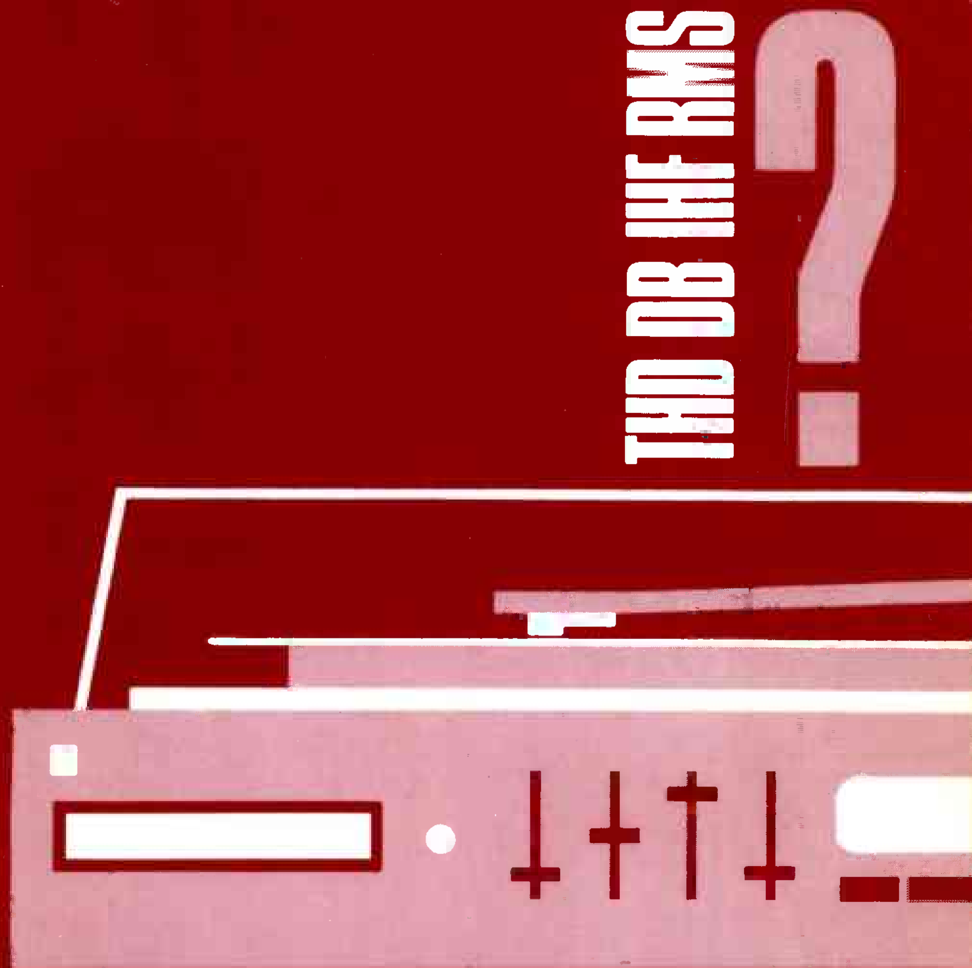

- Interpreting Audio Amplifier Specifications
- Further Adventures in TV Servicing

nri journal

September/October 1973

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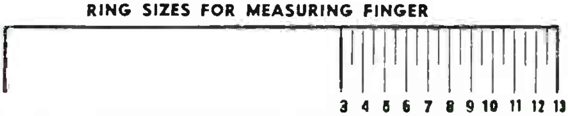

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In this issue, Phil Deem attempts to bring order out of the chaos of audio amplifier specs. Also, J. B. Straughn returns with more TV case histories—including a technique for spotting tornados on your TV screen!

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Interpreting Audio Amplifier Specifications

Phillip D. Deem

Almost anyone who knows of your your interest in electronics or knows that you are taking an electronics course comes to you when they are getting ready to buy a new stereo amplifier to ask your advice. There are a number of ways in which you could guide them toward the equipment that would be best for them. Chances are good that they have already narrowed the field down to three or four systems, all in the price range that suits their pocketbook. Now, they want you to tell them which one is best.

You may help them decide by telling them about your servicing experience or comments you have heard from others concerning the equipment they are interested in. Or, you may want to discuss and examine the *specifications* of the equipment with them. Show them how to compare the specifications of the equipment they are looking at to determine which unit will perform best.

In this article, we will take a look at the various specifications to find out exactly what they mean, how they are derived, and to discover typical values where appropriate.

power output

This is the big, number one spec as far as the manufacturers are concerned. As soon as they learned that the public would fork over more dollars for more watts, they began to cast around for ways to "amplify" (pun) the number of watts at which their equipment could be rated.

