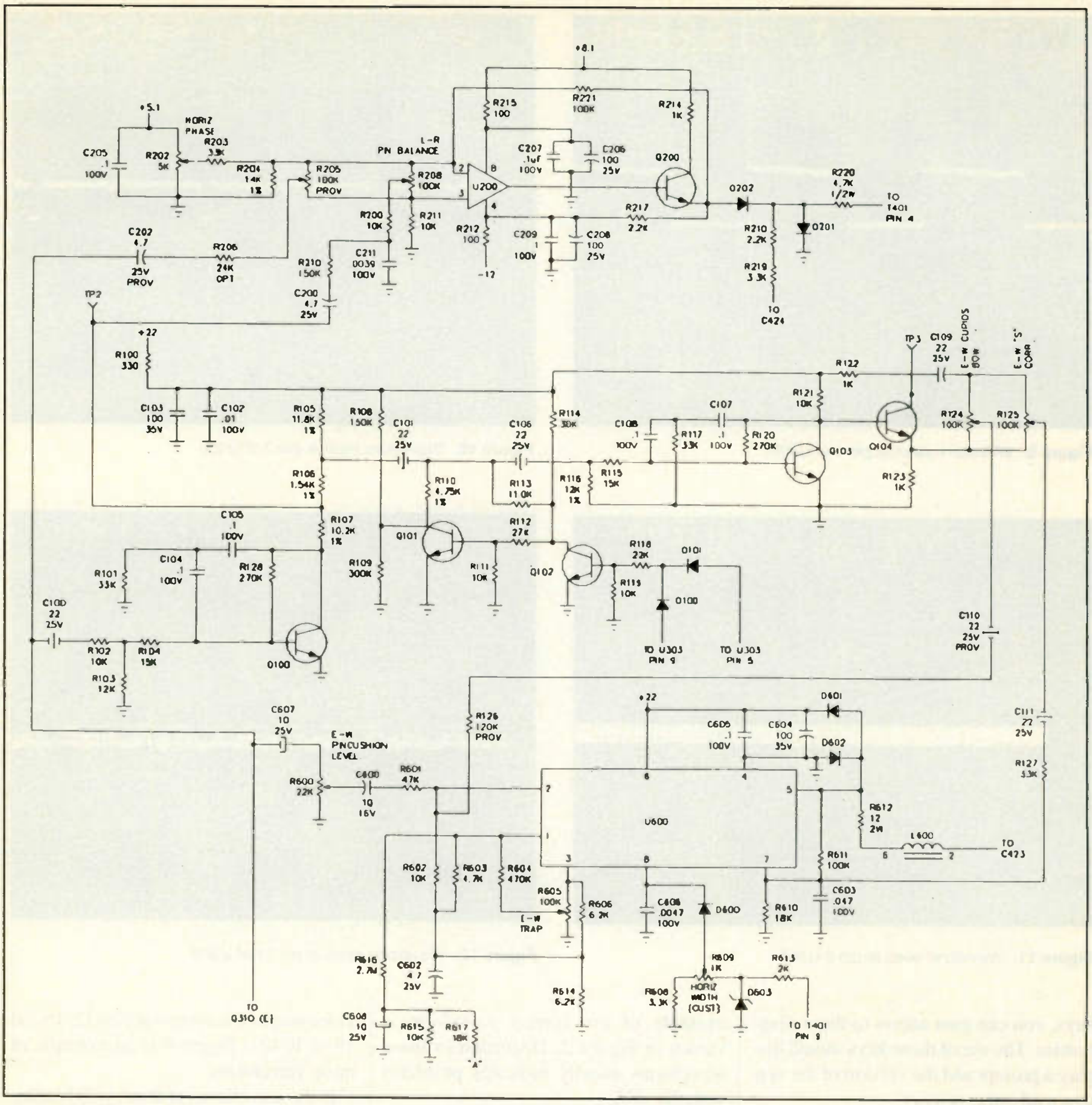


Figure 13. E-W pincushion

Horizontal deflection

The horizontal oscillator output voltage is applied to the base of Q401, the horizontal driver (see Figure 7). From the collector of Q401, the output signal from the driver goes to an interstage, impedance matching transformer. T400 steps down the B+ voltage while a waveshaping circuit consisting of C411, R442 and R443 shape the rectangular drive waveform for the horizontal output transistor.

The drive waveform is applied to the base of Q404, the horizontal output transistor. Q404 becomes cut-off during retrace and a portion of the trace. When Q404 cuts off after flyback, the damper diode, CR409, conducts and produces a portion of the trace at the left side of the raster. In addition, the damper diode suppresses oscillations that could produce white vertical bars on the left side of the raster.

The action of the transistor and the diode reduces the average amplifier current and increases the efficiency of the amplifier circuit. Also, the combination of the horizontal centering control, R447, and a voltage divider consisting of Q407 and Q408 provides electrical horizontal centering of the display.

Capacitor C318 (lower center in Figure 7) ac-couples vertical pulses from the flyback to two transistors. Transistors Q311 and Q312 use those $5.6V_{P-P}$ pulses to generate part of the composite blanking signal. After the pulse is applied to the base of Q311, conduction of Q311 brings its base to ground. Since this action turns Q312 off, +5V appears at the Q312 base during the vertical blanking interval.

The remainder of the composite blanking signal results from a similar opera-

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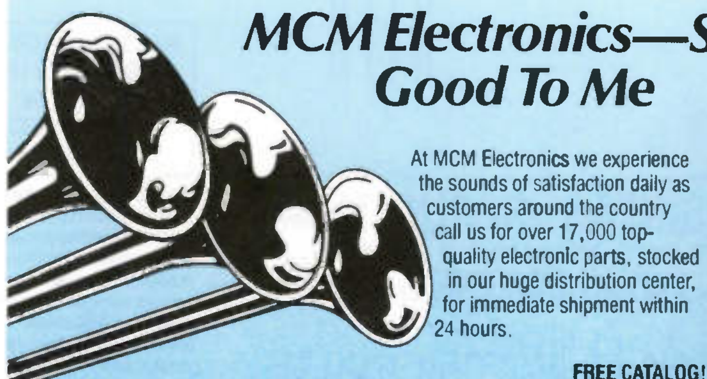

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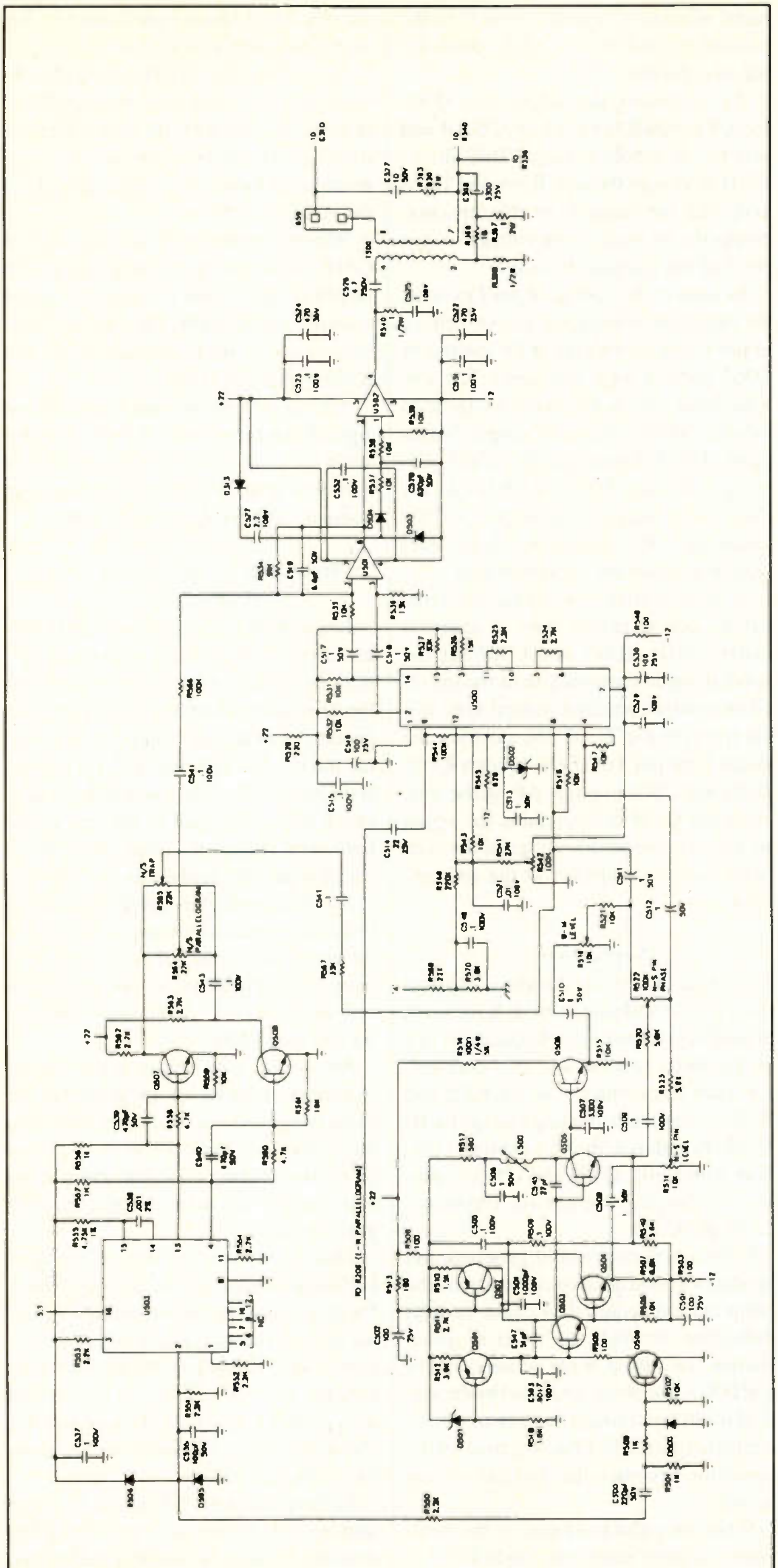

Figure 14. N-S pincushion schematic

tion. R375 couples the -70V horizontal flyback pulse to the base of Q312. With the high-amplitude, negative pulse at its base, Q312 again shuts off. Consequently, a +5V blanking pulse appears at the Q312 collector during the horizontal blanking interval.

Conduction of damper diode CR318 during the retrace portion of the horizontal flyback pulse protects Q311 and Q312 from any reverse-bias damage. During the trace portion of the horizontal flyback pulse, the conduction of the diode holds the collector of Q312 to a lower value. Given that condition, a composite blanking pulse appears at the collector of Q312.

High voltage

Output from the horizontal oscillator begins to develop the high voltage. From the base of buffer transistor Q401 and transformer T400, the horizontal oscillator output goes to the anode voltage driver transistor, Q404. The combination of the transistor and the flyback transformer, T401, produces high voltage. While the focus control determines the amount of voltage applied to the last grid of the CRT, the high-voltage resistor block is the source for the focus and G2 voltages.

If the high voltage exceeds specified limits, shutdown circuitry consisting of Q402, Q403 and D403 shuts the high voltage down. When excessive beam current occurs, diode D403 goes negative and biases Q403 on. As a result, Q402 also becomes forward biased with approximately 8V at its collector. Therefore, horizontal sync pulses at the collector of Q403 become shunted to ground. This cuts the base drive of Q404 and shuts down the high voltage circuitry.

Vertical deflection

Figure 8 is the schematic diagram of the vertical deflection section and the shutdown circuitry. Not surprisingly, the section contains circuitry for vertical signal processing and vertical deflection. U301 and Q303 control the vertical oscillation frequency while resistors R374 and R314 determine the threshold voltage at Pin 3 of U301. With Q303 configured as an emitter follower, it provides the amount of current required to quickly charge capacitors C303 and C305.

C305 charges through R319 and D307 to the zener voltage of diode D306. At pin 2 of the integrated circuit the inverting input voltage is slightly lower than the voltage at pin 2 because of the discharging of capacitor C303.

As mentioned, the output from Q303 feeds through R315 to pin 3 of U301 and sets the threshold voltage. This allows C303 to charge through R316 and D318 and, with the charging of the capacitor, delays the increase of the voltage seen at pin 2 of the integrated circuit.

As soon as the voltage at pin 2 exceeds the threshold voltage, the output voltage at pin 1 and the voltage at the emitter of Q303 go to a logic low level. The low logic level sets the threshold voltage at its original lower value and reverse biases diode D305. Consequently, C303 discharges through R318 and R317 to the threshold voltage value at pin 3. This sends the U301 voltage to a logic level high and causes the cycle to repeat.

With no applied sync signal, the vertical deflection circuit runs at approximately 45Hz. R317 and C303 set the applied signal frequency with the injected normalized positive vertical sync signal from pin 8 of U303. We can trace the signal from pin 3 of U301 through R370, D304 and C304 to pin 8. Along the way, capacitor C304 differentiates the signal so that only the positive edge of the sync pulse becomes injected at the RC network.

Vertical size

Control of vertical height is derived from the vertical size control, R327, and, depending on the mode of operation, one of the three vertical sub-size controls. Each sub-size control — R324, R325 and R326 — sets the regulating voltage for IC U301. In addition, the size controls combine with U301, Q302 and Q303 to provide a charging voltage for capacitors C303 and C305.

C305 functions as a ramp generator and produces a vertical ramp sawtooth and the ramp current required to cause vertical deflection through the vertical yoke. Earlier, we looked at the action of R319 and D307. The pulse generated by the vertical oscillator through those two components charges C305. Charging time for the capacitor becomes the vertical retrace period.

When the pulse produced by the oscillator is a logic level low, diode D307 is reverse-biased and allows C305 to discharge through U301 and Q302. The linear discharge rate of the capacitor becomes the vertical scan time.

As C305 generates the vertical sawtooth, the sawtooth feeds through R320 to buffer transistor Q310. As a buffer, the transistor keeps any unwanted noise or modulation from affecting the stability of the vertical oscillator.

With the vertical ramp at the emitter of Q310, it goes to the vertical deflection amplifier and to the pincushion control module. Additionally, the vertical ramp seen at Q310 feeds through R350 and R353 to pin 2 of U302.

After inversion and amplification, the signal feeds to the base of Q306. The transistor uses the signal to build up enough current to drive a vertical output stage that consists of Q314, Q307 and Q308.

Troubleshooting the ZCM-1492 deflection circuitry

Just as with televisions, several different circuits affect the horizontal and vertical deflection of the ZCM-1492 monitor. Troubleshooting deflection problems becomes a matter of fault diagnosis, signal tracing and component-level testing. If the monitor loses horizontal deflection, check the input signal at the base of the horizontal output transistor Q404. If the signal is present, replace the transistor.

No signal at the base of Q404 leads us to the horizontal oscillator, U400. Check the waveform at pin 1 of the IC and compare it with Figure 9. A good waveform and no horizontal deflection points to transformer T400.

Absence of a waveform at pin 1 leads to a check of the waveform at pin 3 of the same integrated circuit. Figure 10 shows this waveform. With the same symptom of no horizontal deflection and a good waveform at this point, suspect the integrated circuit.

Absence of a waveform at pin 3 of U400 leads back to connector 5A9. Check for the presence of the horizontal sync signal at the connector. The presence of horizontal sync at that connecting point may indicate a defective IC303. If you do find a horizontal sync signal at the connector, check the video connectors and the module-to-module cable.

Finding vertical deflection problem sources calls for the same process. If the monitor exhibits no vertical deflection, check for the waveform seen in Figure 11 at pin 6 of U303. If this waveform is present, but there is no vertical deflection, you can suspect the vertical deflection amplifier and transistors Q307, Q308 and Q314.

No waveform at pin 6 takes us to pin 11 of the same integrated circuit. Compare the waveform of Figure 12 with the waveform at pin 11. A good waveform at pin 11 combined with a "no vertical deflection" symptom usually indicates a problem with U302.

A distorted or missing waveform at pin 11 means that you should check the signal at pin 7 of U302. The combination of no signal at pin 7 of U302 and a vertical sync signal at connector 5A9 indicates a possibly defective U303. Otherwise, check the video connectors and the module-to-module cables.

Pincushion circuitry for the ZCM-1492

Because the flat tension mask technology CRT requires a geometrically perfect display, the ZCM-1492 monitor features a more sophisticated pincushion circuit than most color monitors in its class. Enhanced pincushion circuitry provides the correction needed to provide the correct display. In this scheme, pincushion protection breaks down into four basic sections—the east-west waveform generator and regulator, the north-south waveform generator and the north-south output circuit.

East-West

As you might guess, the east-west waveform generator affects the left and right sides of the display. Integrated circuit U600, the East-West generator, provides signal processing for the East-West pincushion correction. The generator produces three waveforms used for correcting pincushion errors.

When combined at an integrator circuit consisting of Q100 and passive components, the three waveforms form a parabolic correction waveform at its output. The passive components act as coupling devices for a vertical ramp. Figure 13 includes the schematic diagram of this circuitry.

From Q310, the ramp generator, the vertical ramp signal becomes ac-coupled through capacitor C607 to R600, the E-W pincushion amplitude control. Ac-coupling also ties the wiper of R600 through C600 and R601 to pin 2 of U600.

The B+ voltage supplied by the horizontal deflection circuitry modulates the parabolic waveform with a horizontal ramp waveform at the vertical scan rate. Zener diode D603 clips the horizontal flyback pulse and applies it to pin 8 of U600 through R608, R609 and D600. The modulating waveform corrects any distortion at the left and right sides of the raster. Trap control R605 allows some adjustment of the display for better symmetry. In effect, the control adjusts the amount of offset so that the vertical scan rate of the ramp waveform has the proper amplitude and polarity.

Another waveform at the vertical scan rate—a sine wave—is also added to the parabolic waveform. Capacitor C100 ac-couples a vertical sawtooth to an integrator formed by Q100 and its peripheral circuitry.

After integration, output from the transistor forms a vertical rate parabola that is applied to a second integrator. Q103 and its circuitry, the second integrator, form the sine wave at the vertical scan rate. The sine wave corrects any phase errors in the pincushion correction waveform.

Pins 1 and 2 of U600 make up the inputs of a differential amplifier. A resistor network consisting of R602, R603, R604, R605, R606 and R614 plus capacitor C602 set up the dc biasing for the differential amplifier. Operation of the differential amplifier controls the production of the proper correction waveform.

If the vertical size changes, the vertical ramp compensates for the change. If the horizontal size changes, B+ voltage supplied to the horizontal deflection circuitry is sampled. The circuitry uses the sample to adjust the correction waveform.

North-South

Figure 14 is the schematic for the north-south pincushion circuits, the circuits that affect the top and bottom of the display. From our work with television electronics, we know that top and bottom pincushioning works by modulating the vertical sawtooth at the horizontal rate. In other words, the circuit increases the vertical deflection at the top center and bottom center of the display.

In the circuit of Figure 14, U500, or the north- south output circuit, provides the current needed to modulate the vertical signal at the horizontal rate. From U500, the output couples to U501, an operational amplifier. The positive polarity portion of the output goes across pin 6 of the op-amp while the negative portion of the output is applied to pin 12 of U502. Pin 6 and pin 12 respectively serve as the non-inverting and inverting inputs to the operational amplifier. In addition to the output signals, R564—the parallelogram control—also adds a signal to the non-inverting input.

Using gain provided by the op-amp, the power amplifier, U502, drives a step-up transformer, T500. From the perspective of the schematic, you may be able to see that the secondary of T500 is in series with the vertical yoke. However, the output of the vertical scan circuitry is at ac ground with respect to the horizontal rate signal.

Because the yoke coupling capacitor and resistor have low impedances, the transformer secondary and yoke work as if they paralleled one another. Because of the parallel operation, the north-south correction waveform superimposes onto the vertical output signal.

As the electron beam moves from the top of the display to the center, the correction waveform reduces in amplitude. When the beam moves from the center of the display toward the bottom, the correction waveform reverses phase and has an increasing amplitude.

Troubleshooting the ZCM-1492 pincushion circuitry

Finding solutions to pincushion problems involves checking waveforms throughout the pincushion circuit. Before checking those waveforms, though, look at a crosshatch pattern display. If the display is not symmetrical, use the pincushion adjustment to bring back the symmetrical display. If adjusting the pin cushion control does not affect the display, then determine whether the east-west or north-south circuitry has a fault. In addition, remember that signals from the vertical and horizontal deflections affect the pincushion circuits.

Next month

The next article in this series rounds out our look at VGA video display technology with a look at VGA display adapters. The article will address the technology behind the adapter and also include information about troubleshooting the card. ■

Books

CET Exam Book 3rd Edition, By Dick Glass and Ron Crow TAB Books, 304 pages, 180 illus, $17.95.

A companion to The CET Study Guide, this handbook has helped thousands of technicians prepare for their CET exams. As president of the Electronics Technicians Association (ETA) and former director of Certification for ETA respectively, Dick Glass and Ron Crow lend expert guidance on the topics covered on the CET tests.

With the right balance of theory and practice, The CET Exam Book thoroughly explains the principle of troubleshooting, repairing, and maintaining electronic equipment. It also provides many sample tests, so readers can effectively gauge their progress and determine what subjects they need to study most.

TAB Books, Blue Ridge Summit, PA 17294

The Modern Measuring Circuit Encyclopedia, By Rudolf F. Graf, TAB Books, 240 pages, 300 illus, $12.95.