Each manufacturer chose his favorite method of performing the power output measurement. The consumer who purchased his equipment on a dollars-per-watt or, if lucky, a watts-per-dollar basis, had some difficulty in comparing the various amplifiers. In the past, manufacturers have listed the power output as peak power, music power, continuous power, rms power, IHF power, or EIA power. With all these ratings for the same specifications, it was next to impossible to make any accurate comparison among them.

Today, the manufacturers have altered the manner in which they list the power output of their amplifiers. They didn't do this completely on their own, of course. It took a little prodding from the Federal Trade Commission. The little power game did not go unnoticed by the FTC. They came up with a ruling that all manufacturers must list the rms power of their amplifiers. I'm not really sure that this ruling ever officially got on the books; however, it was rather widely publicized and most of the manufacturers seem to have taken the hint.

The only catch in this ruling was that it did not say the manufacturers could not *also* list the power output in any other manner they chose. Most of them list the rms power output along with one or more of the other ratings mentioned previously. It is also interesting to note that the rms rating nearly always follows the manufacturer's favorite rating—on the "sort of bury it in the text and maybe they won't notice it" approach!

Another neat little trick frequently used is to list the *total* power output with all channels running full tilt! If the power rating doesn't specifically say "per channel," you can bet they have added them together, leaving the division by two or four up to the unsuspecting consumer.

Don't forget to take a look at the load impedance the amplifier was driving when the power measurement was taken. Most amplifiers are designed to drive either 4, 8, or 16-ohm speakers. If the manufacturer doesn't list the load impedance, you'll have to assume that he meant 8 ohms, since this is the impedance of most speakers. However, if the amplifier was rated at 4 ohms, you'll have to take three-fourths of this power output to approximate the amplifier's 8-ohm rating.

Now, let's get a good grip on our slide rules (or electronic calculators, as the case may be) and see how these power ratings compare with each other. Some of the ratings are identical. Only their names have been changed to confuse the innocent. Music power is the same as the Institute of High Fidelity (IHF) rating. Continuous power is the same as rms power. If you come across an amplifier whose power output is rated according to the Electronic Industries Association (EIA) standard, ignore it. No manufacturer has any business rating a high-fidelity amplifier using this standard because the power measurement is taken at a 5% distortion level!

peak power

This used to be a frequent favorite of the manufacturers because it would result in about the fattest power output. If the output of the amplifier being tested is essentially a sine wave, up to 2% distortion, the instantaneous peak voltage is equal to 1.414 times the rms value of the sine wave. Since power is proportional to the voltage squared, the instantaneous peak power is 1.414^2 or twice the sine wave or rms power.

While the foregoing discussion is theoretically true, it is seldom proven out in practice. In order to obtain a peak power measurement which is double the rms rating, the amplifier's power supply would have to be capable of delivering the same voltage as under no-signal conditions. For this reason, the peak power measurement is seldom taken. The music power rating, which takes this factor into consideration, is used instead.

music power

The ideal power supply would be one that has zero impedance. Thus, as the current demand increased, there would be absolutely no voltage decrease from the power supply. While this theoretical ideal can be approached in practice, it can never be achieved.

If the increased current demands are very brief, the power-supply filter capacitors will be able to supply most of the required current. If the current peaks last for a longer period of time, the dc voltage will be reduced and the stages in the amplifier will not be able to operate over the most desirable portion of their characteristic curves. As a result, the power output decreases and distortion increases.

Some argue that since speech and music are not made up of steady-state sine waves, the power output should be rated to take this into consideration. Under the IHF standard, music power measurements are taken by applying a tone burst to the input of the amplifier. An oscilloscope is used to observe the amplified signal across the load at which the amplifier is to be rated. The scope is calibrated in terms of power output.

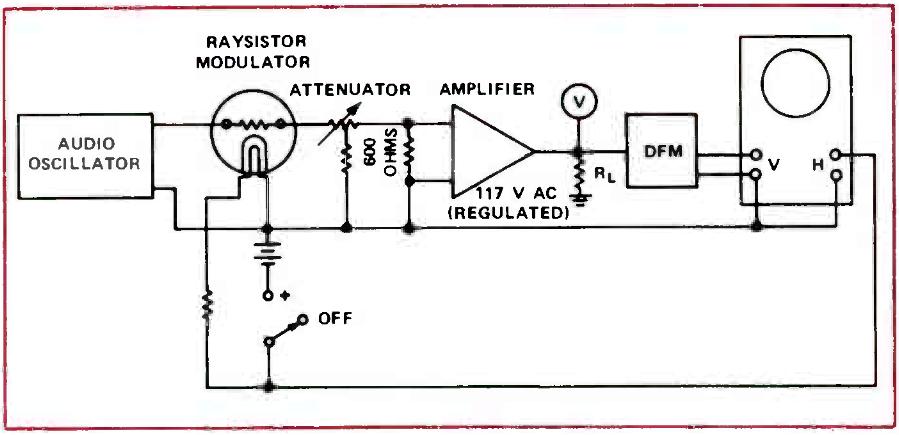


FIGURE 1. MUSIC POWER RATING TEST SETUP.

The test equipment setup is shown in Figure 1. An audio oscillator adjusted to 1000 Hz is burst-keyed by the lamp and photoresistive element. This combination is used to establish a burst with a rise time of 10 to 20 milliseconds. A pulse generator could be used, if the rise time can be adjusted to this value. A pulse from the modulator is also fed to the horizontal input of the scope so that one sweep will take place during each burst. The scope monitors the amplifier output through a distortion factor meter (DFM) so that both power output and distortion can be determined. A voltmeter is connected across the amplifier output terminating resistor (R_L) as a check on output level. The amplifier is powered from a regulated 117-volt ac source to ensure that line voltage variations do not affect the measurement.

A power output measurement determined in this manner will be 10 to 30% higher than the amplifier's rms rating. The IHF standard requires that both the music power and rms power output be stated. The difference between the two will be largely determined by the ability of the power supply to maintain its output voltage constant under varying load conditions.

continuous power (rms)

The rms power output measurement is taken by applying a low-distortion (0.1% or less) 1000-Hz sine wave to the input of an amplifier for a period not less than 30 seconds. The input level of the signal is adjusted until the distortion at the output reaches the level chosen by the manufacturer. At this point the power measurement is taken.

±1 db IHF

In their never-ending quest for listing higher power output ratings, the manufacturers have come up with another bit of trickery. They list the power output at ±1 db of the IHF or music power rating. The manufacturers know that the general public does not really understand the use of db. No manufacturer in his right mind is going to list the power output at −1 db. He is going to list it at +1 db. This will result in an output rating 1.259 times the standard IHF rating. For example, a

POWER RATINGS	
PEAK	= 2 X RMS
IHF	= RMS + 10 TO 30%
CONTINUOUS	= RMS
±1 DB IHF	= 1.259 X IHF
RMS	= IHF - 30%

FIGURE 2. HOW TO CONVERT ONE POWER RATING TO ANOTHER.

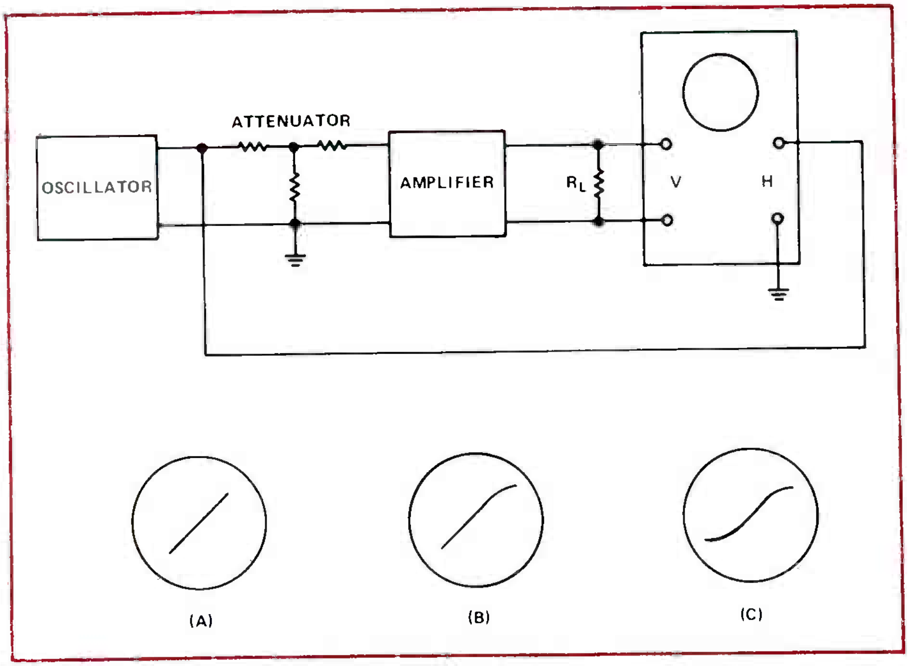


FIGURE 3. OBSERVING HARMONIC DISTORTION USING AN OSCILLOSCOPE.

typical Layfayette amplifier is rated at 150 watts ±1 db or 120 watts IHF. Notice that 120 watts +1 db = 120 X 1.259 = 151.08 watts. Sneaky, huh?

Figure 2 is a table showing how to handle the various power ratings. By manipulating the numbers listed for power amplifiers you are interested in, you will be able to make reasonably accurate comparisons between those having different ratings.

harmonic distortion

Harmonic distortion is produced by nonlinear amplification of a frequency causing harmonics at the output of the amplifier that were not present at the input. Harmonic distortion can be viewed on an oscilloscope by using the setup shown in Figure 3. Generally, the distortion must be between 2 to 5 percent before it will be easily detectable, with higher-order harmonics being the most easily discernable. No harmonic distortion is shown in Detail A, even-harmonic distortion at B, and odd-harmonic distortion at C. The oscilloscope measurement method is not very satisfactory, since it is difficult to determine the amount of distortion present. At best, only the presence of distortion and whether it is even or odd can be determined.