This reference features the latest circuit technology used to monitor electronics applications. Electrical engineers, technicians, and students gain access to creative circuitry ranging from bridges and battery testers to probes and volt meters, all presented in their original form to eliminate any possibility of transcription error.

Organized alphabetically by application for readers with specific interests, this handy benchtop companion contains up-to-date measuring circuits. The book features strong organization, painstaking accuracy and ease of use and focuses on specific types of circuitry. The author supports each circuit diagram with required specifications, a brief explanation of how the circuit works and what it's used for, and its original source.

TAB Books, Blue Ridge Summit, PA 17294

Dictionary Of Computing, By Jonar C. Nader, Prentice Hall, 540 pages, $24.95, paper.

This comprehensive, illustrated computing dictionary, includes official international standards, illustrations, tables and a style manual for correct usage of computer terminology. Over 150 people and 95 companies helped the author compile thousands of computer terms. Each entry describes the meaning behind the words, phrases, acronyms and abbreviations used in present day technology in a wide cross-section of business and industry. The book also highlights the history of the computer industry so that you can learn about the products, events, discoveries, inventions, and people behind the computer industry. The book looks to the future by covering new directions in database management, microchip technology, robotics, fiber optics and the use of satellites in information technology. The book covers a comprehensive cross-section of the computer industry: artificial intelligence, benchmarking, communications, desktop publishing, expert systems, fiber optics, graphic arts, hardware, information technology, JCL, keyboards, languages, memory, networking, operating systems, printers, query languages, robotics, software, typography, UNIX, virtual reality, and windows.

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The Digital Pot

By Vaughn D. Martin

Control of most audio circuits is still accomplished the same way it has been for the last fifty years. The control element is the mechanical potentiometer. From the volume control knob to the sliders on an equalizer, the control judge is a human — the feedback is through the ears. Microprocessors have entered nearly every other segment of electronics, including the audio segment, but they always are stopped by the mechanical potentiometer.

This article focuses on microprocessor control of conventional audio circuits through the use of digitally controlled potentiometers. However, these devices can be applied to many other applications as well.

Conventional audio control

Designs incorporating mechanical potentiometers are still found in the majority of audio applications. The volume control on most car stereos is a rotary potentiometer. Volume control circuits generally resemble Figure. 1. In this design, the potentiometer is used to control the signal reaching a fixed gain amplifier section. A potentiometer in this application would likely have a logarithmic taper, since volume is a logarithmic function.

Tone controls can vary from single pot and capacitor circuits to complex active filters. The Baxandall filter network has been the workhorse of the audio industry for years. This design, illustrated in Figure. 2, utilizes two linear taper potentiometers to control the gain of an active filter. In this configuration, the potentiometer replaces a portion of both the input and feedback resistors. By moving the position of the wiper, both resistors change in opposite directions.

Graphic equalizers are one of the fastest growing modes of audio control. A graphic equalizer contains a group of bandpass filters, usually seven. Each filter has a potentiometer controlling the gain to that band pass. Potentiometers generally appear as sliders on the face of the equalizer.

A typical graphic equalizer schematic is shown in Figure. 3. EQs are used to compensate for the imperfections of a listening environment by boosting or cutting gain at specific frequencies. By using a spectrum analyzer and a "pink" noise generator, the response of an audio system can be customized for a particular room or concert hall. This is accomplished by inputting a desired response to the system—generally flat across the audio band, with some attenuation at higher frequencies, often referred to as "pink" noise. The equalizer is then adjusted until the system output, displayed on the spectrum analyzer, closely matches the pink noise input.

This process of matching a system to a room is often referred

Martin is Chief Engineer in the Automatic Test System Division at Kelly Air Force Base

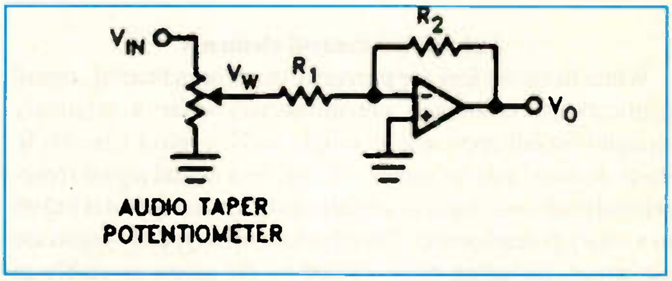


Figure 1. A conventional pot used as a volume control

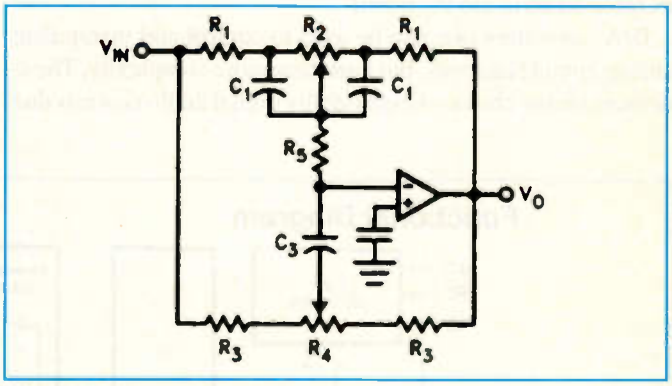


Figure 2. A baxandall control

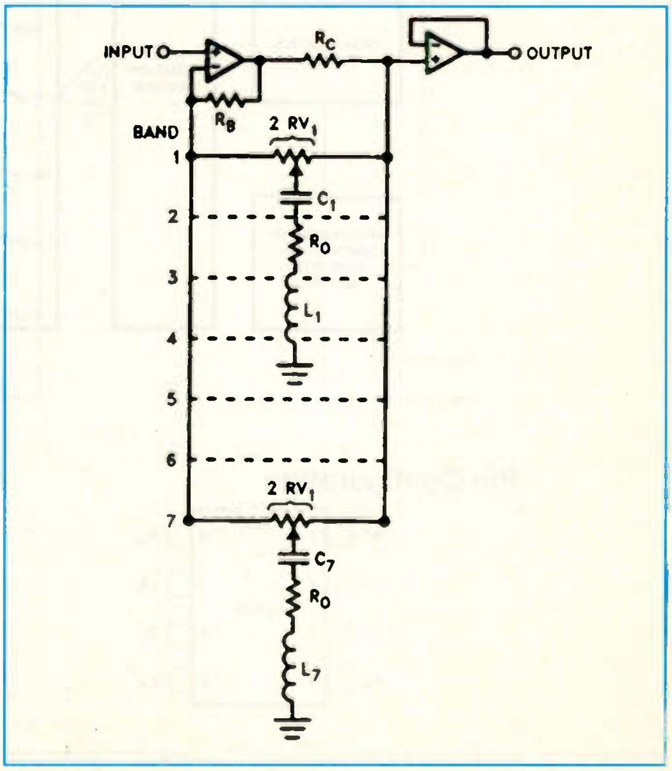


Figure 3. A graphic equalizer configuration

to as environmental calibration. It is a process requiring the listener to read the display of the spectrum analyzer and manually adjust the potentiometer/sliders of the equalizer.

The heart of the control of each of the circuits described earlier is the mechanical potentiometer. Automated control of these devices is a challenge. Clearly, microprocessor control of these functions is desirable. The control elements utilized for automated control are discussed below.

Automated control elements

While these devices are primarily used for industrial control applications, motorized potentiometers offer a relatively straightforward approach to simple audio control circuits. In these devices, a dc reference voltage, or a digital signal representing position is input to a small motor assembly that is linked to a rotary potentiometer. Drawbacks to this type of system are numerous, including noise caused by the motor assembly as well as the increased space and power requirements of placing a motor on an audio PC board.

D/A converters can also be used to control and manipulate analog circuit functions, but introduce more complexity. These devices are the choice of high fidelity digital audio controls due to their high precision. But for the analog circuit designer, they can be a little intimidating. For example, one way to control volume with D/A converters is illustrated in Figure. 4. In this circuit, the signal is sampled with an A/D converter, manipulated by a microprocessor, and returned to the analog world with a D/A converter. This design entails sampling, real-time processing, as well as A/D and D/A conversions. Not only may the analog designer be faced with portions of his circuit that may be unfamiliar, the results may be overkill.

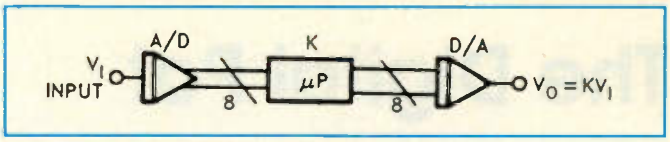
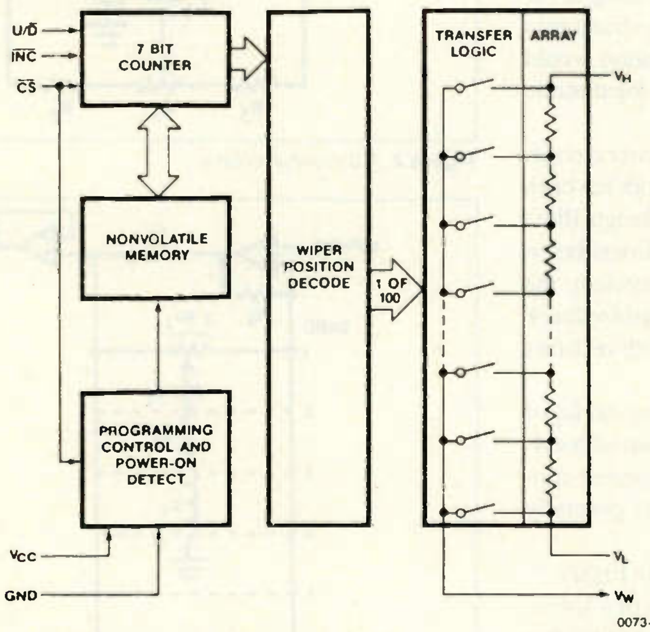


Figure 4. An A/D and D/A controlled volume control

The digitally-controlled pot

An array of resistors with a wiper tap that can be selected with digital control offers many advantages of the microprocessor world without the complexity of D/A conversion. These are referred to as digitally controlled potentiometers. Logic circuits, counters, and memory circuits are often teamed

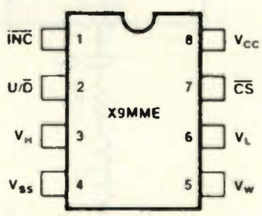
Functional Diagram



Mode Selection

CS	INC	U/D	Mode
L	↓	H	Wiper Up
L	↓	L	Wiper Down
↑	H	X	Store Wiper Position

Pin Configuration



Pin Names

V_H	High Terminal of Pot
V_W	Wiper Terminal of Pot
V_L	Low Terminal of Pot
V_{SS}	Ground
V_{CC}	System Power
U/D	Up/Down Control
INC	Wiper Movement Control
CS	Chip Select for Wiper Movement/Storage

Figure 5. The Xicor X9MME digitally controlled pot

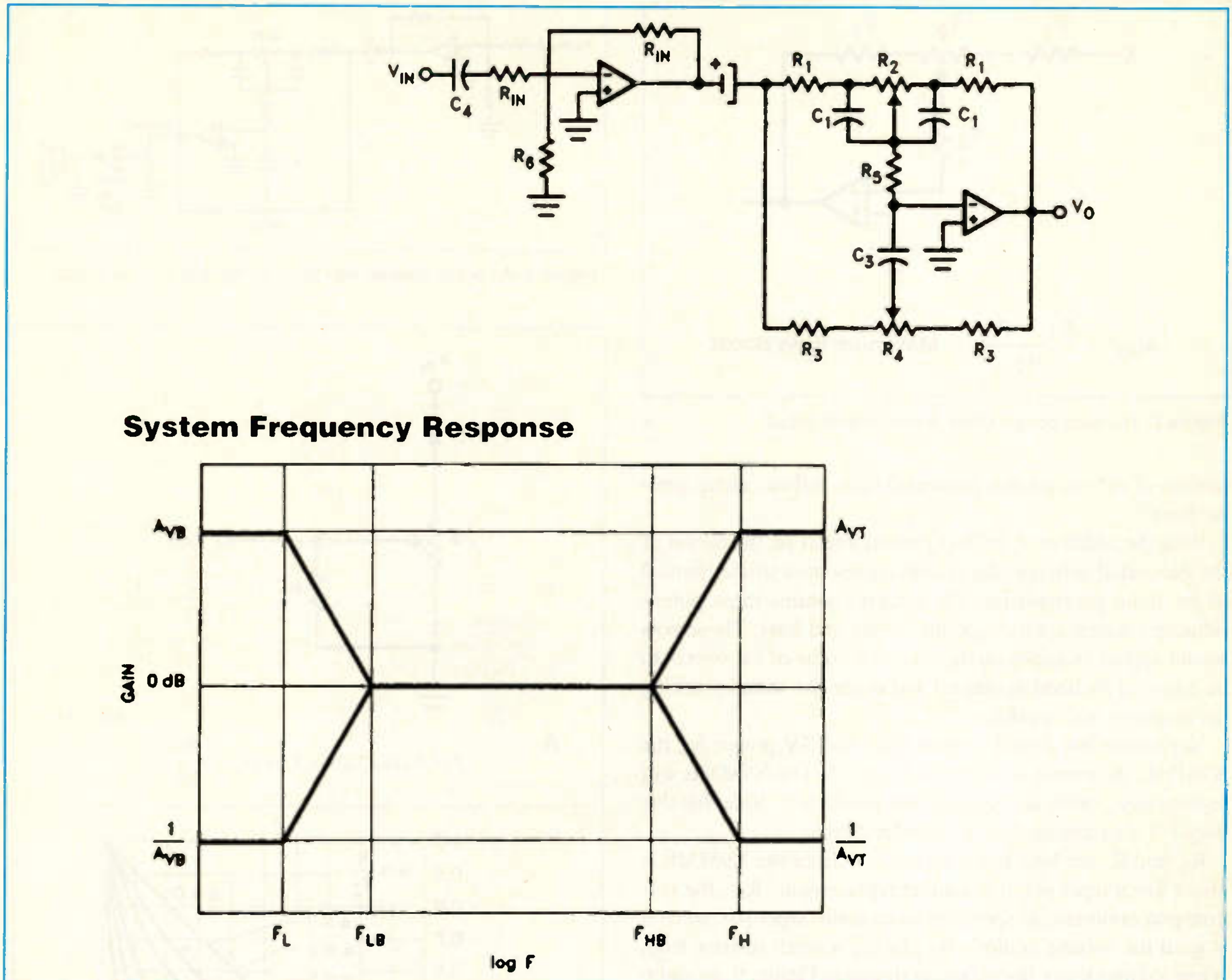


Figure 6. An active filter preamplifier

up with resistor arrays to accomplish an approximation of potentiometer control. Recently, a few manufacturers have introduced devices which incorporate many of these functions in one device. Examples are Xicor's X9MME, Toshiba's TO9169AP, and National's LMC835.

The Toshiba and National parts are designed around specific audio applications and are distinctively different from the Xicor device. They incorporate features that lend themselves well to audio designs, but are not intended for general purpose potentiometer replacement. Moreover, they offer only a limited number of wiper positions.

Xicor's X9MME combines a single 99 position potentiometer with three line digital controls. Figure 5 contains a functional diagram, pin description and mode selection for the device. In addition to the internal counter circuitry for wiper position control, this part also incorporates nonvolatile memory to retain wiper position. It has been designed as a digitally controlled replacement for the mechanical potentiometer. With its conventional three terminal potentiometer design, it integrates easily into existing analog designs.

To illustrate digital control of potentiometer circuits, the X9MME from Xicor was used to replace mechanical potentiometers in a well known audio circuit. The following should demonstrate the ease of designing with the X9MME as well as the advantages of microprocessor control in audio circuits.

The X9MME in an audio circuit

The Baxandall tone control circuit is the basis for the designs shown here. The following sections will discuss the principles behind the Baxandall circuit and then walk through the design utilizing the X9MME. Special design considerations for the X9MME will be discussed, and the performance and operation will be evaluated.

The Baxandall circuit, its response, and equations for gains and filter frequencies are shown in Figure. 6. This circuit contains two active filters whose gain is controlled by two potentiometers. Figure 7 illustrates the bass portion of the circuit. The maximum gain of this circuit is at low frequencies, where the capacitors in the circuit can be considered to be open circuits. The capacitors have been omitted for clarity. (The treble

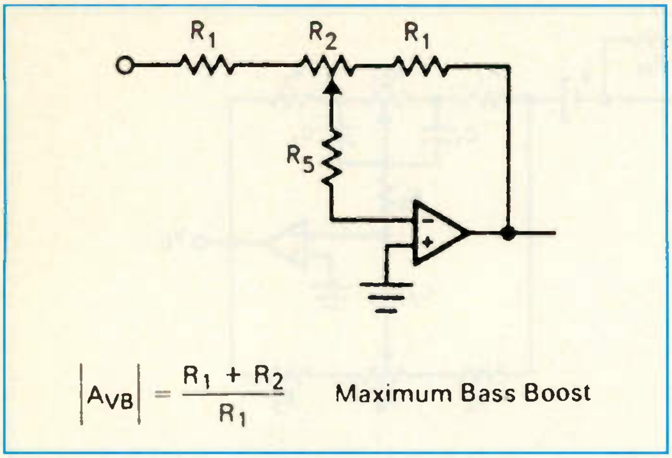


Figure 7. The bass portion of the active preamp circuit

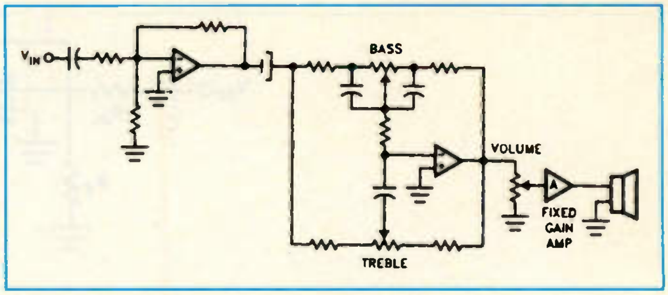


Figure 8. An active preamp with bass, treble, and volume control

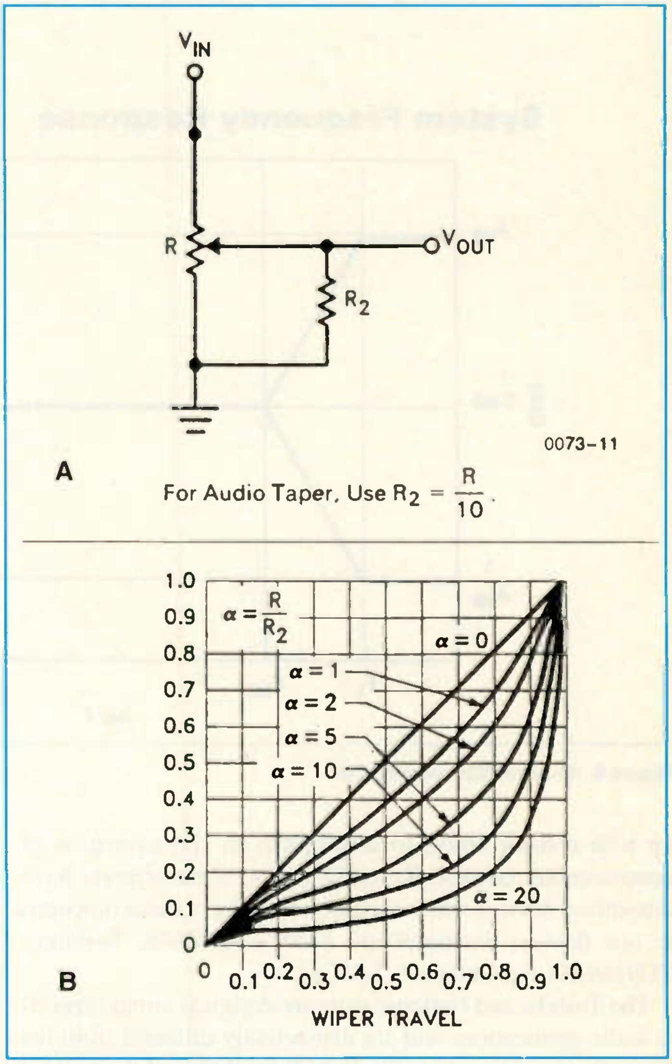


Figure 9. Trimming a pot with an external resistor

portion of the circuit, not illustrated here, follows along similar lines.)

With the addition of another potentiometer on the output of the Baxandall network, the system represents a single channel of an audio preamplifier. The circuit contains three potentiometers which control volume, treble and bass. These pots would appear as knobs on the face of a home or car stereo, to be adjusted by hand to control and shape the sound reaching the amplifier and speakers.

Neglecting the digital control lines and 5V power for the X9MME, the circuit is shown in Figure. 8. The X9MME will replace bass, treble and volume potentiometers. Note that this does not alter analog design considerations.

R_2 and R_4 are both linear taper pots. Since the X9MME is also a linear taper pot, it is a direct replacement. R_V, the volume potentiometer, is specified as an audio taper pot, since it is used for volume control. By placing a small resistor from wiper to low on any linear pot, as shown in Figure. 9, an audio taper can be approximated. In this case a resistor of one-tenth the total pot resistance is a close approximation of an audio pot (reference 1).

This circuit is designed to have a gain of one across the entire audio range, with the potential for a boost or cut of 20 dB at the frequencies selected by the designer.