A professional harmonic distortion analyzer operates on the heterodyne principle wherein the audio test frequency is mixed with an oscillator in the analyzer, producing a difference frequency at the analyzer's i-f. The i-f is a highly selective amplifier. The best frequency is measured by a metering circuit calibrated in percent and voltage. The total harmonic distortion may be calculated by:

$$\% \text{ distortion} = \sqrt{(\%f_2)^2 + (\%f_3)^2 + (\%f_4)^2} \ldots$$

where f_2 is the second harmonic, f_3 is the third harmonic, etc.

Harmonic distortion is usually stated as a specific percentage at a particular frequency and power output level. It is sometimes listed as a percent for a band of frequencies and power level. A typical rating for a high quality amplifier would be: "less than 0.1% at 1000 Hz with 1 watt output; less than 0.25% from 20 Hz to 20 kHz at 60 watts output."

intermodulation distortion (IM)

Intermodulation distortion is "the production in a nonlinear circuit element of frequencies corresponding to the sum and differences of the fundamentals and harmonics of two or more frequencies which are transmitted through that element." The measurement differs from harmonic distortion in that two frequencies are fed into the amplifier. The low frequency is adjusted to have an amplitude four times that of the higher frequency. The overall amplitude of the composite signal is adjusted to drive the amplifier to the desired output level.

This rating was developed because it represents a more accurate means of measuring distortion in audio amplifiers. Two amplifiers of the same manufacture, design and harmonic distortion characteristics may be found to differ drastically in how they sound. It is likely that the difference would be measurable as different IM distortion percentages. The IM distortion measurement more nearly approximates the way the human ear hears than any other measurement.

An IM distortion rating for a high-quality amplifier would be: "less than 0.1% with 60 watts output, using 60 and 6000 Hz mixed 4:1."

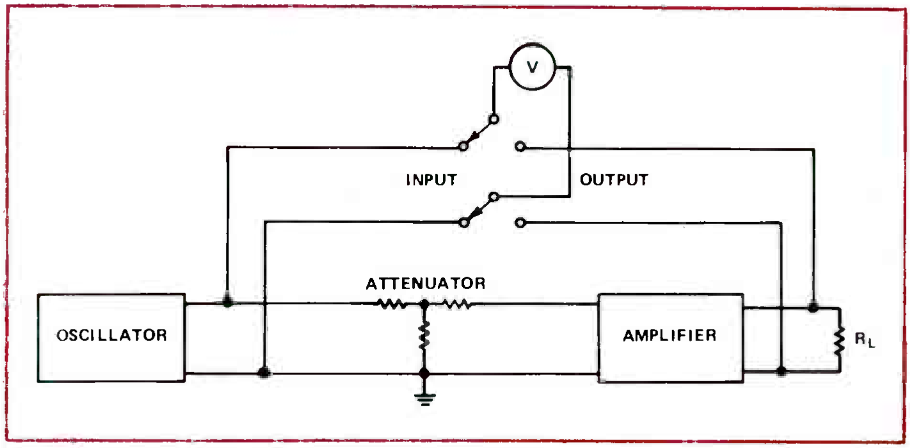


FIGURE 4. METHOD OF MEASURING THE FREQUENCY RESPONSE OF AN AMPLIFIER.

frequency response

The frequency response of an amplifier is a measurement of its ability to maintain a constant output level over a band of frequencies of constant level at its input. The frequency response of an amplifier can be measured in several different ways. One of the simplest test setups is shown in Figure 4.

This system uses an audio oscillator, attenuator, and a high-impedance voltmeter. Since the same meter is used to measure both the input and output voltage levels, the frequency-response characteristic of the meter is canceled. The attenuator serves as a means of matching the oscillator output to the amplifier input. It also allows a signal of sufficient amplitude to be measured at the input of the attenuator while reducing the signal to a relatively low level at the amplifier input.

Measurements are taken by adjusting the oscillator to several different frequencies and adjusting the oscillator output for a constant input level. The resultant output level is then measured for each frequency and plotted, usually using the 1000-Hz measurement as a reference, as shown in Figure 5. The frequency response of this particular amplifier would probably be stated as: 80 Hz – 10 kHz ±3 db. A typical, high-quality amplifier would have a frequency response of 5 Hz to 100 kHz ±0.5 db.

hum and noise

The hum and noise rating is a measurement of the extraneous signal voltage at the output of an amplifier under no-noise input conditions. It is usually stated as a number of db below the amplifier's rated output. Sometimes it will be stated when different inputs, such as phono or tape head, have been selected. The hum and noise level under either of these conditions will be somewhat higher, since additional circuitry is involved.