The design

The design chosen is intended for car stereo applications. It should therefore operate from a single ended, 12V supply and adapt well to speakers that are commonly used in automobiles. Considering the limited bass response of most car speakers, the bass boost or cut should not be so low that the speakers cannot reproduce the sound.

The desired circuit would operate from a 12V power supply, have a 20dB boost or cut at 100Hz (bass) and 10kHz (treble). The available resistor values for the X9MME are 10K, 50K, and 100K.

Steps in the design:

1. R_2 = 50 kilohm (arbitrary, X9503)

The design must start somewhere. This value was actually determined after running through the design a couple of times and comparing the values determined for the potentiometers with those available.

2. $A_{VB} = 1 + R_1/R_2$; for 20 dB (10),
$R_1 = R_2/9 = 5.6$ kilohm

The bass portion of the circuit must have a maximum boost of 20dB. This is determined with the bass pot all the way to the input side. A quick look at Figure. 8 illustrates this.

Here, the formulas for the cutoff frequencies of the active filters are broken down to determine the element values to use.

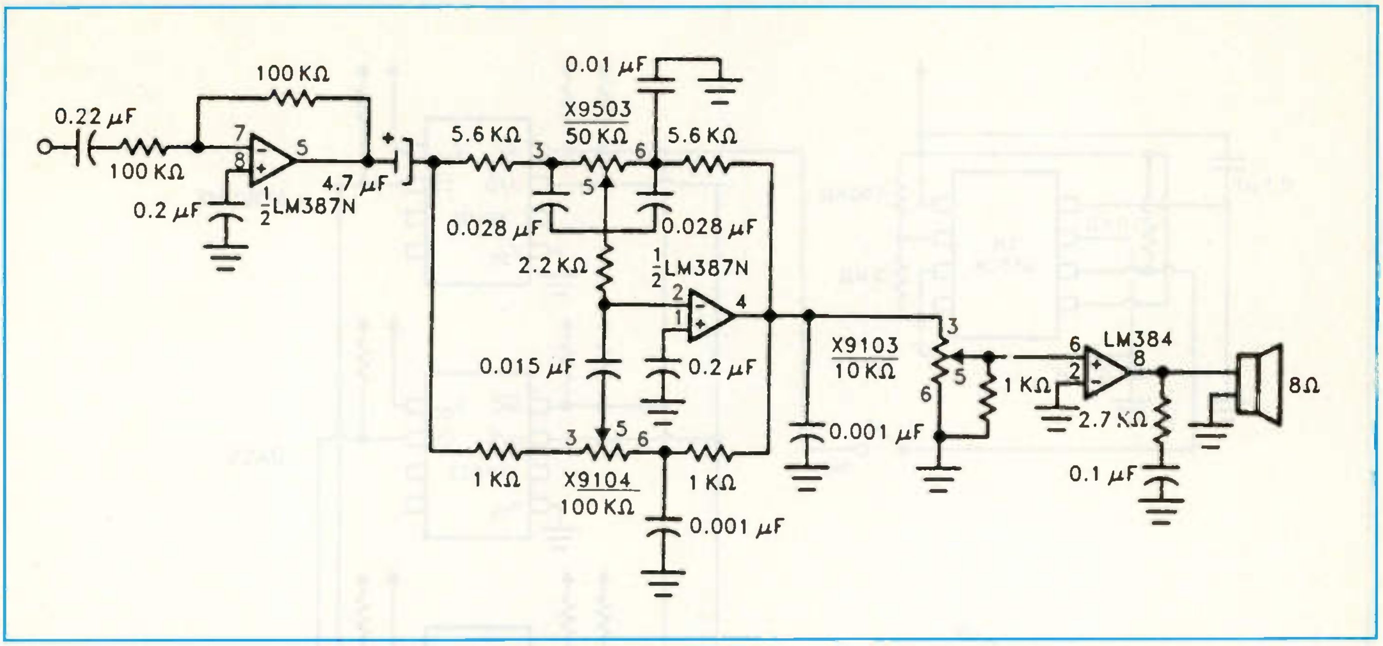


Figure 10. A preamp with three digital pots (No digital controls shown)

Here, the maximum treble gain is calculated in similar fashion to the maximum bass gain.

The circuit with the X9MME inserted is shown in Figure. 10. These are the values that were used in lab experiments and for demonstration purposes.

The X9MME can be a source of high frequency noise. There are internal voltage generators on the device which are used to operate switches internally as well as to store information into the device's nonvolatile memory. The principal noise frequencies begin at approximately 150kHz, and while this is

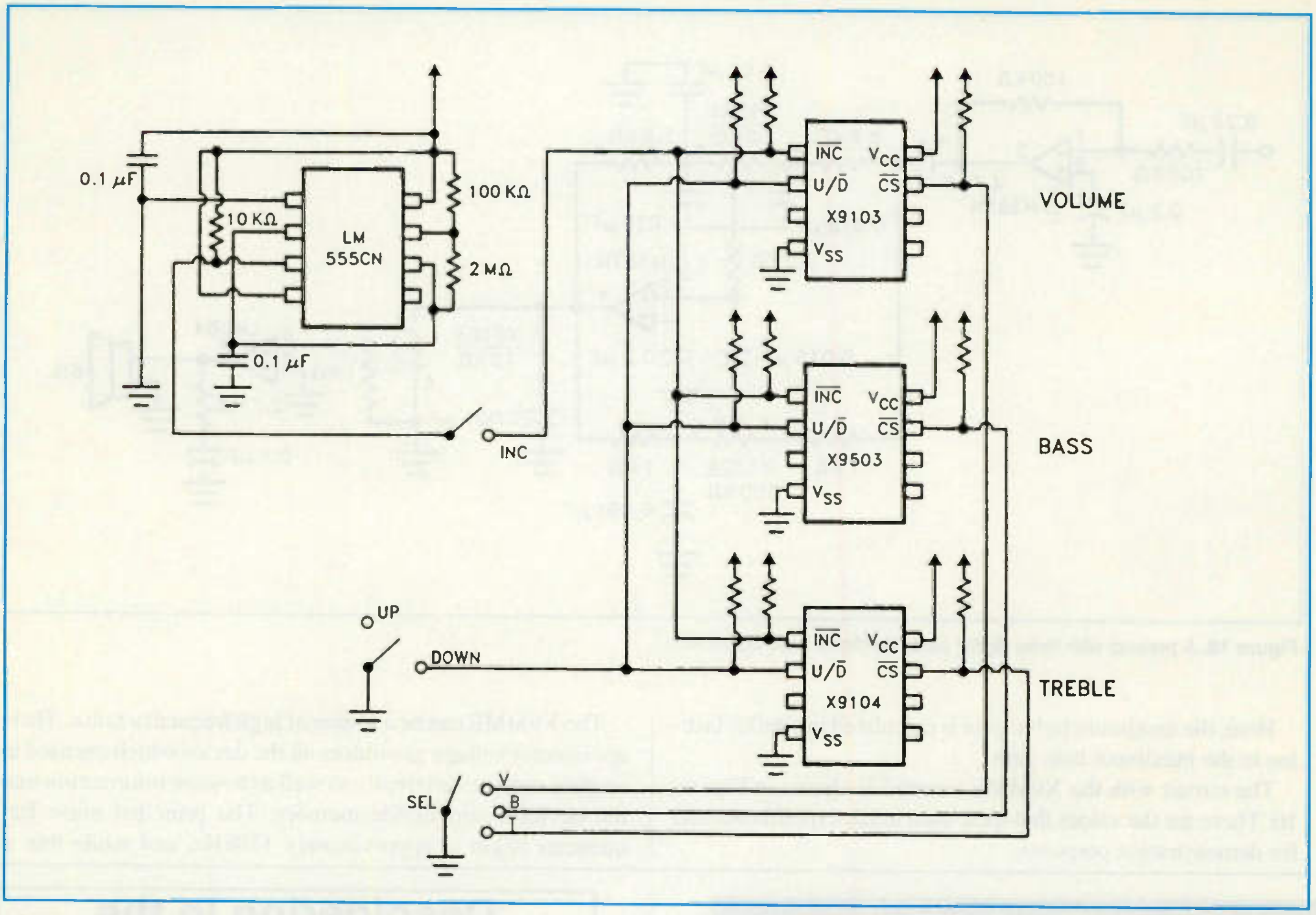


Figure 11. Switch network for manual operation

beyond the audio range, it can still be a source of problems in the circuit. Capacitors were added around the X9MME to filter noise. These are included in Figure 10.

Digital control

The digital control lines of the X9MME are INC, CS, and U/D. CS (chip select) allows the wiper to be moved. U/D (Up/Down) determines the direction in which the wiper will move, the INC (increment) initiates movement on its falling edge. CS is also used to store the wiper position in nonvolatile memory. When CS is returned high, a store operation is commenced.

When initially designing with the part, it was helpful to assemble a simple switch system for controlling the parts. A 555 timer was used to generate a fairly slow clock pulse and connected through a momentary switch to the increment pin of each X9MME. With pull up resistors on each digital line, a grounding switch was connected to U/D and another to CS. To move the wiper up, CS was set to ground, U/D to 5V and INC pulsed with the clock. Each step of the clock produced a 1% change in wiper position. Figure 11 illustrates the switching network that was utilized for controlling all three X9MMEs.

This initial procedure allowed the analog portion of the design to be separated from the digital. Once the circuit was functioning adequately with the switch network controlling the X9MMEs, microprocessor interface was relatively simple.

Microprocessor interafce

With three devices on the board, 9 control lines are required. To simplify interface to an 8 bit microprocessor, the INC lines for all three parts were connected to the same pin.

The pin configuration used for interface to the 6502 microprocessor system is as follows:

1 = Volume
2 = Bass
3 = Treble

To move the wiper of a given pot, that pot's CS is brought low, the U/D for the appropriate pot is asserted H or L depending on the direction of wiper movement, and INC is toggled. For example, to increase the volume the following two patterns are alternated to the port connected to the E^2 PREAMP.

NC	INC	CS	U/D	CS	U/D	CS	U/D
1	0	0	1	1	1	1	1
1	1	1	0	1	1	1	1

Note that CS has been selected, U/D set to 1 and INC toggled. Bass and treble settings are altered in a similar manner. The microprocessor system used in the lab consists of a 6502 based keyboard monitor. The controlling program scans the keyboard for a recognized ASCII character which transfers control to the specified subroutine. For any given input, the appropriate increment is toggled 10 times before returning to the controlling program.

An example of a volume, bass, or treble adjusting program, in the microprocessor's mnemonic code, follows:

```
     LDX  #00   Load counter with zero
0333 LDA  0006  Load accumulator with first pattern
     STA  A000  Output pattern
     JSR  ED2C  5 ms wait
     LDA  0007  Load 2nd pattern
     STA  A000
     JSR  ED2C
     INX
     CPX  0008  Compare counter to 10
     BNE  0333
     RTS
```

In addition to the adjustment subroutines, an initialization subroutine can also be called up. This subroutine sets the volume to zero and bass and treble to 50%. This is used to reset the controls. It would be used only during installation of the system.

This first section of the one time initialization program sets all pots to zero.

```
     LDX  #00   Load counter with zero
0111 LDA  0000  Load accumulator with first pattern (80h)
     STA  A000  Output pattern
     JSR  ED2C  5 ms wait
     LDA  0001  Load 2nd pattern (C0h)
     STA  A000
     JSR  ED2C
     INX
     CPX  0008  Compare counter to 100
     BNE  0111
```

This section sets the bass and treble pots to 50% and returns control to the controlling routine.

```
     LDX  00    Load counter with zero
012C LDA  0003  Load accumulator with first pattern (85h)
     STA  A000  Output pattern
     JSR  ED2C  5 ms wait
     LDA  0004  Load 2nd pattern (F5h)
     STA  A000
     JSR  ED2C
     INX
     CPX  0005  Compare counter to 50
     BNE  0333
     RTS
```

Operation and performance

The E^2 preamp circuit operates much like many sophisticated home stereo systems today. All controls are digital switches—in this case, a keyboard for demonstration purposes only. There are no moving parts beyond the switches, and the entire system is relatively free from problems with vibration or jarring (potential hazards in mechanical pot systems).

Keys 1 through 6 on the keyboard represent the up down controls for the circuit. By depressing 1, the volume is increased by 10 steps. Key 2 decreases volume in the same way; 3 is treble up; 4 is treble down; 5 is bass up; 6 is bass down. The I key calls the initialization routine. Beyond allowing control of step size and the auto zero or initialize function, the present system does not take advantage of the versatility of microprocessor control.

Performance of the system was nearly identical to the same circuit with mechanical potentiometers. The X9MME is quiet to -65 dB below a 1V signal, which is fair for audio quality devices. For audiophile quality, this number should be around -120 dB, but in car stereo or communication equipment applications this device works adequately.

Aside from the obvious advantage of a smaller number of moving parts, the ability to choose step size in adjusting the controls has shown to be the most useful added feature. Ten steps per adjustment proved to be an easy value with which to work.

Having demonstrated the ability of the X9MME to replace mechanical potentiometers in analog circuits, more complex circuits may now be considered. With microprocessor control, advanced circuit design and digital control simply becomes an extension of the principles discussed so far.

Microprocessor control of this and other analog circuits is simple when utilizing a digitally controllable potentiometer. The gain of the entire circuit, or the boost or cut of a given frequency range is instantly alterable via microprocessor commands. Once control is assumed by the microprocessor, any parameter of the analog circuit that is controllable by a potentiometer is available to the programmer.

For example, the graphic equalizer/spectrum analyzer combination discussed earlier can easily be automated once microprocessor control is assumed. By controlling the position of potentiometers that control the gain of the individual equalizer bands, the system frequency response can be calibrated to any room or listening environment.

Here is just one scenario: A "Calibration" button is depressed on the equalizing circuit. This activates a "pink" noise generator which sends a short burst of sound to the system. The spectrum analyzer in the system then decides which frequencies require adjustment, changes the positions on the appropriate potentiometers, and the system is calibrated. No sliders need to be adjusted; no separate (and expensive) spectrum analyzer; moreover, a relatively unsophisticated user can now perform an accurate environmental calibration of the system.

A simpler version of an auto calibration circuit could be incorporated into home and car stereos as a one time only installation adjustment. When a car stereo is first installed, the installer would push the calibration button on the back of the unit. This would adjust a compensation circuit, separate from the main tone controls. The settings would then remain in the nonvolatile memory of the digital pots until the system was upgraded or installed into another car. Thus the same unit would be customized for different speakers, different amplifiers, and even different auto interiors. ■

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2. National Semiconductor Corp., "Product Data Sheet, LMC835", April, 1984.

3. Toshiba Corp., "Product Data Sheet, TC9169AP-TC9170AP" June1985.

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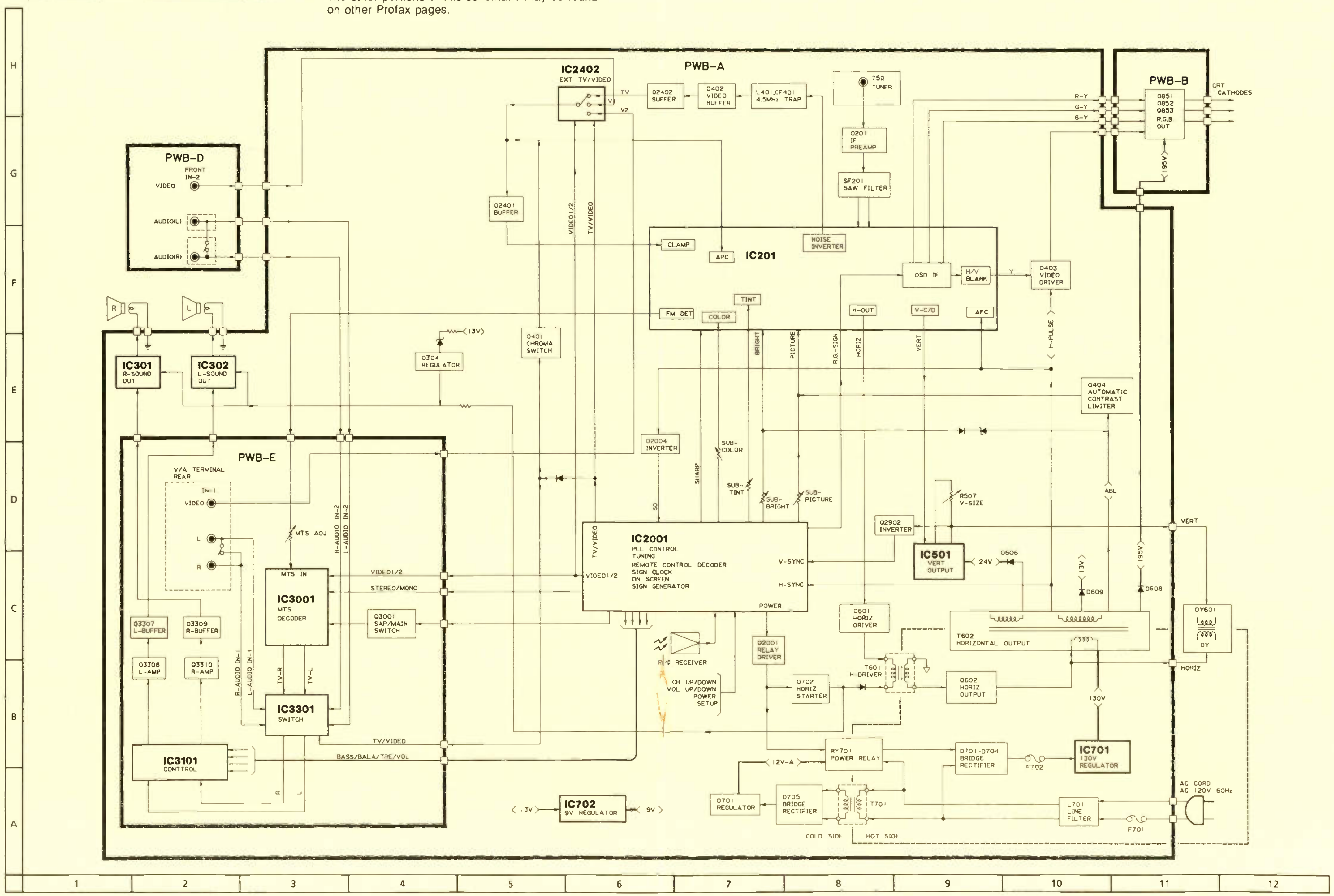

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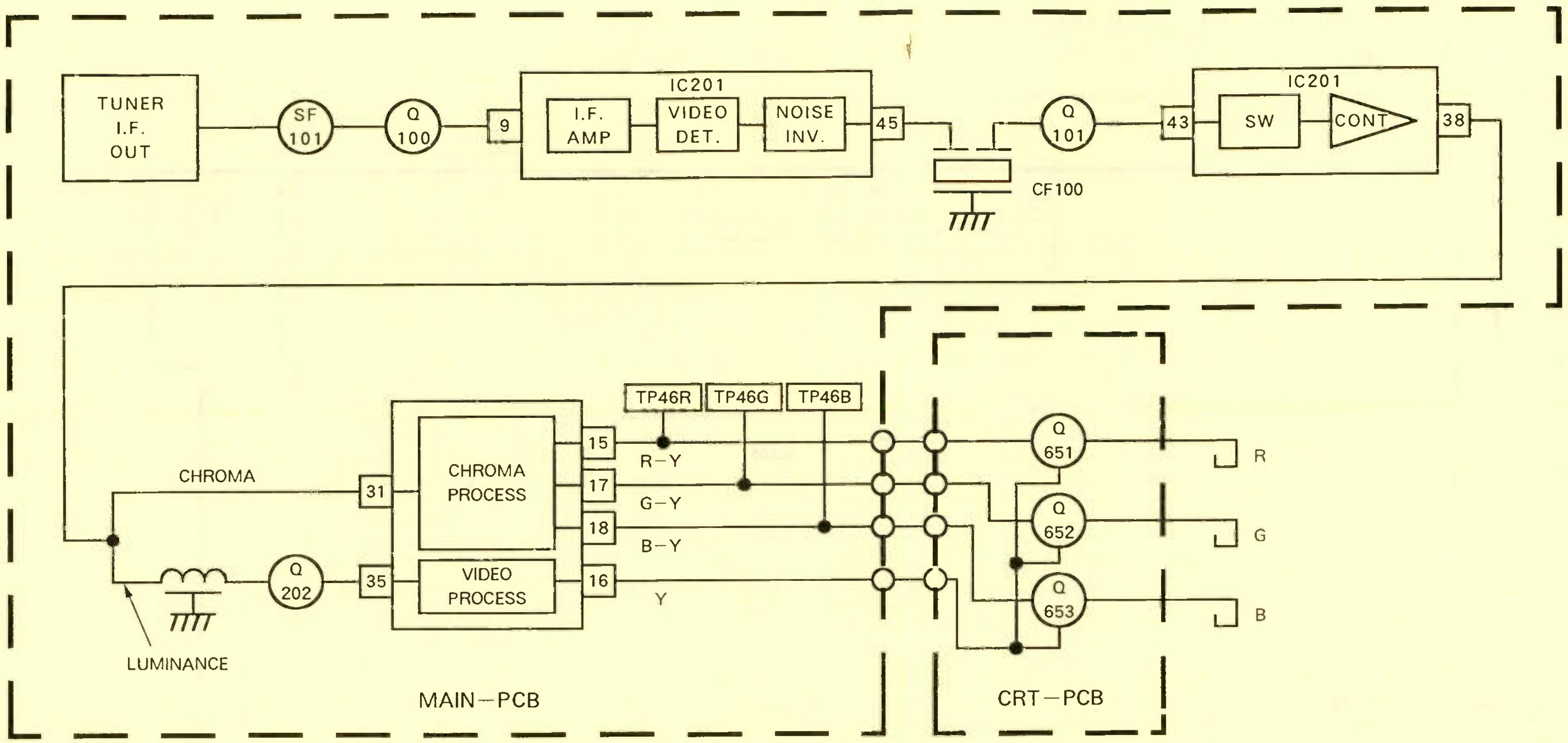
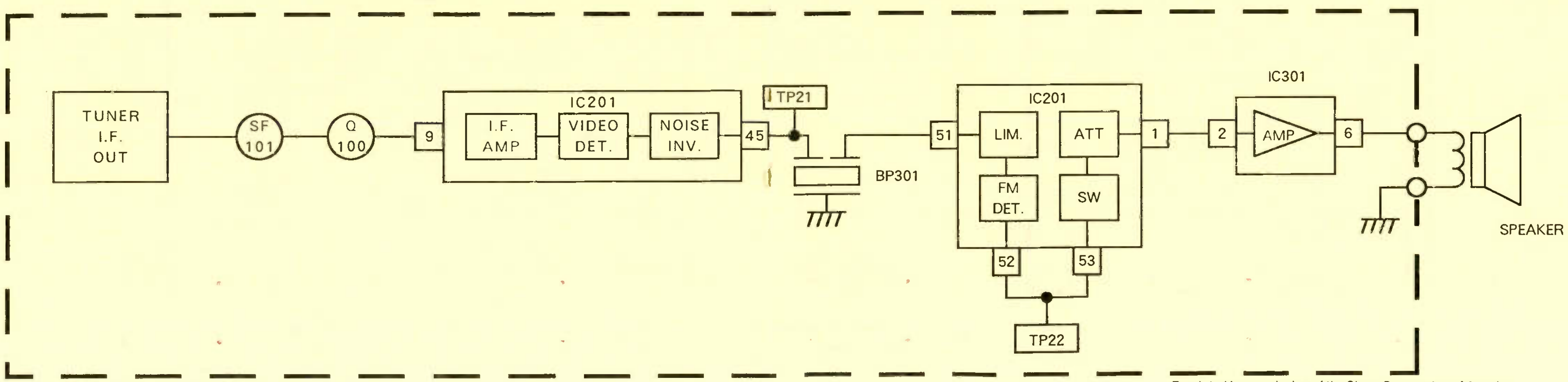