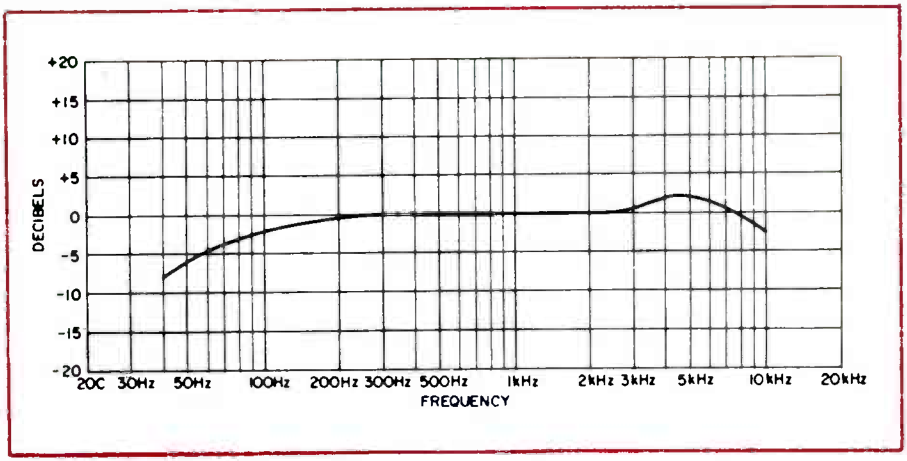


FIGURE 5. AMPLIFIER FREQUENCY RESPONSE.

The hum and noise level for a high-quality amplifier would be listed as: "95 db below rated output."

separation

This rating refers to the isolation between the two sections of a stereo amplifier. Most stereo amplifiers use a common power supply, which accounts for a major portion of signal coupling from one channel to the other. Coupling through stray capacitance, wiring and ground connections make up the remaining leakage paths.

The measurement is taken by measuring the signal voltage at the output of the channel to which the signal is applied, then measuring the output of the other channel, to which no signal is applied. The ratio of the two signals is the separation and is expressed in db. Separation for a high-quality amplifier should be 55 db or better.

output impedance

Although nearly every manufacturer lists this rating as output impedance, they really mean load impedance. The load impedance is the impedance the amplifier is designed to drive. Most amplifiers are designed to drive speakers of 4, 8 or 16 ohms, although special precautions may have to be observed when driving loads in the 4-ohm range, since the current is maximum under this condition.

The actual output impedance is the impedance looking into the amplifier output terminals and is frequently much lower than the rated load impedance. This is one reason that one must be cautious in connecting additional speakers to an amplifier. If the overall load impedance drops below 4 ohms, the amplifier will attempt to deliver increasing current until the output transistors are destroyed or, at a minimum, the protective circuitry will take over, causing a distorted output signal or shutting the amplifier down.

damping factor

The subject of amplifier damping and its effect on the performance of a loudspeaker is somewhat controversial. Manufacturers frequently state the damping factor as the ratio of the loudspeaker impedance or amplifier's rated load impedance to the amplifier's internal output impedance.

Proponents of the damping factor rating believe that the ideal amplifier internal impedance would be zero. This would theoretically allow the amplifier to offer ultimate control over the movement of the speaker voice coil. Damping comes into play when the system receives a short, high-energy tone burst or transient waveform. There is a slight delay at the beginning of the tone due to good old inertia (a body at rest tends to remain at rest) and another delay after the burst has passed for the same reason (a body in motion tends to remain in motion). It is believed that an amplifier with a high damping factor can reduce or control the speaker to lessen the tendency to "remain at rest or remain in motion."

Those that disagree seem to find greatest fault with the manner in which the rating is stated rather than the damping principle. They feel that the dc resistance of the voice coil must be taken into account, as shown in the following formula:

$$D_f = \frac{Z_L}{Z_{out} + R_{vc}}$$

where

Z_L = rated load impedance

Z_{out} = internal output impedance of the amplifier

R_{vc} = the dc resistance of the voice coil

Assuming a voice coil resistance of 6 ohms and a rated load impedance of 8 ohms, the maximum damping factor, even if Z_{out} was zero, would be 1.33. Yet, manufacturers of high-quality amplifiers sometimes list damping factors as high as 100!