VIDEO/CHROMA SIGNAL PATH



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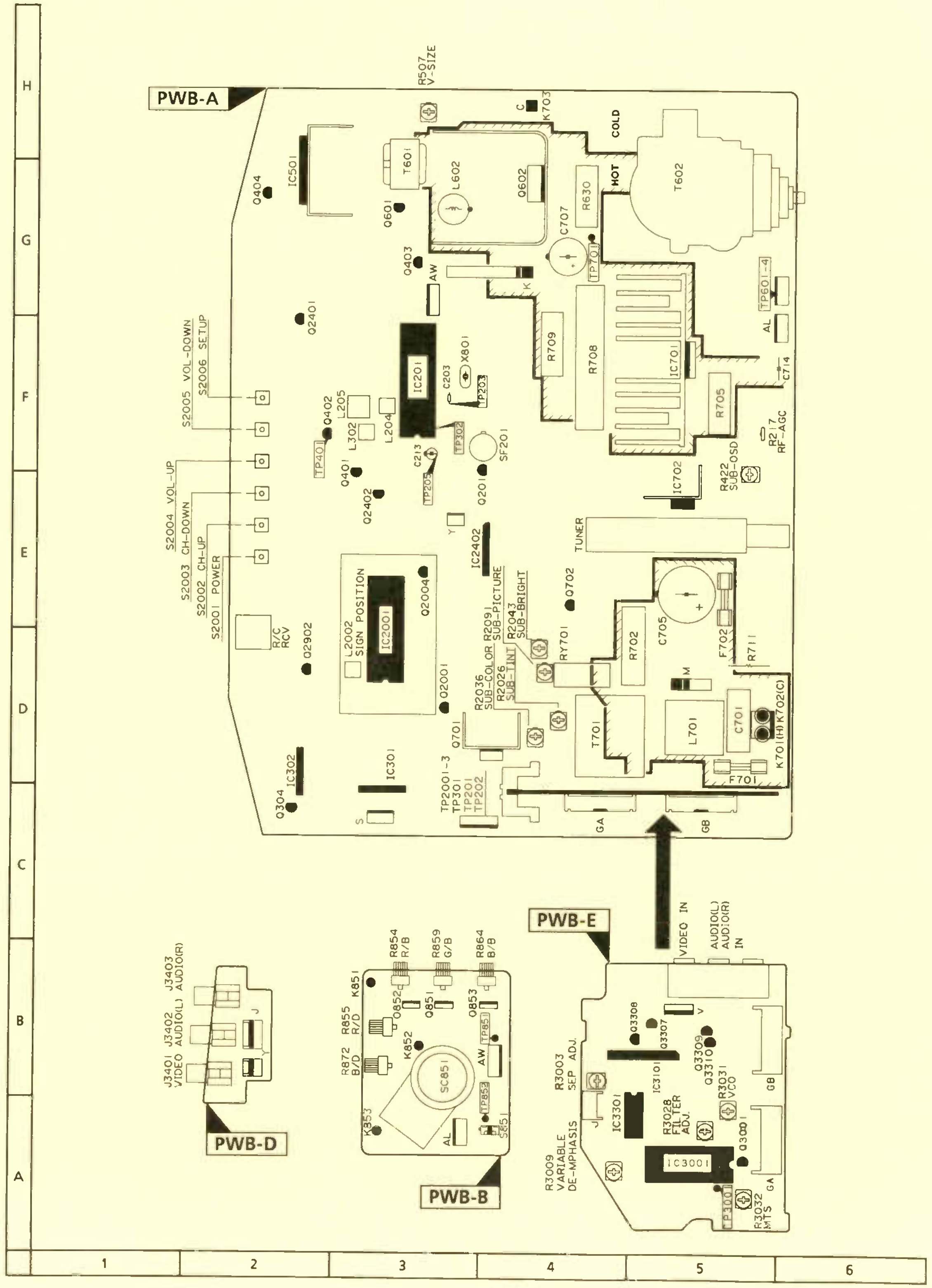

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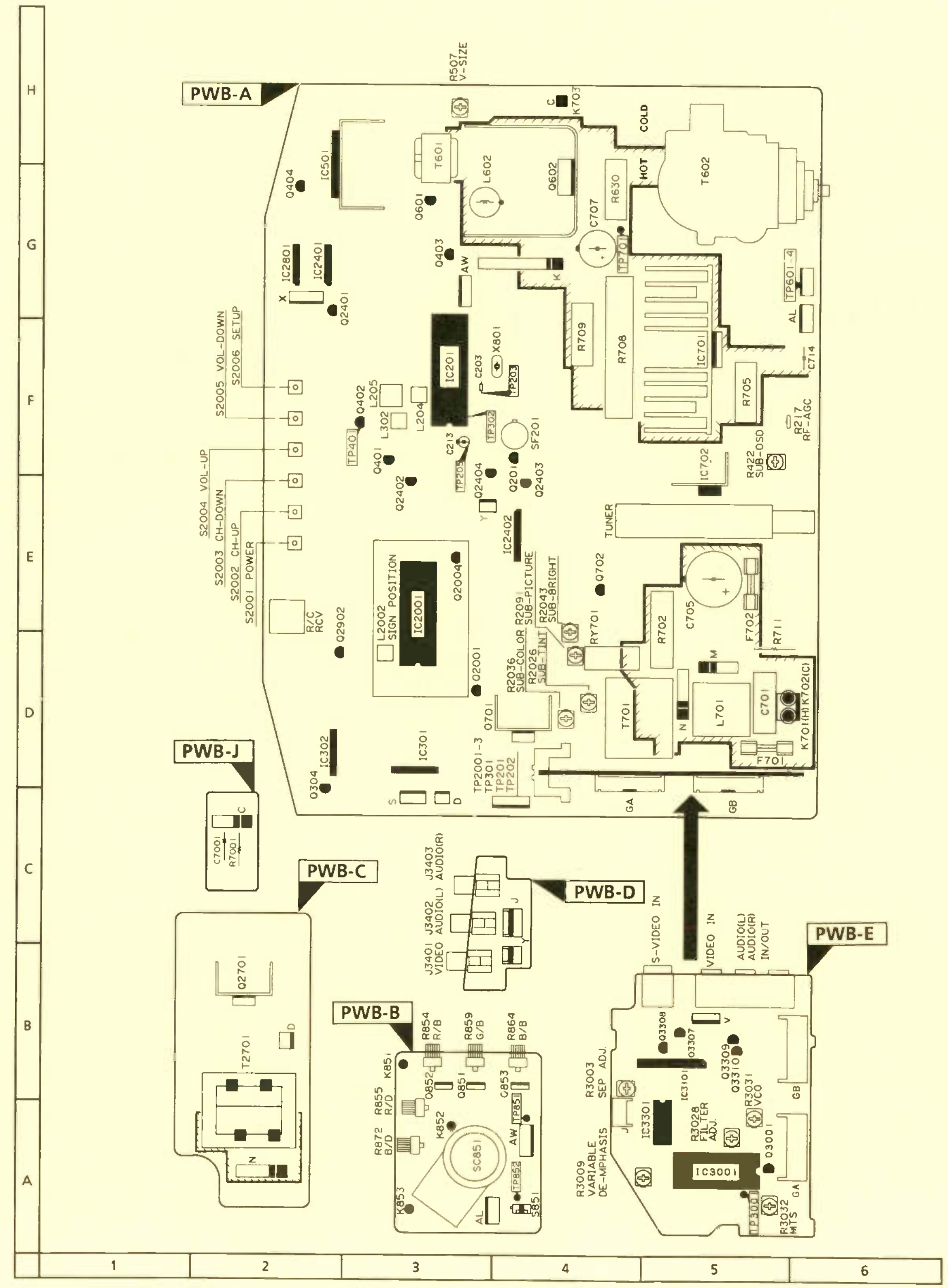
Use of substitute replacement parts that do not have the same safety characteristics as recommended in factory service information may create shock, fire, excessive x-radiation or other hazards.

This schematic is for the use of qualified technicians only. This instrument contains no user-serviceable parts.

The other portions of this schematic may be found on other Profax pages.

All integrated circuits and many other semiconductors are electrostatically sensitive and require special handling techniques.



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PROFAX
BS&T Manufacturers' schematics

**Sharp
Color Television
Chassis No. C10
Model 20C-5300**

JANUARY 1993

SIMPLIFIED FS-L90 FUNCTIONAL BLOCK DIAGRAM

Product safety should be considered when component replacement is made in any area of an electronics product. A star next to a component symbol number designates components in which safety is of special significance. It is recommended that only exact cataloged parts be used for replacement of these components.

Use of substitute replacement parts that do not have the same safety characteristics as recommended in factory service information may create shock, fire, excessive x-radiation or other hazards.

SIMPLIFIED FS-L90 FUNCTIONAL BLOCK DIAGRAM

BS&T Manufacturers' schematics
PROFAX
3096

This schematic is for the use of qualified technicians only. This instrument contains no user-serviceable parts.

The other portions of this schematic may be found on other Profax pages.

All integrated circuits and many other semiconductors are electrostatically sensitive and require special handling techniques.

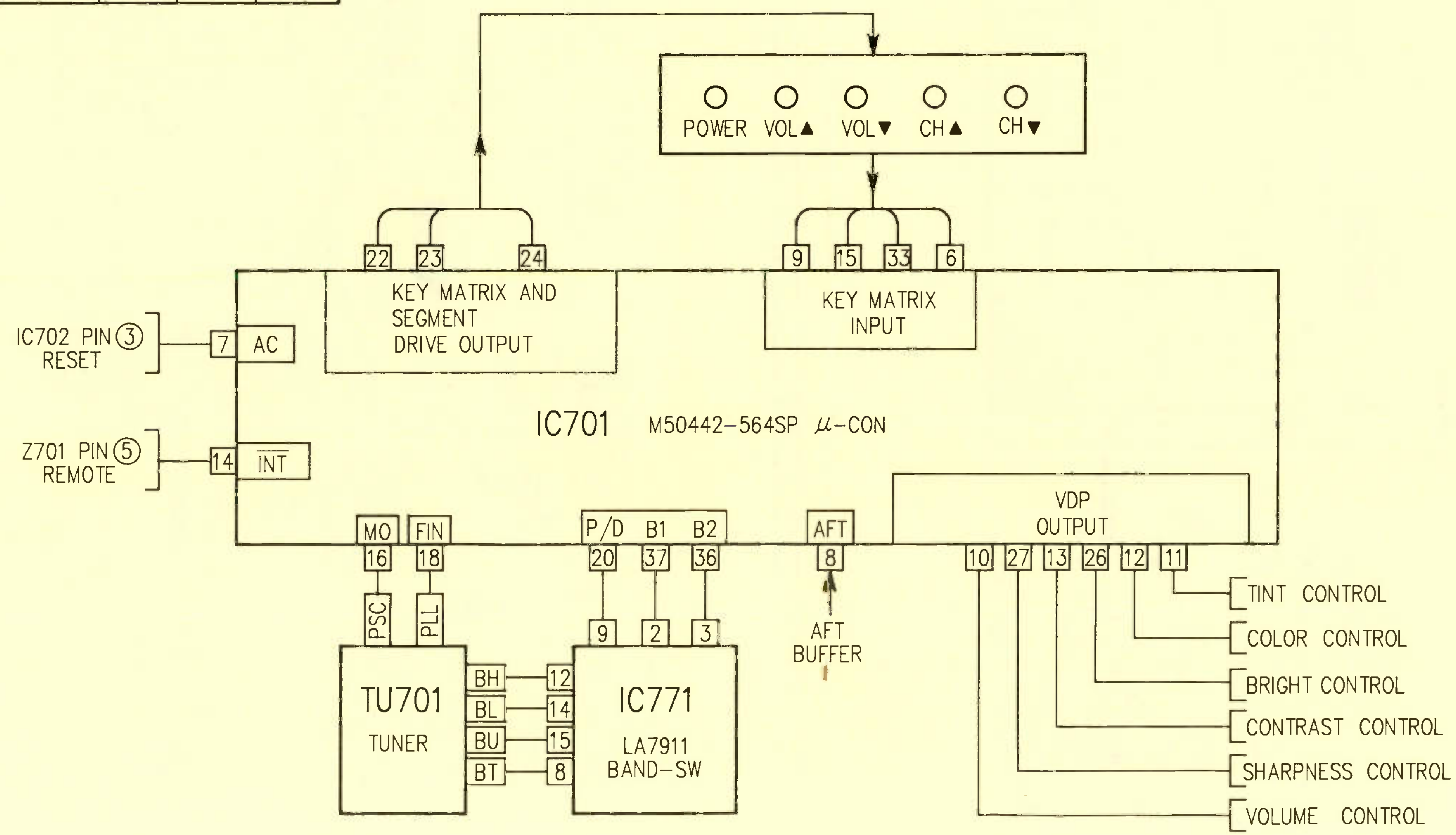
KEY MATRIX

IO PORT \ SCAN	KOUT 0	KOUT 1	KOUT 2
PIN 9 K0	—	POWER	VOL ▲
PIN 15 K1	—	—	VOL ▼
PIN 33 K2	—	—	CH ▲
PIN 6 K3	—	—	CH ▼

BAND SWITCHING TRUTH TABLE

SYMBOL NO.	IC701		IC771			TUNER		
	37	36	15	14	12	BL	BH	BU
UHF HYP/ULTRA	L	L	12V	Z	Z	0	0	12V
VHF-L /MID	L	H	Z	12V	Z	12V	0	0
MID/VHF-H SUP/HYP	H	H	Z	Z	12V	0	12V	0

Z: HIGH IMPEDANCE



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Test your electronics knowledge

By Sam Wilson, CET

1. When there are 6 address lines into an address decoder the number of addresses is ________.

2. Eight individual inputs can be selected - one at a time by a

A. multiplier
B. de-multiplexer

3. The equation $dB = 20 \log V_2/V_1$ can be used

A. any time
B. only when the input and output impedances are the same.

4. A Kelvin Bridge is used for

A. measuring inductance
B. measuring high resistance values
C. measuring low resistance values
D. measuring capacitance.

5. Which of the following circuits might use a discriminator?

A. afc
B. agc
C. phase-locked loop
D. both A and B are correct

6. Identical transformers are connected as shown in Figure A. The output voltage is

A. equal to the line voltage
B. twice the line voltage
C. half the line voltage
D. zero volts

7. In Figure B connect the switches so the lamp can be turned ON or OFF by either switch.

8. Some technicians claim the best way to measure the internal resistance of a dry cell is to use the test setup in Figure C. In this test the variable resistor is adjusted until the voltmeter reads

A. 9V
B. 0V
C. Neither choice is correct

9. Is this statement correct? In figure D the outputs will always be opposite to each other.

A. True
B. Not true

10. Is the following statement correct? A diac acts like two zener diodes connected back to back.

A. True
B. Not true

(Answers on page 49)

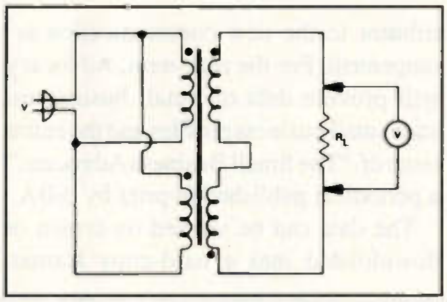


Figure A

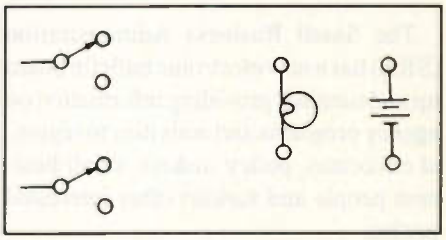


Figure B

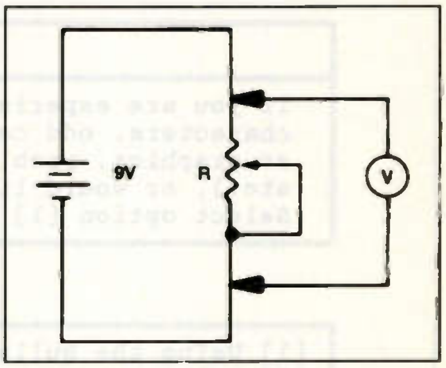


Figure C

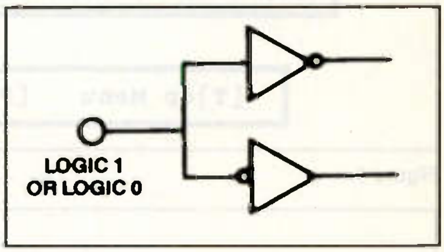


Figure D

Wilson is the electronics theory consultant for ES&T

The SBA goes online

By the **ES&T** Staff

The Small Business Administration (SBA) has a new electronic bulletin board up and running, providing information on agency programs and activities to regional advocates, policy makers, small business people and various other interested parties.

The Office of Advocacy is a major contributor to the new communication arrangement. For the near-term, Advocacy will provide data on small businesses, state small business profiles and the entire issue of "The Small Business Advocate," a periodical published in print by SBA.

The data can be viewed on screen or downloaded into a hard-copy format. Future information for the bulletin board may include press releases, legislative issue profiles, research summaries, entire publications — such as "The Catalog of Completed Research Studies" and "The State of Small Business: A Report of the President" — and information on how to order Advocacy publications.

```
                 GENERAL INFORMATION ON HELP

   If you are experiencing problems with the BBS (e.g., strange
   characters, odd colors on the screen, inability to display color
   or graphics, problems downloading files, problems locating data,
   etc.), or would like basic information of how Bulletin Boards work,
   Select option [1] below.

                            UTILITIES
 [1] Using the Bulletin Board System        [4] List Callers(DISABLED)
 [2] Talk with the SYSOP (M-F 8am-9pm EST)  [5] Change User Profile
 [3] Display Remaining Logon Time           [6] Change Your Password

   [T]op Menu   [P]revious Menu   [M]ail   [F]iles   [G]oodbye
```

Figure 1.

```
                    Change User Profile:

   A - Set ANSI codes On/Off         G - Set IBM Graphics On/Off
   W - Set Terminal Width            T - Set New Terminal Type
   L - Set Line Feeds On/Off         C - Set Lower Case On/Off
   N - Set # of Nulls                M - Set Message Base Defaults
   U - Set File Upload Protocol      D - Set File Download Protocol
   P - Set Page Pause (-more-)       S - Show Current Settings

   Type Selection or ? for help, Carriage Return to exit: A

   Can your terminal display ANSI codes? Y

                    Change User Profile:

   A - Set ANSI codes On/Off         G - Set IBM Graphics On/Off
   W - Set Terminal Width            T - Set New Terminal Type
   L - Set Line Feeds On/Off         C - Set Lower Case On/Off
   N - Set # of Nulls                M - Set Message Base Defaults
   U - Set File Upload Protocol      D - Set File Download Protocol
   P - Set Page Pause (-more-)       S - Show Current Settings

   Type Selection or ? for help, Carriage Return to exit: G

   Can your hardware and communications software display graphics?
```

Figure 2.

```
MAIN MENU                                  Welcome to
                                           SBA Online!
[1]  General Information
[2]  Services Available
[3]  Local Information
[4]  Outside Resources
[5]  Quick Search Menu

[H]elp              [M]ail              [G]oodbye
```

Figure 3.