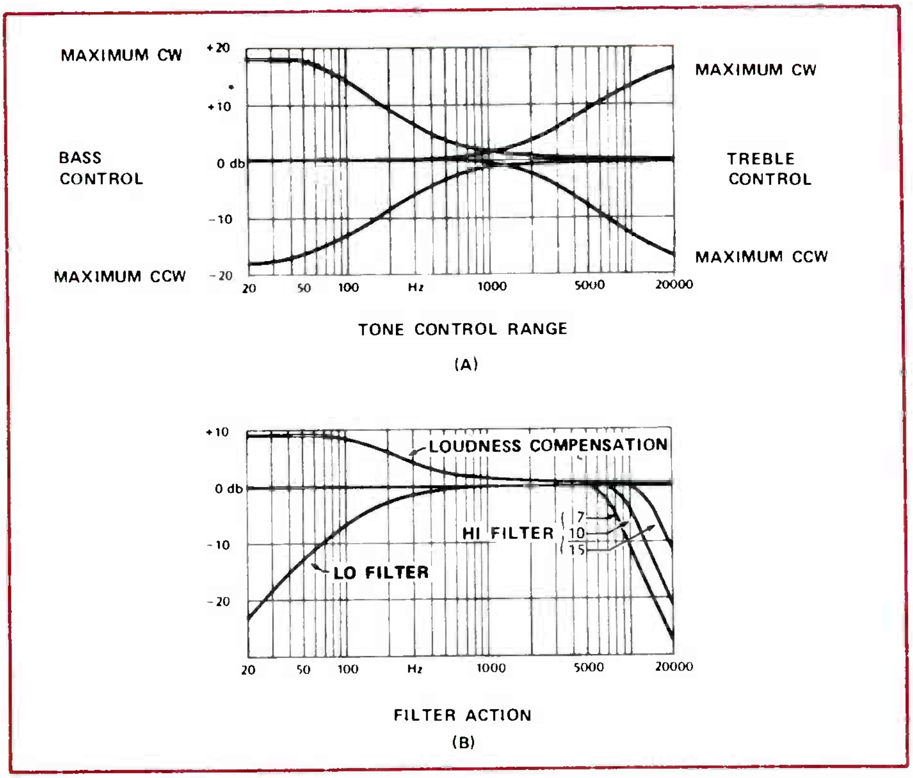


FIGURE 6. GRAPHS SHOWING THE EFFECT OF TONE CONTROLS AND FILTERS ON AMPLIFIER FREQUENCY RESPONSE.

tone controls and filters

The amplifier tone controls, designated as bass and treble, allow the listener to tailor the frequency response of his amplifier to suit his own listening preferences, make up for speaker deficiencies, or adjust the system's response to match the room acoustics. They cause the amplifier's gain to increase or decrease, depending upon the setting of the control.

The effect of typical tone control circuits on the frequency response of an amplifier is shown at A in Figure 6. The manufacturer rates these controls as: "±16 db at 50 Hz, ±12 db at 10 kHz." This means that the gain of the amplifier can be increased or decreased by 16 db at 50 Hz by the bass control. The treble control can increase or decrease the gain of the amplifier by 12 db at 10 kHz.

Most amplifiers include a loudness compensation circuit to make up for the apparent loss of low-frequency response at low listening levels. This loss is a fault or function of the human ear and not an amplifier deficiency. The effect on the amplifier's frequency response is shown at B in Figure 6. When this circuit is switched in, the gain of the amplifier is increased by about 9 db between 20 and 70 Hz.

For those of us who have noisy turntables, a rumble or low filter is included. This circuit is also useful in a system with difficult hum problems. By activating this circuit, about 11 db of attenuation is available at 60 Hz, as shown at B in Figure 6.

Some amplifiers include a high-frequency filter to get rid of high-frequency noise produced by worn records or tape hiss. These filters usually have sharper cutoff characteristics that can be obtained from the use of the treble tone control.

The high-frequency filter in this particular unit allows switch selection of 7, 10 or 15 kHz, as shown at B in Figure 6.

As you have seen, interpreting amplifier specifications can be a pretty tricky business for the uninformed. Armed with the information presented here, you should have no difficulty in making the best choice in any given price range.

Phil Deem, presently a technical editor, joined the NRI staff in 1970 as an instructor. Prior to that he served 5½ years as a communications specialist with the White House Communications Agency. He was also employed by a microwave research and development firm, designing, testing, and evaluating microwave components, digital logic circuitry, antenna position control systems and ECM equipment. Phil studied engineering at the University of Illinois and is an avid ham, holding an Amateur Extra Class License (WB4EGA).

A short time ago we received a letter from NRI grad Waldo W. Primm, who claims the distinction of being the oldest regularly employed NRI man. Mr. Primm graduated in 1923 and is still active full-time in communications work at the age of 73.

Notes from an Old Grad

Waldo W. Primm

My introduction to radio came in 1922, through a friend who invited me to his home to listen to a radio receiver which he had constructed. Instantly I became fascinated with the instrument which, once in awhile, would pick up a few audible words or notes of music, and all the time a great volume of noise which I was told was static. I am sure I must have worried this friend from time to time with my inquiries concerning the variocoupler and variometer and other gadgets used in the receiver. My greatest interest was in the properties of the tubes. Tubes were something rather new to the art and the most popular type was the UV201. Not having the basic knowledge of radio tubes I began acquiring all manuals I could find which dealt with the subject. I recall that the functions of the detector tube were one of my greatest problems. The books I had acquired failed to make the functions of the detector tube understood as thoroughly as I wished them to. That was when I began considering a source of study which would fulfill that need. I enrolled with NRI.