Advocacy hopes this will facilitate caller access to its most requested data.

The bulletin board is maintained by the agency's Office of Information Resources Management and must be accessed with a modem. To access the bulletin board, call 202-205-7265. For additional information, contact Doug Tillett, Office of Advocacy, 202-205-6531.

SBA ONLINE also offers the following two toll-free numbers, courtesy of Sprint: 1-800-697-4636 (9600 bps), and 1-800-859-4636 (2400 bps)

Making contact

Before you try to contact SBA Online, you have to set the correct information for your modem. SBA Online can operate with any data rate from 300bps to 9600bps, No Parity, 8 Data Bits, 1 Stop Bit, Echo Off. Once you establish contact, the system will ask you for your first name, last name, and the city you're calling from. Then it will ask you to give it a 1 to 8 character password which it will ask you for whenever you make contact subsequently.

Customizing the system

Pressing H (for Help) from the main menu will allow you to customize the online system for your computer system. When you press H, you will get the screen shown in Figure 1. Pressing the number 5 from this menu will then get you the listing shown in Figure 2. Pressing A brings up the question: Can your terminal display ANSI codes? In the case of ES&T, the answer was Y, for yes.

After pressing Y, the correct information will be entered, and the screen of Figure 2 will appear. Pressing G will bring up the question: Can your hardware and communications software display graphics? Pressing Y configured the system to provide this computer with graphic treatment of some of the systems features. Figure 3 shows what the main menu looks like (without the color) after the ANSI and graphics were selected.

Sub menus

From the main menu, the user can access any of the five sub menus. There isn't room here to go into what's available from all of the menus, but selecting the number [1] General Information, gets the user to the sub menu shown in Figure 4. Or, selecting [5] Quick Search Menu, gets the user to the sub menu shown in Figure 5.

From the sub menu shown in Figure 4, selecting [1] Overview of SBA results in the display of the following information. The presentation of the information in this article is different in appearance from what a user of the system will see on the screen, because we changed it to fit the magazine's format.

Overview of SBA

"The U.S. Small Business Admini-

```
GENERAL INFORMATION MENU                  Serving the
                                          Small Business Community!!
[1] Overview of SBA
[2] Thirty Most Asked Questions
[3] SBA Employment Information
[4] Other Federal Employment Info

[H]elp  [T]op Menu  [P]revious Menu  [M]ail  [F]iles  [G]oodbye
```

Figure 4.

```
--------[ DIRECT ACCESS BY KEYWORD/TOPIC ]--------
[1]  7(j) Minority Counseling            [L]  Legislation
[2]  8(a) Contracting Opportunities      [N]  Lenders
[3]  Advocacy                            [O]  Loans
[4]  American Indians                    [Q]  Marketing
[5]  Asian                               [R]  Microloans
[6]  Banks and Other Lenders             [S]  Minorities
[7]  Black Owned Businesses              [U]  Physically Challenged
[8]  Business Development                [V]  Procurement Assistance
[9]  Business Plan                       [W]  Srvc Corps of Retired Execs
[0]  Counseling                          [X]  Small Business Institutes
[A]  Development Companies               [Y]  Sm. Business Investment Co.'s
[B]  Disaster Assistance                 [Z]  Sm. Bus. Development Ctrs.
[C]  Exporting                           [#]  Starting Out
[D]  Financial Assistance                [*]  Surety Guarantee
[E]  Government Contracting Opport.      [$]  Training
[I]  Hispanic                            [-]  Veterans
[J]  International Trade                 [+]  Women's Business Ownership
[K]  Investment

 [H]elp   [T]op Menu   [P]revious Menu   [F]iles   [M]ail   [G]oodbye
```

Figure 5.

stration (SBA) was created by Congress in 1953 to help America's entrepreneurs form successful small enterprises." Today, SBA's program offices in every state offer financing, training and advocacy for small firms. These programs are delivered by SBA offices in every state, the District of Columbia, the Virgin Islands and Puerto Rico. In addition, the SBA works with thousands of lending, educational and training institutions nationwide.

"Small businesses are the backbone of the American economy. They create two of every three new jobs, produce 39% of the gross national product, and invent more than half the nation's technological innovation. Our 20 million small companies provide dynamic opportunities for all Americans." If your business is independently owned and operated, not dominant within its field, and falls within size standards met by the SBA, we can help you.

"Through workshops, individual counseling, publications, and videotapes, the SBA helps entrepreneurs understand and meet the challenges of operating businesses-challenges like financing, marketing and management. The SBA has business development specialists stationed in more than 100 field offices nationwide. Technical assistance, training and counseling also are offered by three partner organizations."

There's a lot more in this segment of the SBA online system, but we'll let you call it up for yourselves.

Guidelines for a business plan

If you press [5] from the main menu, you will get the screen shown in Figure 5. If you then press [$] Training, you can even call up instructions on how to write a business plan, information on financing a business, or franchising a business. See Figure 6.

The SBA Online system is a useful, easy to use system. Best of all, it's free, provided that you use the 800 number to access it. Even if you aren't eligible to obtain direct assistance from SBA, some of the information available from this online system might be useful to you. ■

```
SBA TRAINING MODULES MENU              Welcome to SBA's
                                      Training Services!
[1] Developing Your Business Plan
[2] Financing Your Business
[3] Franchising Your Business

 [H]elp  [T]op Menu  [P]revious Menu  [M]ail  [F]iles  [G]oodbye
```

Figure 6.

At Pyramid Electronics, keeping technicians well educated and informed on latest technology is key to success

By Jeffrey R. Uschok

Located in uptown Manhattan, NY, Pyramid Electronics has been in operation since 1947. Joe Passaretti started as a technician in 1965, slowly worked his way up to supervisor, and is now owner of the service center. In the early 70's after leaving Pyramid Electronics for a while Passaretti gained valuable experience in broadcasting by working for ABC and NBC.

This service center, like many others, started out servicing primarily TV's, but now the facility services a variety of products, and has 10 full time technicians each specializing in different areas.

Because of the service center's location, Passaretti feels that one of the biggest differences between his facility and others around the country is the type of clientele that come into the facility to get their products serviced. "We cater to a lot of upscale clientele, doctors lawyers and businessmen. Although this type of clientele is good for business, they can also be very demanding at times.

Figure 1. Pyramid Electronics, located in Manhattan, NY has been servicing consumer products for over 45 years

Being prepared

Always being prepared for new high-tech items is one of the main reasons why Pyramid Electronics has been successful over the years. "We like to stay on the front line whenever a new piece of equipment comes out," says Passaretti. One product that has been very profitable over the years for Pyramid has been the word processor known as "Video Writer" by Magnavox. Although they are no longer being manufactured, many still come into the shop for repairs. The center is also authorized for 27 major brands of consumer products. Passaretti feels that the ability to phase out old products and move into new ones is a key to staying on top.

Education is key

Because Pyramid Electronics is an authorized service center, the technicians are asked to go to many training seminars put on by the manufacturer. Although a lot of it is duplication, Passaretti feels it is vital to be continually educated on new products that come out. "Because of the type of clientele we have a doctor may come in with a TV for example that he bought in Japan that hasn't even been introduced to the United States yet. We not only get a first hand look at new products coming into the country but we also have to be prepared to fix it as well. This keep us on our toes as far as technology is concerned," he adds.

Having a staff of 10 technicians is also another advantage. The service center has a shop supervisor who not only services specific items but can help any other technician if he has a problem troubleshooting a product. While one technician works primarily on TV's, and another on VCR and another on CD's the service center gets a steady flow of output from its workers. "Because we now have a vast amount of knowledge with such a diverse group of technicians, we are now reaping the benefits," says Passaretti.

Exploring new industries

As many service centers are finding out, to stay ahead of the game today one must move into new areas of servicing. Because of Passaretti's background in the broadcast industry he feels that this area

Uschok is Associate Editor of **ES&T.**

Figure 2. According to owner Joe Passaretti, accessories are an important ingredient to customer satisfaction and repeat business.

Figure 3. Joe Passaretti, his daughter Donna and staff supervisor Franklin Mayer have been running Pyramid for over six years.

can be very profitable. "We are slowly phasing into industrial broadcasting equipment - VCR's editing machines, broadcast cameras," says Passaretti. Keeping your head above water is a problem for a lot of service center owners. Pyramid Electronics tries a lot to combat these tough times by cutting overhead and reducing prices to stay competitive. The most profitable items coming into the shop are VCR's and CD players. TV's and cameras also top the list with a good flow of audio cassette decks and telephones.

Decisions, decisions

One major decision Passaretti had to make with Pyramid Electronics was whether to stay on the technical side or move over to the business side. Although the decision was to move into management, it was difficult because of his abilities as a pure technician for many years. ``Service center owners today try to do both in a big operation to save the cost of a technician, but you have to make a choice. Do you want to run a shop properly or just save costs by being on the bench? To be successful you have to be one or the other." Passaretti added.

Having moved into management Passaretti is now more comfortable on that side. One of his biggest assets as an owner is his ability to deal with the tough customers the store encounters on a daily basis. More importantly, he has developed all the present computer software the shop uses to make things flow more efficiently and effectively. As an owner he feels that to run a business smoothly the right type of computer software is vital, and because each shop is different each owner must use a program that is best suited to his needs.

Store policies

Pyramid Electronics charges an estimate fee, but incorporates that into the final price of the service for the product. This, Passaretti feels, encourages customers to come back for more business.

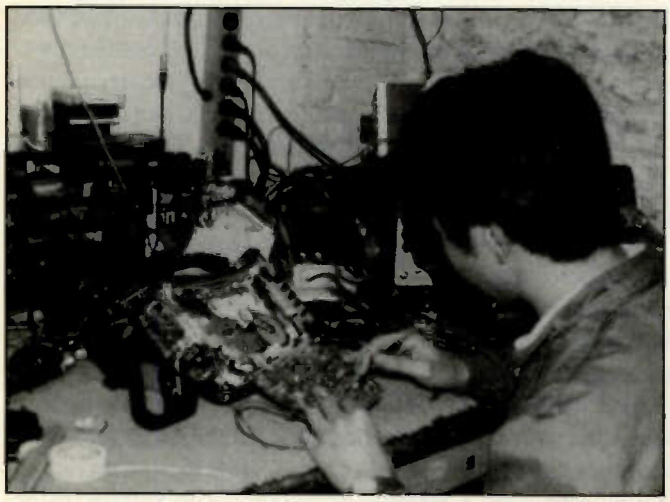


Figure 4. Technician So Chan, specializes in camcorders, which is a profitable item for Pyramid Electronics.

Figure 5. Eliza Betancurt, works on her specialty - VCRs. Each technician at Pyramid specializes in a different area.

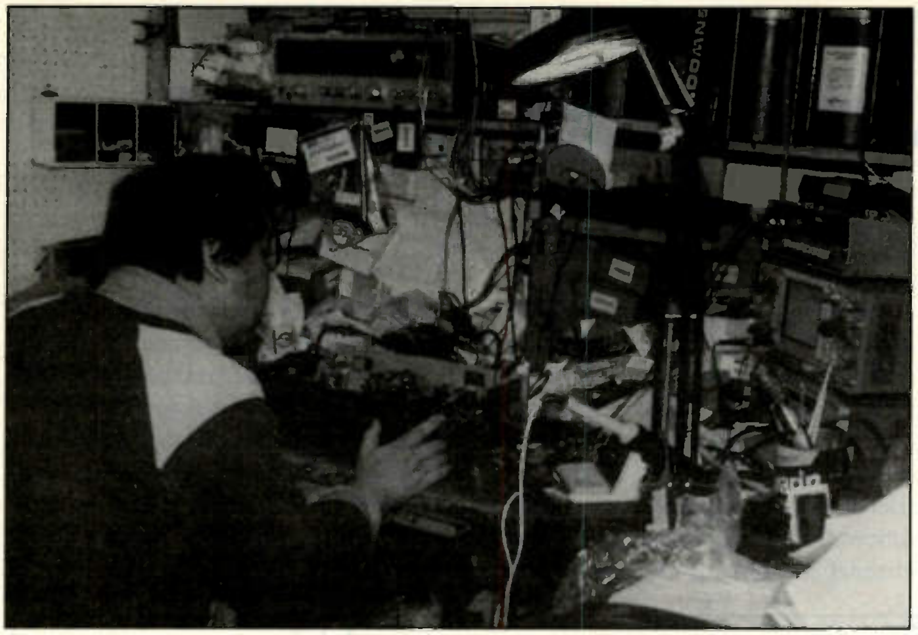


Figure 6. CD player specialist Ho Chan shown here troubleshooting a CD player

Pyramid does not operate on the basis of flat rates, but rather charges by the hour. This, Passaretti says, is much fairer to the customer.

Associations

Passaretti is heavily involved with many organizations. He is presently president of the Metropolitan Electronics Television Service Dealers Association (METSDA) a service association for owners of service companies which services the five boroughs of New York City. Passaretti is also a certified administrator for ISCET and gives the CET exam to technicians. "Its always a benefit to belong to these groups. The smaller service centers benefit most because of all the seminars these groups provide them with," he adds.

Advice to stay on top

There are two key areas, according to Passaretti, that a service center owner must focus on. First they must always maintain their technician proficiency levels. Because of the constant change in the servicing industry they must always be prepared for new items being brought into any service center. There must be ongoing training, including reading publications to keep up on the technical side. Secondly, Passaretti feels that one must choose between being a technician or a business owner. Those who choose to be owners must know how to develop a profit and loss program, know how much it costs when you open your shop in the morning, and keep constant track of day to day operations. Customer satisfaction is of course one of the most important aspects as well.

While most service centers today face many of the same problems, staying ahead of the technology is the key to any good business and Joe Passaretti and his staff at Pyramid Electronics seem to be doing just that! ■

Test your electronics knowledge

Answers to the quiz *(from page 43)*

1. $2^6 = 64$ addresses. The input to an address decoder is a binary code, and, the number of outputs equals 2^x where x is the number of binary inputs.

2. A. The multiplexer selects the inputs one at a time.

3. B. This equation is useful for calculating losses and gains in transmission lines where the input and output impedances are the same. It cannot be used for calculating dB gain for amplifiers where the input and output impedances are not the same.

4. C. This type of resistance bridge is used in applications where the resistances of the connections can affect accuracy.

5. A. A discriminator can be used to produce an output voltage if the oscillator drifts off frequency. That voltage is used to correct the oscillator frequency·

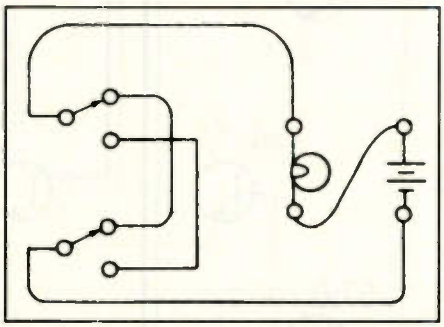


Figure E

6. D. This situation would occur if the secondary windings are in opposite directions. The two outputs are 180° out of phase and the resulting voltage across RL is zero volts.

7. See Figure E

8. C. The variable resistor is adjusted until the voltage across the variable resistor is one-half the rated voltage of the battery. Then, the voltage across the internal resistance is the same as the voltage across R. The last step is to remove R from the circuit and measure its resistance. (I do not like this test!)

9. B. Both gates invert the input, and their outputs will be the same.

10. A. If you answered B give yourself half credit. Diacs have a very sharp breakover curve. Take a diac and subject it to an ac signal that periodically places a reverse voltage across it. Look at the breakover on a scope using the sweep expander. Compare that curve with the curve of a zener diode.

I tried this with a few components, but, I would be interested in hearing from some readers on this. (My answer was taken from a text book).

On-screen video display circuitry - Part III

Adapted from the June 1990 issue of "The Expander" a publication produced by Mitsubishi Electric Sales America Inc., to inform their authorized service centers.

Figures are numbered consecutively, starting with Figure 1 in Part 1 of this article.

On-screen video displays have been used for some time in both direct view and projection televisions. In today's video products the display has become a crucial factor in the interface between the product and the consumer, informing the user of virtually all current operating conditions. In addition to displaying current channel and time of day, the on-screen display is an integral part of the user adjustments and selection process.

This article is the third part of a series that examines the on-screen video display in the V10 projection chassis by Mitsubishi. Part 1, which appeared in Video Corner in the November 1992 issue, covered the Video/chroma display signal path. Part 2, which appeared in Video

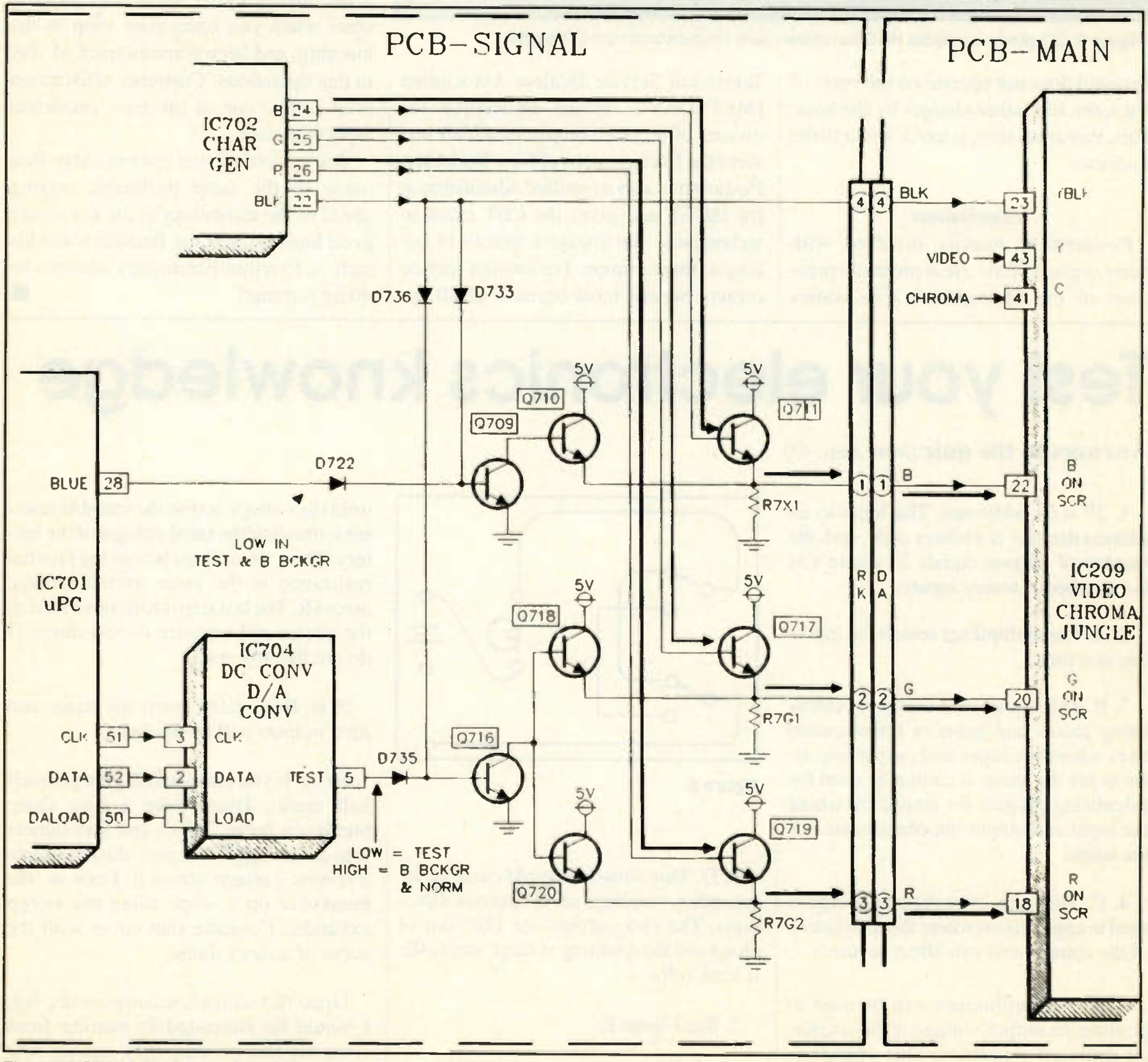


Figure 6. Display background control

Corner in the December issue, covered character generator and display synchronization. This third and final part discusses menu/test background control.

Menu/test background control

The backgrounds used in the menu and test modes are added to the display signal in the discrete component display drive circuitry. The display drive and background control circuitry is illustrated in Figure 6. Transistors Q711, Q717, and Q719 are responsible for coupling the blue, green and red character drive signals from IC702 to their respective on screen inputs in the video/chroma jungle, IC209.

It was stated earlier that the BLK (Blanking) output from pin 22 of IC 702 produces the black edging around characters in the display by blanking video and chroma in the specified areas. The BLK signal is directed to the YBLK input of IC209 at pin 23, and through diodes D736 and D733 to the discrete display drive transistor inputs at Q709 and Q716. In a normal insertion display mode, the BLK signal applied directly to pin 23 of IC209 produces the black edging around characters. In the menu or test modes, the BLK signal applied to the discrete transistor drive circuitry accomplishes the same purpose.

The display drive circuitry also generates the blue background signal for the menu mode, and the blue and white background signals for the test mode. The backgrounds are controlled by two logic

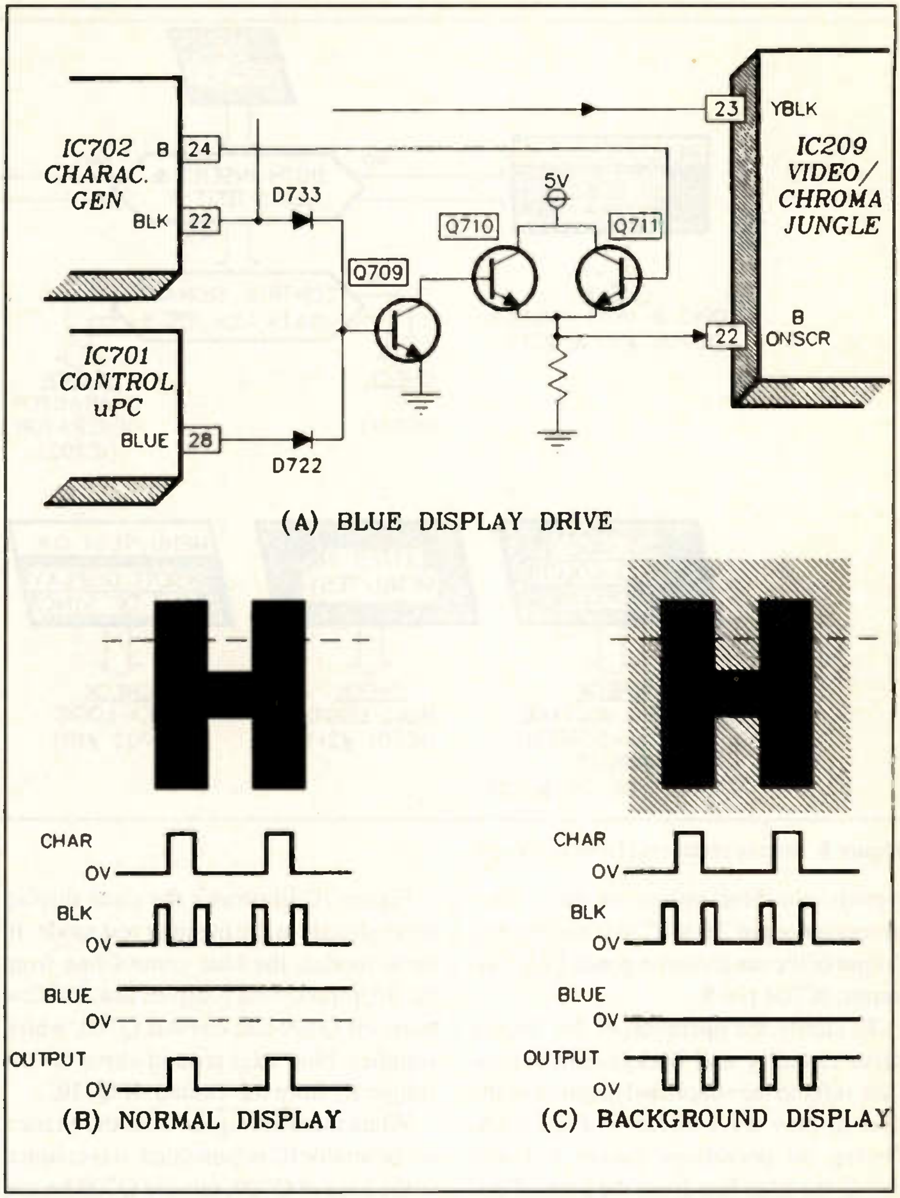


Figure 7. Blue display drive circuit

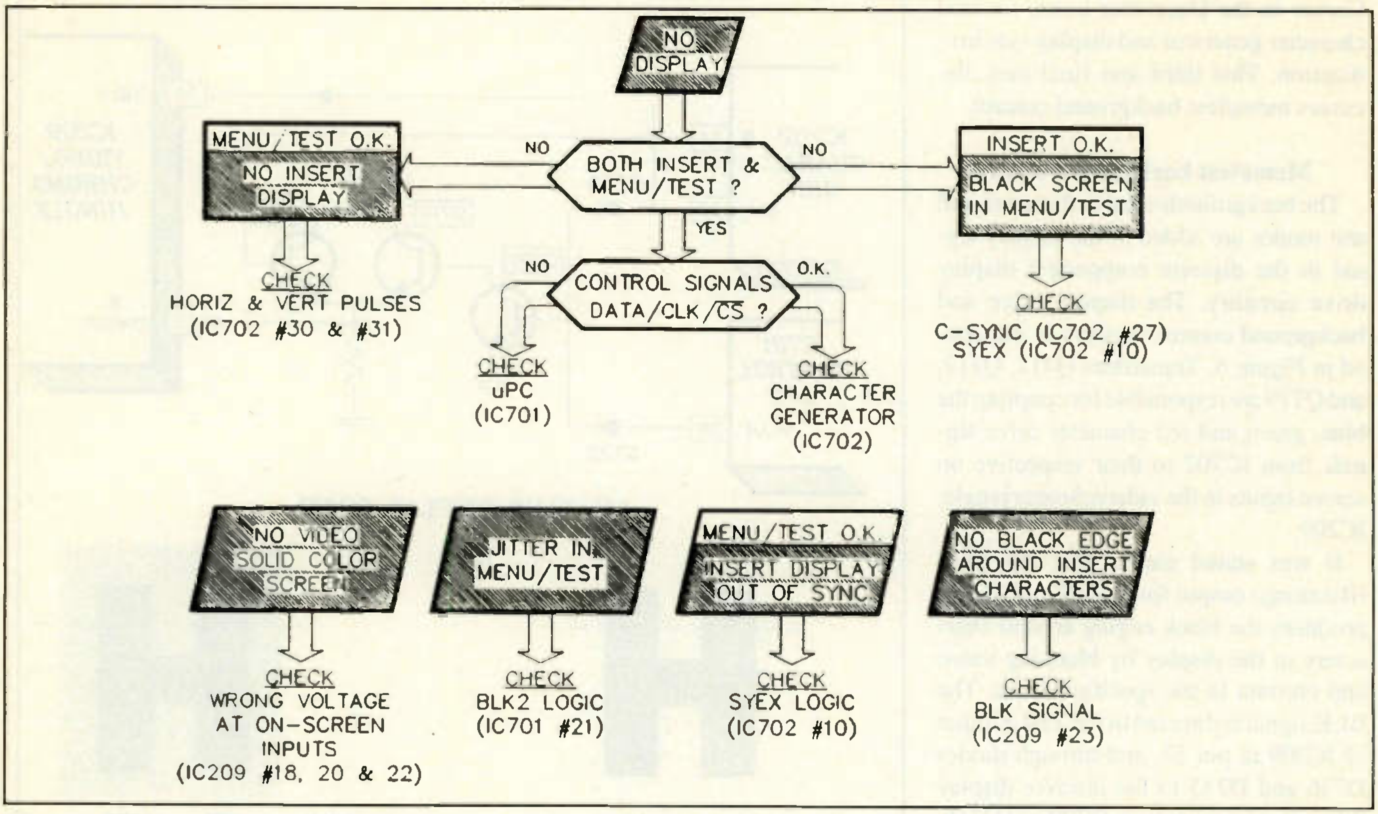


Figure 8. Display problems (Tuner is source)

signals: the blue output of the microprocessor at pin 28 of IC701; and the test output of the static convergence D/A converter, IC704 pin 5.

To clarify the operation of the display drive circuitry and background activation, refer to the simplified diagram of the blue display drive circuit in Figure 7A. During all operations except test and menu, the blue line from the control microprocessor is high. The high on the blue line turns on Q709 which in turn turns Q710 off. This effectively disables any blue drive to IC209 from Q709 and Q710.

Typical signals for a normal display insertion mode are illustrated in Figure 7B. When a display is activated, the blue character drive from pin 24 of IC209 is applied to the base of Q711, output at the emitter and directed to the video/chroma jungle IC. Although the BLK signal is directed through D733 to the base of Q709 it has no effect since Q709 is already conducting from the high on the blue line.

However, the BLK signal is also directed to the YBLK input of the Jungle IC, which generates the blanking signals required to produce the black edging around display characters.

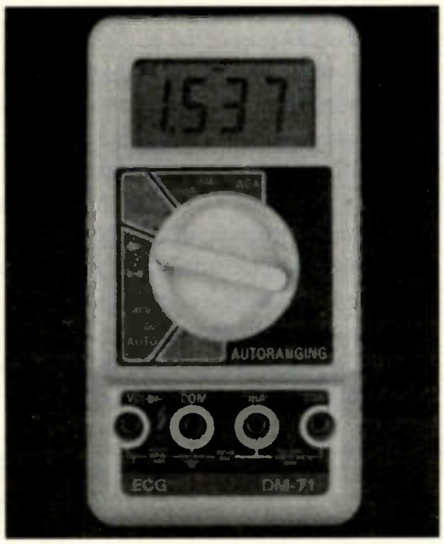
Figure 7C illustrates the same display drive signals in the menu or test mode. In these modes, the blue control line from the microprocessor is driven low. The low turns off Q709 and enables Q710, which supplies blue background drive to the Jungle IC from the emitter of Q710.

When the BLK signal from the character generator IC is generated, it is coupled to the base of Q709, turning Q709 on and Q710 off during the period of the blanking signal, removing blue drive from the blue control line. After the BLK signal period, blue character drive turns Q711 on, producing blue drive during the character period. Since blue drive from Q710 is also resumed after the BLK signal, the blue produced from the character drive is brighter than the normal blue background.

This same analogy can be applied to the red and green display drive circuitry, except they are controlled by the test output of IC704 instead of the blue control line (See Figure 6.) Normally the test line is high, removing drive from the green and red display outputs. When the test mode is activated, the test line goes low and outputs are produced from both the red and green drive. The red and green drive, in conjunction with blue drive, produce the white background used in the test mode.

When a display is not activated, the on screen red, green and blue inputs of the jungle IC are not internally disconnected from the video circuitry. Therefore, a defect in the display circuitry can affect the normal picture. For example, if Q709 is open, Q710 is turned on supplying constant blue drive to the jungle IC. The constant blue drive produces a blue screen which overrides any existing video signal, whether a display is activated or not.

When a display problem is encountered, an analysis of all available symptoms will help isolate the problem. For instance, is the problem present in both an insertion display mode and a full screen display mode? If the trouble is only in open mode, the cause is usually a synchronization problem. If in both modes, insert and menu/test, it may be due to the loss of a control signal from the microprocessor or possibly the character generator IC. For a quick reference aid in troubleshooting the display circuitry in the V10 chassis, the problems discussed in this article, when using the tuner as the signal source, are presented in a flow chart format in Figure 8. ■



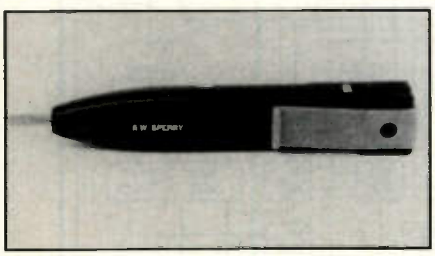
Autoranging DMM

Philips ECG introduces a heavy duty, autoranging digital multimeter that is simple to operate, easy to read and durable. The ECG model DM-71 offers the convenience of autoranging in combination with a large, high-contrast display and full-function design. Special features include a 0.65 inch high 3 1/2 digit LCD with range indicator, rugged construction and a high-impact plastic case (withstands 5-foot drop). Measurement functions include voltage to 750V/1000Vdc, current to 20A ac/dc, resistance to 20MΩ, plus audible continuity and diode tests. Basic accuracy is 0.5%; input impedance 10MΩ.

Circle (12) on Reply Card

Electrical tester

A.W. Sperry Instruments, Inc. a leading national marketer of portable electrical and electronics test equipment, announces the introduction of their new electrical tester Model ST-401A. This



fully insultaed handy pocket screwdriver is also a high voltage circuit tester, continuity tester and polarity tester. The ST-401A checks voltages from 1.5 to 250Vac/dc.

Circle (13) on Reply Card

Quick change soldering tips

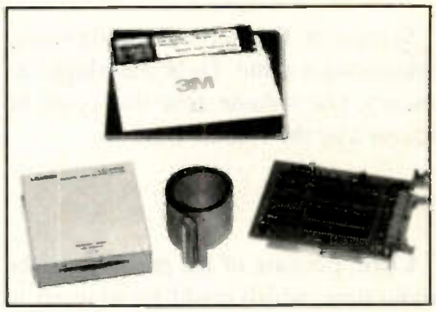
Weller now makes it possible to switch heating elements on its new line of WP series professional soldering irons without tools. With just a twist of the soldering iron's knurled collar the element can be unplugged and changed for the required wattage. In the past, a change of heaters required a screwdriver and the possibility of losing the screws that held the heater in place. Now a single handle plus the three different elements provides a trio of irons to handle different jobs. For

additional safety, all irons are offered with a three-wire cord. Heaters are available in 25, 30 and 35 watts plus eight interchangeable, iron plated tips that make the series suitable for a wide range of electrical and electronic applications.

Circle (14) on Reply Card

Data acquisition kit for the handheld DSO/DMM

Leader Instruments Corp. announces the availability of the model 300-PC data acquisition kit which offers a total system solution for the uploading and downloading of waveforms and data between the memory card used with the Model 300 handheld DSO/DMM and a personal computer. The software enables computer control of stored waveforms. In the long word length mode, waveforms can be expanded, scrolled through and printed in a similar fashion as when operating



the Model 300 in the DSO and logic scope modes. File labels can be entered for each displayed screen of waveform data for indentification. The kit is compatible with IBM PC-AT personal computers or equivalents running with MS-DOS version 3.1 or higher.

Circle (15) on Reply Card

Microwave leakage tester

A microwave leakage detector from *Simpson Electric* allows easy measurement of microwave radiation for insures and risk management professionals. The unit is designed to measure microwave leakage from enclosures and door seals for compliance with Federal safety standards. Applications include inspection of consumer and institutional microwave ovens, plus the wide range of microwave based industrial ovens and dryers. Four measurement ranges provide direct readout of 2450MHz microwave power density using the system's nonpolarized, wide range probe. Accurate to ± dB, the 380-2 features switch selectable fast (1.2 sec maximum) and slow (3.0 sec maximum response) settings. Operating temperature range is 10° to 40°C, with temperature coefficient of ±0.057 db per 10°C.

Circle (16) on Reply Card

Troubleshooting Tip

Symptom: This set had a good picture, but no station audio. There was a high frequency, low volume, tone that could be adjusted by the volume control.

Cure: Because of the presence of the audio tone, which could be adjusted in volume, my first thought was that the audio circuits must be functional, and the problem must be elsewhere. A check of the audio circuits confirmed this. All passive components were within tolerance. In addition, dc voltages on IC301 were the same as those specified on the schematic diagram (see Figure 1.).

Tracing the audio signal upstream from pin 2 of IC301 led me to pin 1 of IC201, a 54-pin device. This IC contains most of the audio and video circuitry (Figure 2).

I had no desire to remove and replace a 54-pin device and then find that it was not the culprit, so I carefully checked dc voltages on all pins of the IC. Some of the voltages were considerably higher than those specified on the schematic, leading me to conclude that some of the circuitry in this IC must be open circuited; possibly as a result of electrical overstress (OES) or electrostatic discharge (ESD).

I ordered a replacement for - and when it arrived I soldered it into the circuit, applied power to the set and held my breath. In just a moment the set came to life with the audio returned to normal.■

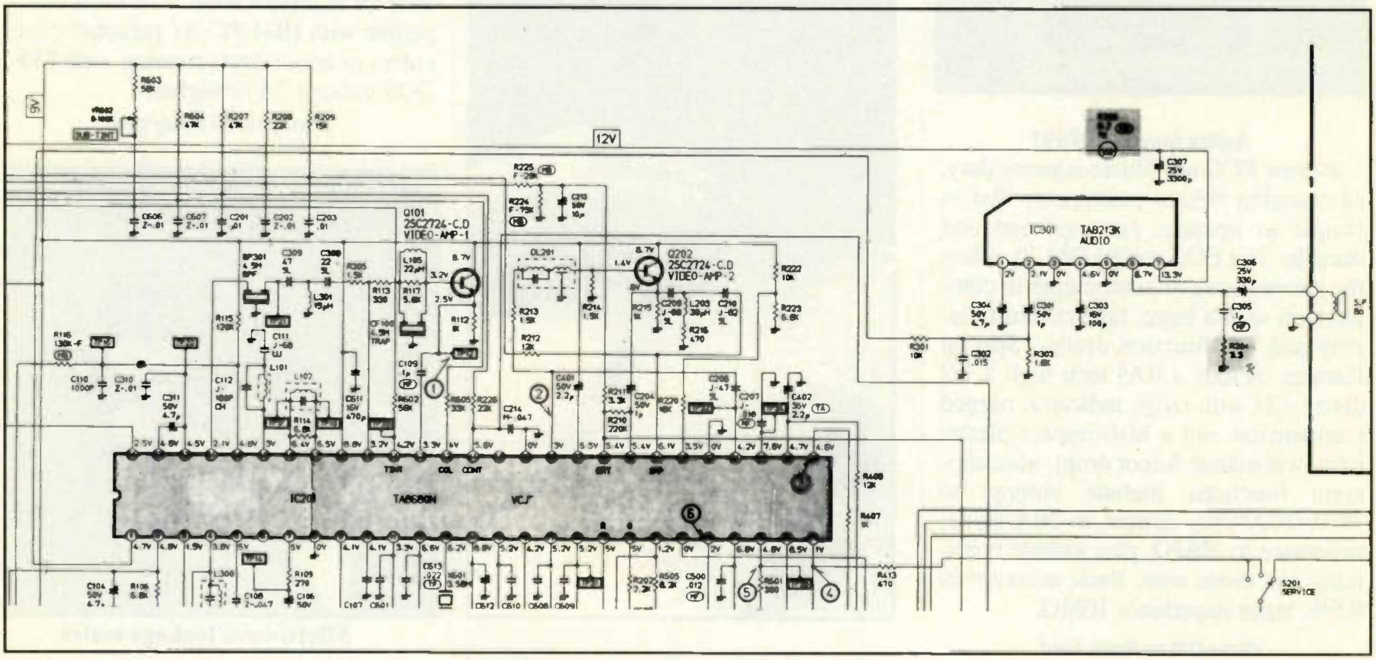


Figure 1.

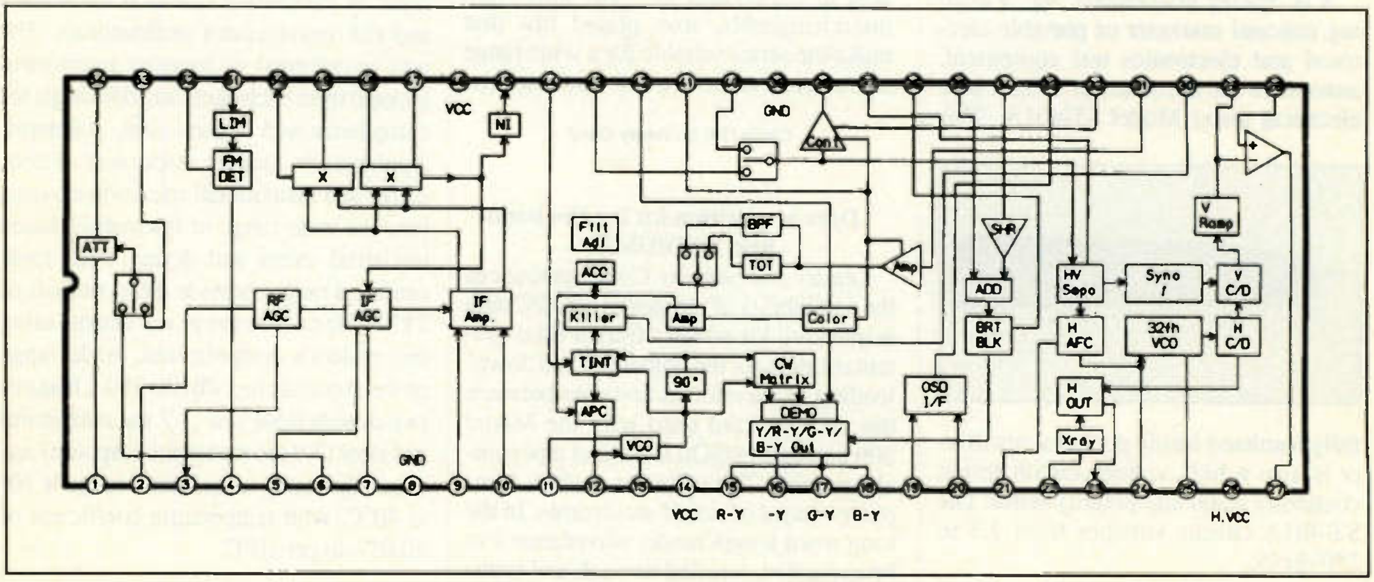


Figure 2.