My job as office manager, stock-room clerk, and bookkeeper at an automobile agency in Raleigh, N.C. required my time from 8:30 AM until 6:00 PM six days per week. This meant that my studying had to be done at night and on Sundays, although I was averse to using the Sabbath as a day for studying. Many were the nights I studied until after midnight. The further I progressed the more interested I became. I wanted to become actively involved in radio work. There was no radio station in the immediate area; in fact, very few stations were operating at that time. At times we were able to pick up WLW, Cincinnati, WSB, Atlanta, KDKA, Pittsburgh and a few others. The sensitivity of receivers was quite low. The Westinghouse receiver was one of the earliest. Their regenerative two-unit, three-tube receiver made a pretty good interference transmitter as well as a distance-getting receiver. The average receiver had at least four knobs which had to be adjusted for each change in station.

My interest turned to repairing and building receivers for sale. This gave me an opportunity to put into practice some of the theory I was learning through the NRI course. Many makes of receivers began to appear on the market; super-regenerative, tuned-radio-frequency and neutrodynes, along with many other circuits. This meant that radio service work was going to be big business in the not too distant future. That's when I really concentrated on getting along with the business of learning all I could about the art.

In 1929 I was offered my first full time radio job as an expert radio serviceman. This change took me to Rocky Mount, N.C., with a company that was selling a lot of radios and repairing many more. This was what I had been looking for; a place where I could devote all my time to radio repairing. Continuous studying was required in order to keep pace with the rapid changes of the industry.

In 1932 I went into the radio repair business on my own. Much of my test equipment was of my own make; such as audio and radio frequency generators, volt-ohm meters, grid-dip meters, etc. Soon it was necessary to employ two servicemen in order to keep up with the work. We achieved a very enviable record of honesty and ability in the radio repair field. Our service radius expanded to more than fifty miles in many directions. I had worked hard to put into practice the excellent training I had received from NRI, and now it was paying off.

In 1938 I decided to get into the other end of the radio business; that of broadcasting. Without attending any school or subscribing to any correspondence course I passed the FCC test without difficulty. I did some review work before taking the test, but I attribute the success to the basic training received from NRI as much as anything else. During those years all questions had to be answered in longhand; the multiple-choice answer type of examination had not been instituted. The test required my using more than fifty pages. Since then I have had experience in all phases of broadcasting, from the most menial to managerial responsibilities.

My engineering assignments have carried me over a good portion of the United States, including California, the deep south, the far north and the eastern seaboard states. My recording assignments have placed me in company with many radio stars and prominent individuals.

I came to WDNC on December 26, 1955 as an operating engineer. About two years later I was promoted to chief engineer, the position I have held ever since. We are a three-tower, two-power, two-pattern operation, plus automated FM stereo with 36-kw ERP. We operate with a 1-kw Gates transmitter during nighttime and a Gates 5-kw transmitter during daylight hours, with separate patterns for the two powers. Power and pattern changes are made simultaneously with the actuation of two pushbutton switches. Our FM transmitter is a Gates FMS10B feeding a five-bay Gates antenna.

My fifty years in radio have been happy years as well as productive years. I find there is a never ending area of learning. Of course there have been instances of disappointment, as in any profession, but those who are dedicated to their work in the field of radio seem to be able to tolerate adversities and continue on with enthusiasm and success.

If I were asked what I consider to be the most important advice to give NRI students, I think it might be this: . . . ."Learn every paragraph of your study course to the point where there is no mystery about the contents." It is most important that the student understands each treatise thoroughly; else he will never be able to understand advanced lessons, and the time he has spent on his studies will result in confusion rather than knowledge.

Job Ops

WANTED: Radio-television and appliance service men. To work for established radio-TV and appliance dealer in Kapuskasing, Ontario. Must be a graduate of a recognized radio school. Ability to speak French helpful. For further information, send your qualifications in writing to Latour Radio Electric, 7 Queen Street, Kapuskasing, Ontario, Canada.

OPPORTUNITY: For the right person who wishes to own and operate his own two-way communication business. Physical plant, heat, and light will be provided in return for a suitable percentage arrangement. Write to Charles L. Smith, President, Eastern Electronics, Box 211, Clintonville, PA 16372.

FOR SALE: TV sales and service business. Established for 20 years in a progressive town with a very large servicing territory. Franchised dealer for RCA, Sylvania, Zenith. Low overhead, clean environment. All test equipment, full sets of service manuals, tools. $5000 plus inventory. Write to Andrew Ogorzalek, Ogorzalek Radio and TV, 312 N. Washington Street, Thorp, WI 54771.