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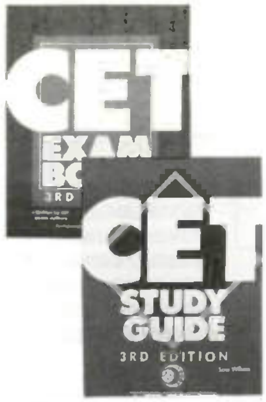

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What do you know about electronics?

Sam - Science and math?

By J.A. Sam Wilson, CET

When I first started to write for a living I used the name J.A. Wilson because there was already a writer who used the name Jack Wilson. Professional ethics dictates that you don't use someone else's name when you write.

Now, all of a sudden, there is another author of electronics subjects writing under the name J.A. Wilson. I've tried to avoid confusion by using the name J.A. Sam Wilson (sometimes just Sam Wilson). In high school I was called Sam because I was always singing the song "Sam, You Made the Pants too Long." However, if you ask me where the name SAM came from I will probably tell you that it is an acronym for Science And Math.

I don't think changing my name to J.A. Sam Wilson is working. I get missives about stuff written by J.A. Wilson that I didn't write. For anything I did write lately the author's name will be given as Sam Wilson or J.A. Sam Wilson. I try to get the publishers to put CET after my name but that doesn't always work. If it is my material it will be published by:

- McGraw Hill
- TAB
- Prentice Hall
- **ES&T** Magazine
- Cleveland Institute of Electronics (CIE)
- The Electron
- ISCET
- Professional Electronics Magazine
- International Correspondence Schools

Most of my earlier works under the name J.A. Wilson are either out of print or they soon will be.

More on the microprocessor

The design of the switch-type memory in the previous issue will have to be improved before it is suitable for use with a microprocessor system. The design of each byte, as we left off in the last issue, is shown in Figure 1.

The first step is to replace the data switches. I am going to select CMOS parts because they can be operated with a 9V battery. That is just in case someone does want to build some of these circuits.

The component often chosen for memory cells goes by several different names: *D-Flip Flop (for Data* Flip *Flop), data-latch, data storage device, and hold-follow latch.* We can't call it by all of those names, so, we will just call it a data latch.

Figure 2 shows the symbol and the truth table for the D-flip flop we will use. A good choice for replacing the data switches in our original memory is the C4508B. It has 4 flip flops in one integrated circuit package.

The object here is to enter data and hold it until we no longer need it. For our purpose the *Reset* and *Disable* terminals are not used, so, they are permanently connected to logic 0.

As shown by the truth table, whenever the strobe is at logic 1 the data input is present at the output.

When the strobe is set to logic 0 the data is latched so that any further input to the D terminal will not affect the logic level stored at Q.

Figure 3 shows some examples of D-

Wilson is the electronics theory consultant for **ES&T**.

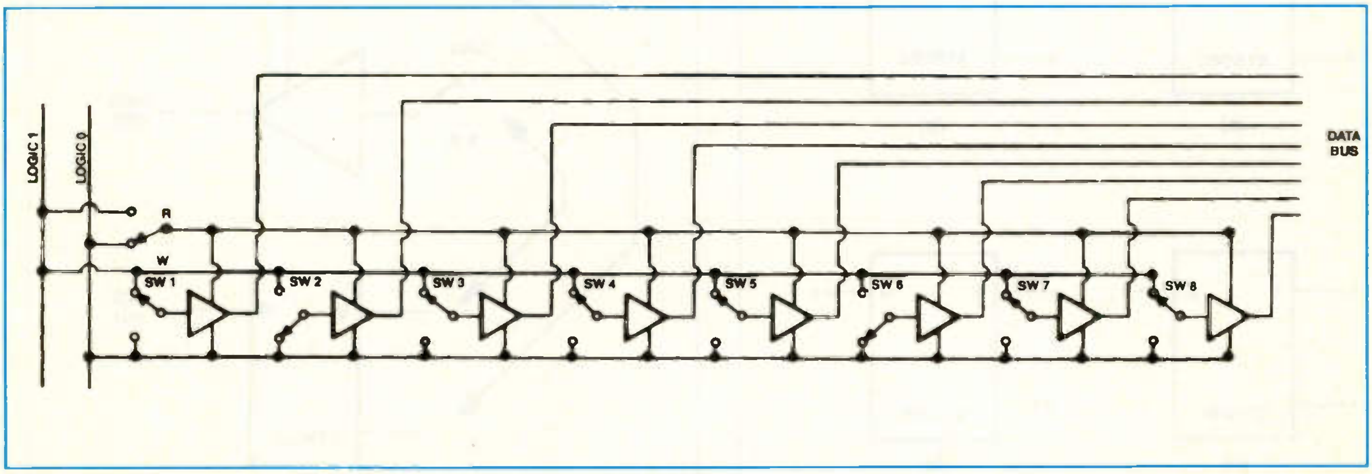


Figure 1

flip flop operation. In (a) the flip flop (FF) is latched. The output is at logic 0 because that level was stored previously.

In (b) a logic 1 is delivered to the D input. However, the output does not change because the strobe terminal is still at logic 0.

In (c) a logic 1 is delivered to the D terminal. At the same time a logic 1 is delivered to the strobe. That unlatches the FF and the output changes from 0 to 1.

After the output changes the strobe is returned to logic 0. That latches the logic 1 output.

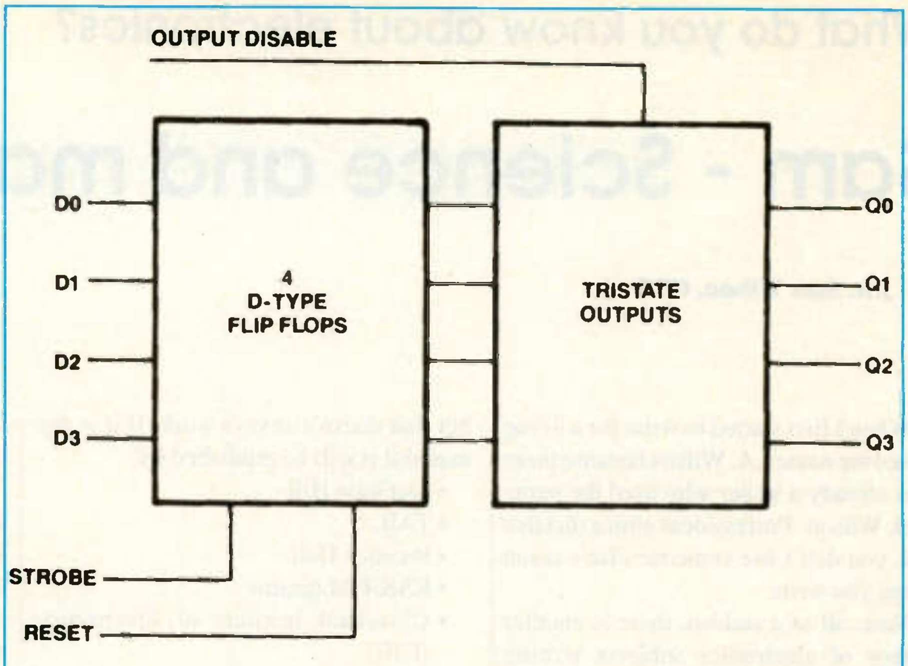
Now look at Figure 4. It compares the memory cell in Figure 4 of the previous issue with a memory cell made with D flip flops. Note that the strobe input of the new memory cell serves the same purpose as the R/W terminal of the previous memory cell.

The difference is that a logic 1 or logic 0 signal input can be used to enter data. In the previous cell it was necessary to set switches to enter data. The obvious advantage is the ease and high speed of handling data.

Address select

We are still faced with the problem of selecting the address of each byte. In the design of the previous issue there was a switch for each address. For a 1024 byte memory we would have to operate 1024 switches for the addresses and 8 additional data switches to completely load that memory.

Recall that setting the memory switch



TRUTH TABLE

RESET	DISABLE	STROBE	D INPUT	Q
0	0	1	1	1
0	0	1	0	0
0	0	0	X	LATCHED
1	0	X	X	0
X	1	X	X	Z

0 = LOGIC 0 X = DON'T CARE
1 = LOGIC 1 Z = HIGH IMPEDANCE

Figure 2.

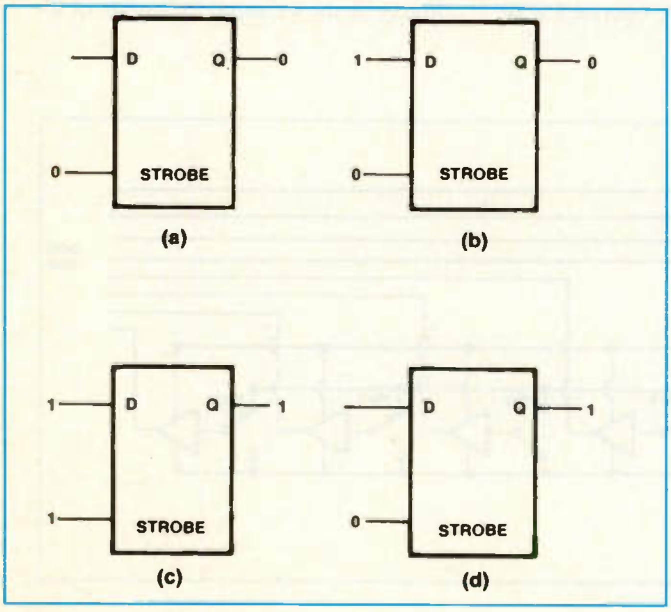


Figure 3.

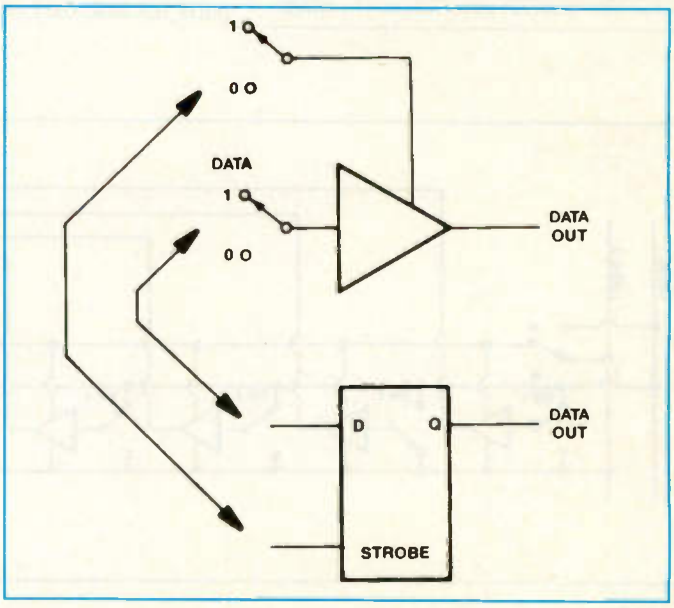


Figure 4.

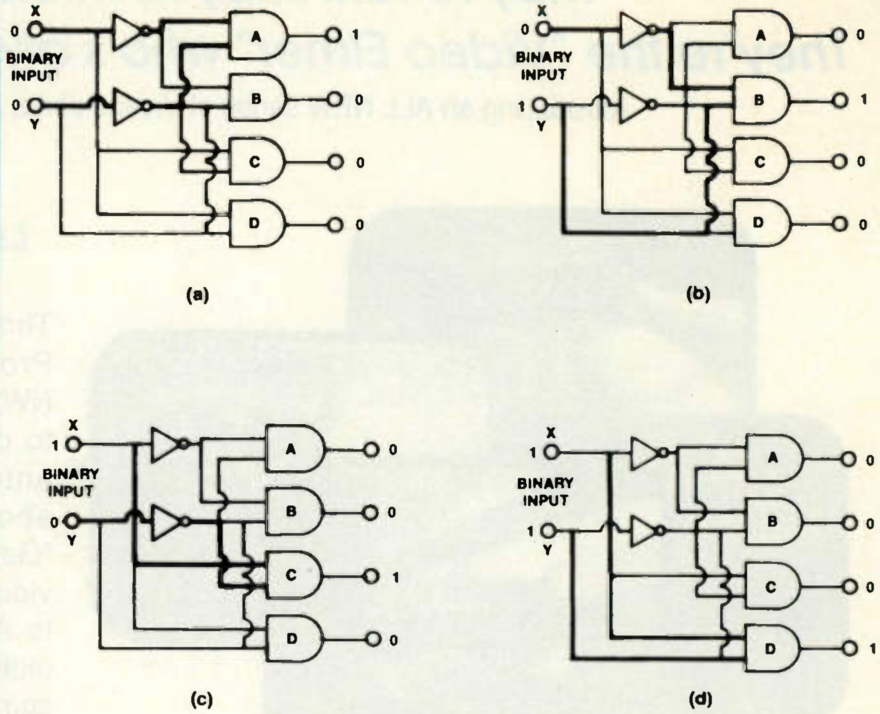
to the desired byte simply delivers a logic 1 to select that byte. All we need is a circuit that will deliver a logic one to any selected address.

Figure 5 shows an *address decoder.* It is also known as a 1-of-4 decoder. There are two input terminals and each terminal has two possible logic levels: 1 or 0. The total input possibilities is 22, or four possible inputs. They are shown in Figure 5.

Observe that by entering a binary count into the decoder, the decoder will automatically sequence from register to register.

The CD4017B CMOS 1-of-10 decoder can be used for the circuit of Figure 5. As you would expect, any number of outputs can be obtained from a decoder. If there are x input possibilities to a decoder there are 2x output lines that can be selected one at a time. (That information might help you answer a question in *Test Your Electronics Knowledge).* Maybe not.

In the next issue we will take an of-the-shelf memory and analyze its input and output signals. Then, we will look at an experiment that allows us to perform the job of the microprocessor in controlling a random access memory (RAM).



TRUTH TABLE

X	Y	A	B	C	D
0	0	1	0	0	0
0	1	0	1	0	0
1	0	0	0	1	0
1	1	0	0	0	1

Figure 5.

Can you read high-class technical literature?

Neither can I.

I was writing a request for a government grant and I decided to double-double check everything. You make a dumb mistake in that stuff and they just assume your lid isn't on tight.

I even checked the direction of current flow in the circuits! For that I got out my *American Institute of Physics Handbook.*. Here is a direct quote about current in a cell or battery circuit: *"In the external portion of the circuit electrons flow from anode to cathode, whereas positive current is said to flow in the external conductor from cathode to anode. Within the cell the positive current flows from anode to cathode, thus completing the circuit..."*

How's that again? To continue:

"Note that in an electrochemical cell operating spontaneously the anode is the negative pole and the cathode is the positive pole."

I'm sorry to say that I don't understand all I know about that information from the American Institute of Physics! I know the book was put together by PHD's and there must have been many gofers. I'm not about to get into an argument with all that power.

Still, electrons flowing from anode to cathode outside the source!???

Just where is Kelsey's barn?

Recently I was asked where I got the expression going by way of Kelsey's barn. Here is the true story.

I had attended a KEA (Kansas) convention and was about to return to Colorado. I could get on the North/South highway by driving across town. To avoid traffic, I decided to go North from where I was and then cut left someplace along the way.

I picked a nice wide road and started north. The road went from four lanes to two lanes. Next it turned into a dirt road. There were no promising roads going left.

The condition of the road kept getting worse. I was about to give up when I saw a very old man sitting on the porch of a run-down house. I decided it was time to seek expert help. I got out of the car and went up and sat on the steps of the porch. I wanted to be sure I didn't alarm him or arouse his suspicion. So, we talked a little while about the weather and the crops. Finally, I got around to asking the big question: "By the way, how do I get on the main north/south road from here?".

"Easy" he said "just keep going down this road until you get to Kelsey's barn - then turn left. That will take you right to the highway."

"Alright" I said. "By the way, how will I recognize Kelsey's barn when I see it?"

"You fool - you can't see it! It burned down over 20 years ago!"

I could see he was getting angry so I left. I found my own way. ■

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3068	Sep	90
3069	Oct	90
3070	Nov	90
3071	Dec	90
3072	Jan	91
3073	Feb	91
3074	Mar	91
3075	Apr	91
3076	May	91
3077	Jun	91
3078	Jul	91
3079	Aug	91
3080	Sep	91
3081	Oct	91
3082	Nov	91
3083	Dec	91
3084	Jan	92
3085	Feb	92
3086	Mar	92
3087	Apr	92
3088	May	92
3089	Jun	92
3090	Jul	92
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3092	Sep	92
3093	Oct	92
3094	Nov	92
3095	Dec	92

Company index — 1982-1991

	Profax #	Month
CURTIS MATHES		
Proj. TV : Models 4100, 4600, 521	Special	1992/93
GENERAL ELECTRIC		
Color TV, AC-D AC-E	2015	Apr 83
B&W TV, XE chassis	2018	May 83
Color TV, EM chassis	2023	Aug 83
Color TV, PM-A chassis	2028	Oct 83
Color TV, PC-B chassis	2832	Dec 83
AF/C chassis	2037	Mar 84
GL/X chassis	2038	Apr 84

1992 Profax Directory

	Profax #	Month
XK B&W chassis	2039	Apr 84
XJ B&W chassis	2042	Jun 84
EC/K chassis	2044	Jul 84
XE B&W chassis	2049	Sep 84
AB/AC chassis	2051	Nov 84
CM chassis	2055	Jan 85
XM-E chassis	2057	Jan 85
PC-A chassis	2058	Feb 85
GK chassis	2060	Mar 85
EC-A chassis	2064	May 85
EP-B chassis	2066	Jun 85
19PC-F/H chassis	2067	Jul 85
PM-B chassis	2068	Aug 85
BC-N chassis	2073	Nov 85
EP chassis	2074	Nov 85
PC-J chassis	2075	Dec 85
PM-A chassis	2078	Jan 86
BC-A chassis	2079	Feb 86
25 PC(J) chassis	2082	Apr 86
HP chassis, tuning and control systems	2084A	May 86
HP chassis, chroma	2084B	May 86
NF chassis	2087	Jul 186
PM-C chassis	2088	Jul 86
X110 chassis, B&W TV	2091	Oct 86
TV/AM/FM clock radio	2092	Oct 86
14-inch portable color TV	2094	Nov 86
X110 chassis (cont.)	2095	Dec 86
CTC140 chassis, color TV	3014	Nov 87
MK-1 chassis, model 8-1938	3008	Jul 87
MK-1 chassis	2099	Feb 87
MK-2 chassis	2097	Jan 87
NF chassis update, color TV	3003	May 87
7-7130A chassis, 5-inch B&W	3004	May 87
1VCR2006W model, VCR	3027	Jul 88
1VCR2018W model, VCR	3019	Feb 88
NC-05X3/06X1 chassis, color TV	3032	Sep 88
Projection TV 8-4500	3020	Mar 88
PW chassis, model 40PW3000KA01 TV	3037	Dec 88
VHS VCR, model 1VCR2002X	3044	Apr 89
Color TV, 1987 CTC136	3047	May 89
CTC135-S1 color TV	3052	Aug 89
1987 8-4500 projection color TV	3057	Nov 89

HITACHI

	Profax #	Month
Camcorder Model UM-E2A	Special	1992/93
Color TV, Chassis AP13	3085	Feb 92
Color TV, chassis NP80SX	2003	Nov 82
Color TV, GTX chassis No.615	2008	Jan 83
Color TV, NP9X chassis	2011	Feb 83
Projection color TV, CT5011	2014	Mar 83
NP81X chassis	2054	Dec 84
CT2516 chassis	2059	Feb 85
CQ4X chassis	2061	Mar 85
CT1358 chassis, color TV	3005	Jun 87
CT2020W, CT2020B chassis	3010	Aug 87
CT2250B, CT2250W chassis	3000	Apr 87
CT2250B, CT2250W chassis	3012	Sep 87
CT1344 chassis color TV	3029	Aug 88
CT1358 chassis color TV	3018	Jan 88
CT2647/CT2648/CT2649 chassis color TVs	3025	Jun 88
CT2652, CT2653 color TVs	3024	May 88
CT3020W/CT3020B	3033	Oct 88
VHS VCR, model VT-63A	3035	Nov 88
CT1955 color TV, NP85XA chassis	3038	Jan 89
Color TV, chassis CT1941/CT19A2, NP83X	3043	Mar 89
CT1955 color TV	3045	Apr 89
CT2066 color TV	3050	Jul 89
CT2086 B/W chassis G7NU3 color TV	3055	Oct 89
CT1395W G7NSU2 color TV	3060	Jan 90
G7XU2/3 chassis color TV	3063	Apr 90
G7XU2 - models CT2087B/W, A087		
(MT2870 through MT2878)		
G7XU3 - models CT2088B/W, A088		
(MT2880, MT2886, MT2887)		
CT4580K, VP7X2 chassis proj. TV	3065	Jun 90
VP9X1 chassis color TV	3069	Oct 90
CT1947/CT19A7 chassis color TV	3079	Aug 91
CT2541/2542 chassis color TV	3080	Sep 91
VCR Model 3267E	3087	Apr 92
VCR Model VT-F551A	3090	Jul 92
VCR Model VT-M40A	3086	Mar 92
VCR Model VT-150A	3095	Dec 92

MAGNAVOX

	Profax #	Month
B&W TV chassis 09M101	2010	Jan 83
Color TV, chassis E31-38	2021	Jul 83

MEMOREX

	Profax #	Month
Pocketvision 26 TV, Catalog Number 16-163	Special	1992/93

MITSUBISHI

	Profax #	Month
VCR Model HS-U55	Special	1992/93

NAP

	Profax #	Month
Color TV, chassis 09C201 CQ4X	2002	Oct 82
B&W TV, model MQA014GY (w/radio)	2006	Dec 82
B&W TV, AM/FM radio UVG-1	2016	Apr 83
Color TV, chassis E34-18, -19, -32, -33	2017	May 83
B&W TV, model B386QWA01	2020	Jun 83
B&W TV, chassis 12M101	2024	Aug 83
B&W TV, chassis 12M101 (duplicate)	2026	Sep 83
Color TV, 13C3 series	2030	Nov 83
Color TV, 19C3 series	2031	Dec 83
E34 chassis	2034	Jan 84
19C2 chassis	2035	Feb 84
E32 chassis	2040	Apr 84
E32-58, -59 chassis	2043	Jun 84
K10 chassis	2045	Jul 84
RD 425S1 & RXC 192SL chassis	2047	Aug 84
E53-45, -46, -47, -48 chassis	2048	Sep 84
BD3911 SL01 B&W chassis	2051	Nov 84
UXC chassis	2063	Apr 85
EC-31-52, -56 & -58 chassis	2069	Sep 85
E-34-18, -32 & -33 chassis	2071	Oct 85
E51-56 chassis, color TV	3030	Aug 88
E54-10 chassis, projection TV	3021	Apr 88
E54-15 chassis, projection TV	3026	Jun 88
RD4502SL/RLC312SL color TV monitors	3036	Nov 88
Color TV, series 19C2 chassis (Magnavox)	3039	Jan 89
Color TV, chassis E34-11	3042	Mar 89

1992 Profax Directory

	Profax #	Month
Color TV, chassis E54-15	3049	Jun 89
(Magnavox RD8518 and RD6520; Philco model P8190S; Sylvania PSC410 and 420)		

NEC

Color video monitor, chassis Z7A	2000	Oct 82
Video projector, chassis W2A-1	2005	Nov 82
C13-304A chassis	2056	Jan 85
DJ-60EN(R) chassis	2065	May 85

PANASONIC

Color video TV model SR400EK	Special	1992/93

PHILCO

Color TV, chassis K-20	2022	Jul 83

RCA

B&W TV, chassis KCS207B	2001	Oct 82
Color TV, chassis CTC115	2004	Nov 82
Color TV, chassis CTC108	2007	Dec 82
Projection TV, model PGR200/300	2009	Jan 83
Color TV, CTC118 series	2012	Feb 83
B&W TV, chassis KCS 206C	2013	Mar 83
Color TV, CTC117 series	2019	Jun 83
Color TV, chassis CTC120	2025	Sep 83
B&W TV KCS205 series	2027	Oct 83
B&W TV KCS204 series	2029	Nov 83
KCS206 B&W	2033	Jan 84
KCS213 B&W	2036	Feb 84
CTC111 series	2041	Mar 84
CTC123 series	2046	Apr 84
CTC131/132 series	2050	Oct 84
KCS B&W AM/FM clock	2053	Dec 84
CTC117 chassis	2062	Apr 85
CTC118 chassis	2070	Sep 85
CTC121 chassis	2072	Oct 85
CTC126 chassis	2076	Dec 85
MMC100, video monitor	2077	Jan 86
CTC117 chassis	2080	Feb 86
CTC133 chassis	2081	Mar 86
CTC120 chassis	2083	Apr 86
CTC125 chassis	2085	Jun 86
207 series weather clock	2086	Jun 86
CTC136 chassis	2089	Aug 86
CTC130-S1 chassis	2090	Sep 86
B&W TV basic service data	2093	Nov 86
UWJ chassis	2096	Dec 86
CTC117-S2 color TV supplement	2098	Feb 87
CTC134 chassis, color TV	3013	Oct 87
CTC135 chassis, color TV	3006	Jun 87
VDM140 chassis, color TV	3002	May 87
PVM035 chassis color TV	3031	Sep 88
PVM050 color TV	3023	May 88
P42000-S1 projection TV	3048	Jun 89
(additional models: RVM46700, 46GW700, P46000)		
CTC135 color TV	3051	Jul 89
CSM055 color TV/AM/FM/clock radio	3054	Sep 89
CTC91 chassis color TV	3071	Dec 90
CTC99 chassis color TV	072	Jan 91
CTC107 chassis color TV	3073	Feb 91
CTC96 chassis color TV	3077	Jun 91
CTC107 chassis color TV	3078	Jul 91

RCA/GE (Thomson Consumer Electronics)

Color TV, Model 7-7800A	3091	Aug 92
Color TV, CTC145/146 chassis	3040	Feb 89
CTC145/146 color TV	3058	Nov 89
CTC148/149-S2 chassis color TV	3062	Mar 90
CTC156 chassis color TV	3068	Sep 90
CTC169 (PV) chassis Color TV	3070	Nov 90
CTC168 chassis color TV	3074	Mar 91
CTC86 chassis color TV	3075	Apr 91
KCS203 chassis B&W TV	3076	May 91
CTC167 chassis color TV	3081	Oct 91
CTC166 chassis color TV	3082	Nov 91
CTC168 chassis color TV	3084	Jan 92
CTC168-53 chassis color TV	3088	May 92
CTC169 chassis color TV	3083	Dec 91
TX81 chassis color TV	3067	Aug 90
TX82 chassis color TV	3092	Sep 92
VCR Model VG4202	Special	1992/93

SHARP

Color TV, Model 13C-M100	3093	Oct 92
Color TV, Model 27C-5200	3094	Nov 92
Color TV, Model 27SV65 Color TV	Special	1992/93

TOSHIBA

Color TV Model CF2077A: CX21772	Special	1992/93

ZENITH

D2500W chassis, color TV	3009	Aug 87
D13085/D1910B chassis, color TV	3007	Jul 87
SD2501W chassis, color TV	3011	Sep 87
CM-139/B-0 (B) chassis color TV	3028	Jul 88
CM-139/B-3 (I) SD2511G/SD2581H	3034	Oct 88
C2020H chassis color TV	3022	Apr 88
PV800 color monitor	3017	Jan 88
Color TV, CM-140/b-2(G) chassis	3041	Feb 89
CM-14-0/B-3(1) color TV	3046	May 89
(models SE2721H/SE2725R/SE2727H)		
CM-140/B-2(I) color TV	3053	Aug 89
PV4661H rear-projector color TV	3056	Oct 89
CM-139/B2: D5515, SD5535, SD555G	Special	1992/93
CM-140/DIGITAL(C) chassis color TV	3059	Dec 89
(Models SE3135P/SE3191H/SE3535H/ ZB2771H/ZB2771H2/ZB2777H/ZB2777H2/ ZB2797P/ZB2797P2/ZB2797Y/ZB2797Y2/ ZB3193H/ZB3193Y/ZB3539T/ZB3539Y)		
CM-139/B1 (Y) and (K) Color TV Recievers	3061	Feb 90
Models SD2097S (Y) and SD1327W3, SD1327Y, SD1327Y3(K)		
PV-140/Digital (G) Rear Proj. digital TV	3064	May 90
PV454-1P chassis color TV	3066	Jul 90

Reader's Exchange

Reader's Exchange has been reinstated as a free service.

The following restrictions apply to Reader's Exchange:

• Only individual readers may use Reader's Exchange, and items must be restricted to those that are ordinarily associated with consumer electronics as a business or hobby. If you're in business to sell the item(s) you want to offer for sale, the appropriate place for your messsage is in paid advertisement, not Reader's Exchange.

• Readers Exchange items must be restricted to no more than three items each for wanted and for sale, and may be no more than approximately four magazine column lines in length (about 20 words).

Send your Reader's Exchange submissions to:

Reader's Exchange
Electronic Servicing & Technology
76 N. Broadway
Hicksville, NY 11801

FOR SALE

Sams Photofacts 1-1079 and auto series. Riders vol 9-16. Ann Bichanick, *Jay's Radio and TV Service, 15 West Lake Street, Chisolm, MN 55719.*

SC-3080, VC-93, VA-62, PR-57, and CR-70 all manuals and cables never used-make offer. *Linda Austin, 510-449-6939.*

Sencore SC61 with probes $1500.00. Dwight Abbott, Salida, CO, 81201, 719-539-7571.

245 tubes (mostly TV) in RCA treasure chest tube caddy. $200.00 (plus shipping). Send SASE for list to *Eli Schwartz, 1119 Foster Ave., Brooklyn, NY 11230. 718-434-9011*

Tektronix 465 military grade 100MHz scope $110.00. Leader LBO-516 3 channel 100MHz scope $900.00. Leader LDC-822 80MHz frequency counter $200.00. Call Frank 516-731-0620.

Sencore SC3080 waveform analyzer. 7 months old. Used about a dozen times. First $2500.00 takes it. Call Rob at 812-279-1834.

Hitachi vectorscope waveform monitor-1 year old, B&K 415 SWP/MKR generator, Sencore SG165, B&K 1611 power supply. Call Ed at 209-686-5938

Sencore LC 75 "Z Meter 2" with SCR 250 SCR and triac test accessory. Both units like new with all accessories and manuals, including original shipping containers. Original cost $995 and $148 both for $500.00. Call Bill at 908-583-6153.

Leader model 1021 20MHz dual trace scope, $180.00, B&K model 1077B TV analyzer, $75.00, B&K model 467 3-meter CRT tester, $125.00. Call Gene at 501-246-7234.

2500 tubes new and used with tube caddy $1200.00 no list. Color/dot generator IG-62 Heath $50.00. 210 ES&T magazines $100.00. Field strength meter $15.00. Eico VTVM model 232 $50.00. Call Romy Janusz at 414-541-0957.

Sencore SC61 $1500.00. will include VC63 NT64, PR57, EX 231. Also LC53 for $300.00. Prices firm. Excellent condition. Call Charlene at 216-923-4989.

Video heads, upper and lower drum assembly for Mitsubishi HS 359UR and upper and lower drum for Sears 934-53510650,4 head, also complete cassette housing for Sears VCR above. Call Jackson VCR at 205-643-5906.

Waveform monitors, Tektronix 528 $500.00 and Videotek TSM-5 $400.00. Bert Kuschner, 3340 Turtlemound Rd., Melbourne, FL 32934.

Microfiche. No reasonbale offer refused. Hi-Tech Electronics, Bob 602-855-5400.

Text books, service manuals, diagrams, parts, tubes -90% off list price. Send large S.A.S.E. M. Seligsohn, 1455-55th Street, Brooklyn, NY 11219.

B&K model 466 CRT tester/rejuvenator with 17 adapters and manual, $175. B&K model 607 tube tester with manuals, $75.00 206-241-0507. Ken Goetsch, 12698 Shorewood Drive S.W. Seattle, WA 98146.

Replacement 3"x 4" pc board with a CRT socket, sealed, new, to be plugged onto TV CRT base. On envelope: Philips Consumer Electronics Company, p/n 483526597092 for Magnavox, Philco, Sylvania and Philips TV's. $10.00. Krebs, 1830 Columbia Pike, Apt. 609, Arlington, VA 22204. 703-553-8075.

Retiring, Sencore LC75 Z meter $450.00 Sencore VA 48 $400.00. Hitachi dual trace scope 35MHz $395.00 and other instruments. Harry Dwyer, Binghamptom, NY 607-722-5945.

WANTED

Service notes for grundig satellite 2000 multi-band radio. Copies OK but state price. *Eli Girouard, Elks National Home, Bedford, VA 24523. 703-586-6619.*

Information on what model No. of Hitachi/RCA is equivalent to a Sears VCR #934.53323550. *C.A. Jones 5727 Old Bethel Rd., Crestview, FL 32536.*

Complete front panel for a Toshiba VCR, model M5400. *Ron Purkhiser, 56 Oakhurst Dr., Munroe Falls, OH 44262. 216-688-6624.*

Operations manual or copy for Fluke model 710A RCL bridge, Commodore 1084D monitor, RCA Lafayette/Allied Radio catalogs of 60's/70's, Burwen TNE 7000 transient noise eliminator. Burwen R514A generator. *Robert Miller, Rt.1 Box 223, Anadarko, OK 73005, 405-247-6553.*

Two schematics for Sears color TV model No. 564.4260050, Wards color TV model JSA-1229. James 1201A dynamic noise filter. *Kevin Parks 3532 W. Patterson Pl, Littleton, CO, 80123.*

Horizontal centering pot for GE KE chassis, GE part #EU49X486; Centrarlab part #WT-10, WSK-104, Clarostat part # NPW-10; Mallory part #MR10T, MRS1250, MRS1563. *Mr. William Suhy 203-934-0446.*

Diehl Mark V scanner, excellent condition with manual $150.00 (includes shipping). *Gerard Whealton, 919-745-5707.*

Schematic for Siltronix 1011C transceiver. *Randy Wade, 501-251-2596, 1260-A East Main Batesville, AR, 72501.*

Triplett model 603 analog meter in any condition. *Bill's TV Service, Route 1, Box 11, Sulphur Springs, TX 75482.*

Service manual or schematics for Burroughs Dex 3200/3700 fax machine. Particularly need schematic for power supply section. Also, 6Z10 tube, new or used. *Paul Wojcik, 708-516-9750.*

Service manual for Sears Beta VCR model 562.53442350 or the equivalent Toshiba model for this machine. *LaVere's TV and VCR Repair, 1150 Sleepy Hollow Loop, Grants Pass, OR 97527.*

Old radio tubes - 4-5 pin type. Also early radio - TV - literature, service manuals, books, etc. Audio tubes 6CA7-7199-126-etc. *Maurer 2950 So. 4th Street, Lebanon, PA 17042.*

Marine, GMRS, business transmit and recieve crystals. Complete and functional UHF commercial repeater. *Clarence Wilken, 40 N. Bailey, Freeport, IL 61032. 815-233-0224.*

Schematic for NEC PJ400 40 inch projection T.V. *L. O. Robensin, 4662 Esther Street, San Diego, CA 92115, 619-583-5153.*

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Classified advertising is available by the word or per column inch.

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Per column Inch (classified Display): $235 per column inch, per insertion, with frequency discounts available, 1" minimum, billed at 1/4" increments after that 10" maximum per ad. Blind ads are $40 addition. Reader Service Number $25 additional to cover processing and handling costs. (Free to 4-inch or larger ads.) For more information regarding classified display advertising please contact Jonathan C. Kummer at 516-681-2922. Optional color (determined by magazine) $150 additional per insertion.

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ATTENTION SERVICERS! If you charge hourly rates, you need the DTS125 Labor Tracker! The DTS125 is a unique bench top instrument that automatically measures elapsed service time and computes labor charges for your service work, saving time and money. A large internal memory holds up-to 125 active jobs. The DTS125 Labor Tracker is easy to use and lists for $349.00. On sale now for just $279.00. Satisfaction guaranteed. Call or write for brochure. **Johnson Electronic Technologies**, Dept. E2, 5 Kane Industrial Drive, Hudson, MA 01749 (508) 562-1157.

REDUCED 85%. Diehl Mark 111 scanner $79. Diehl Mark V scanner $199. New. Restore remote control keypads with our conductive coating $8.99 ppd. WEEC, 2805 University Ave., Madison, WI 53705. 608-238-4629, 608-233-9741.

VHS-VCR Repair Solution Sets I, II, III IV, V, VI, VII. Each contains 150 symptoms and cures, updated cross reference chart, free assistance, $11.95 each, all seven $69.95. Schematics available. Visa/MC. Eagle Electronics, 52053 Locks Lane, Granger, IN 46530.

THE ONLY ANSWER TO REPAIRING ELECTRONICS PROFITABLY (this should have been done years ago) **GET SMART!** Someone somewhere has already repaired your next repair **YOUR TOP TECHNICIAN**, who's training you have paid for **JUST LEFT TODAY! YOU'RE THE BOSS** and now you have to put on your old rusty technician's cap. **TODAY YOUR BANK** sent you three NSF checks your customers so graciously gave you, and you don't have time to chase them down to collect, **THEY LEFT TOWN. IT'S TAKING YOU LONGER** to assess the repairs and your customers are now coming to collect their units. You promised to give them a **FREE** estimate, but you just realized you don't have a schematic or time to do it. **NOW YOU ARE DOING NIGHT REPAIRS** because during store hours the phone rings off the hook with nuisance questions about setting VCR clocks and you have parts to order, bills to pay and service literature to file. **CIRCUIT CITY JUST MOVED IN** and your wife say's there's no money in repairs **FRIEND!! YOU DEFINITELY HAVE AN EMERGENCY!!** 10,000 repairs 1987 through 1992 with annual updates. References available on request. **I CAN ASSURE YOU THESE TECH-TIPS ARE NOT DUSTY OLD REPAIRS YOU'LL NEVER SEE.** Other programs don't even come close to comparing. **CALL NOW (305) 474-2677 FOR A "FREE" DEMONSTRATION DISK OR PAPER FORMAT** or mail request to **TV-MAN SALES & SERVICE, 8614 SR-84, FT. LAUDERDALE, FL 33324**

COMPUTER AIDED TV/VCR REPAIR SOLUTIONS: 5 1/4" IBM compatible disks, 1,000 VCR, Printout $83, Disks $72. 5,400 TV, Printout $135, Disks $113 (Harddrive). Add to or quick scan by chassis, model and stage. Two solutions pays for it. Electronic Solutions, 407 W. Ave. "N", San Angelo, TX 76903.

LARGEST SELECTION of original TV & VCR IC's and transistors. Lowest Prices. Call or write for free catalog. **PRELCO ELECTRONICS**, 605 Chestnut Street, Union, NJ 07083, 908-851-8600.

ZENITH 9-516/517 MODULE CURE: Repair easily yourself and save! For instructions send $15.00: TEK ENTERPRISES 702 Overland Avenue, Wilmington, Delaware 19804.

NEW STATE OF THE ART SENCORE LC102 capacitor & inductor analyzer additional supplied accessories, Sencore #PA251 power adapter, Sencore #39G219 low capacity test lead, Sencore #CC254 carrying case, Sencore #BY234 rechargeable lead acid battery. Value of over $2,000, Selling for only **$1,200**. Call 408-633-5196 ask for Francisco.

SENCORE equipment purchased June 1992 must sell, going out of business. SC3080 waveform analyzer, $2,500; LC102 auto Z meter, $1,600; PR57 variable isolation transformer, $400; SCR250 test accessory, $150; CR70 universal CRT analyzer, $1,100. Kenneth Bayne, 1855 Doby's Bridge Road, Fort Mill, SC. 1-803-548-3773.

FOR SALE: Leader LAG-126S audio generator, LDM-171 distortion meter $1,000 for set, LSW-333 sweep marker generator $500, all like new in boxes used twice. Dennis Klas 414-668-6340.

CONSUMER ELECTRONICS SALES & SERVICE: Busy one or two man shop on main business district. Well established with low overhead. Excellent opportunity for VCR technician. Located on Mississippi River in Northern Illinois. 815-589-3010.

SENCORE BENCH: SC61 waveform analyzer, VA62 video analyzer, VC93 VCR analyzer, LC76 Z meter and PR57 isolation transformer. All like new, one year old with original leads, instructions and packaging. Over $12,000 worth. Asking only $9,000. Call 513-842-9909 – Larry.

TV–VCR SHOPS: Now fix those tough dogs! A package of over 2800 fixes on disk. ASCII or data for popular data bases. (PFS, QA, etc.) One fix could pay for all. Only $99.95. TECH-DAT, 212 Earth Row, Waynesville, MO 65583. To order call 1-800-280-2100. VISA & Mastercard Accepted.

WANTED

WANT TO BUY small electronic servicing business. Prefer Western or Southern United States. Call Mike 1-510-783-3648 or Joe 1-918-682-4781.

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Manufacturers Parts and Literature Directory

This monthly section is sponsored by manufacturers to help you find the parts and technical literature needed to service their equipment. Call them for replacement parts or for the name of their nearest distibutor.

Hitachi Home Electronics **401 W. Artesia Blvd.** **Compton, CA 90220** **800-HITACHI**	**Mitusubishi Electronics America** **5757 Plaza Drive** **Cypress, CA 90630** **800-553-7278 fax 800-825-6655**	**NEC Tehcnologies** **1255 Michael Drive** **Wood Dale, IL 60191** **800-366-3632**
Panasonic **50 Meadowlands Parkway** **Secaucus, NJ 07094** **800 545-2672**	**Philips ECG** **1025 Westminister Drive** **Williamsport, PA 17701** **800-526-9354 fax 800-346-6621**	**Quasar** **50 Meadowlands Parkway** **Secaucus, NJ 07094** **800-545-2672**
Technics **50 Meadowlands Parkway** **Secaucus, NJ 07094** **800-545-2672**	**Thomson Consumer Electronics** **2000 Clements Bridge Road** **Deptford, NJ 08096** **800-257-7946 fax 800-524-1498**	**Zenith Electronics Corp.** **1900 N. Austin Avenue** **Chicago, IL 60634** **312-745-2000**

Call Jonathan Kummer at 516-681-2922 to reserve space in this special section.

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Send All Correspondence To:

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Or Call 516-681-2922
FAX 516-681-2926

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We'd like to see your company listed here too. Contact Jonathan C. Kummer to work out an advertising program tailored to suit your needs.

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Phone: (516) 681-2922
FAX: (516) 681-2926

Jonathan C. Kummer
Advertising Manager

Emily Kreutz
Sales Assistant

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