WANTED: Recent graduate to operate fixit and repair shop for new company. Should be hard-working and a top student. Write to Ronald Lennon, Big Creek Trading Post, Ocie, MO 65719.

Reader Exchange

WANTED: Would like to buy a copy of the Rider Radio Manual, Vol. I, and the Rider Index called Set Catalog and Index, January 1921—January 1933. Contact John Tucker, Box 247, Hometown, WV 25109.

further adventures in tv servicing

J.B. Straughn

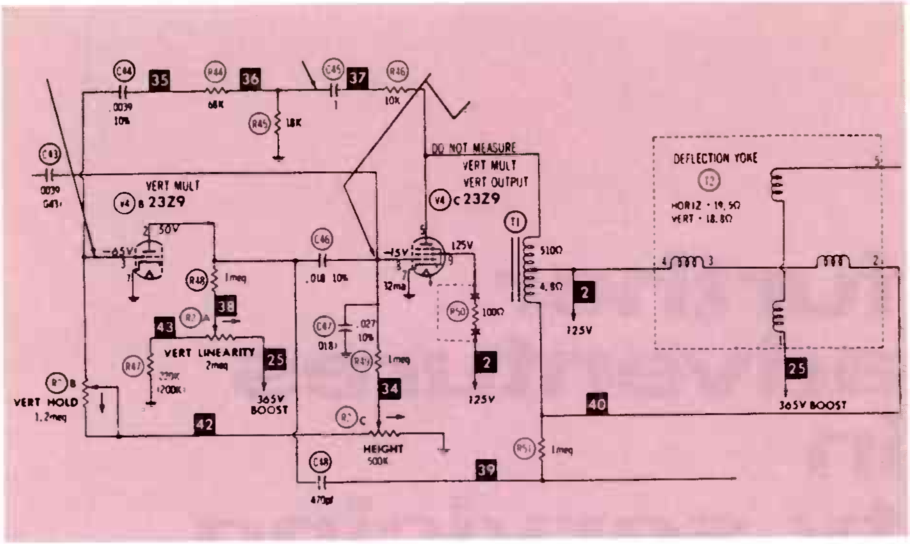
general electric chassis s-2

This set came in dead, with no tubes lighting and the customer reported that a child had poured water down through the louvers on top of the cabinet.

An inspection of the chassis with the back removed did not show anything in particular. A check of the tubes showed the 33GY7 to be defective, and on replacement the filament string lit up. Sound was obtained but there was no complete raster—only a picture about one inch high. The vertical circuit is shown in Figure 1.

A new 23Z9 was tried without helping. With the 23Z9 removed (this breaks the filament string, but does not remove the low-voltage B supply), the plate and screen voltages were measured and found to be present. The plate voltage of the vertical output tube could not be measured if filament voltage were applied as the plate voltage in an operating circuit is high enough to ruin the test meter. That's why the tube was removed.

With the set turned off, point-to-point resistance measurements were made and found to be more or less okay. Points 35 and 36 were found on the circuit board and it was established that C_{44} and C_{45} were not shorted and that R_{44} and R_{45} were not open. With the set turned on and the 23Z9 in its socket, the dc voltages at the socket pins (except plate pin 5) were measured. The voltage on pin 3 was far



Courtesy Howard W. Sams

FIGURE 1. VERTICAL CIRCUIT OF GE CHASSIS S2.

below normal but the other voltages were in tolerance. I suspected an open in C_{44} or C_{45} and located their connection points on the bottom of the circuit board. I removed one lead of each and found both charged properly when checked with the ohmmeter. This showed they were not open. At the same time, I noted that wax had melted and run out of the vertical output transformer. I decided to make a better check on the transformer than had been accomplished by the point-to-point resistance measurement, which had been to establish continuity rather than to look closely at the measured values.

I disconnected the lead to the vertical yoke at point 4 and checked both the yoke and the 4.8-ohm section of transformer T_1. Both were okay. On checking the 510-ohm section, I found it to measure 200 ohms. This, of course, was the trouble, and a close examination showed the transformer to be quite charred.

Transformer T_1 was mounted on the circuit board, so using pliers, the tabs mounting the transformer were cut close to the board. The two tabs at one end were heated with the soldering iron and the core of the transformer was gingerly pried away from the board with a screwdriver. The transformer finally came loose at that end without breaking the board and the iron was transferred to the three leads and other mounting tabs one at a time while the transformer was worked loose. The unit came off the printed board without damage to any of the circuits. If any of the printed circuitry had been destroyed, it could have been repaired by bridging the break with ordinary hook-up wire.

The area GE Distributor was called over their WATS line (no charge to the caller) and a new transformer was shipped me by UPS. A local wholesaler was not contacted because Sam's manual showed only a factory replacement part number.

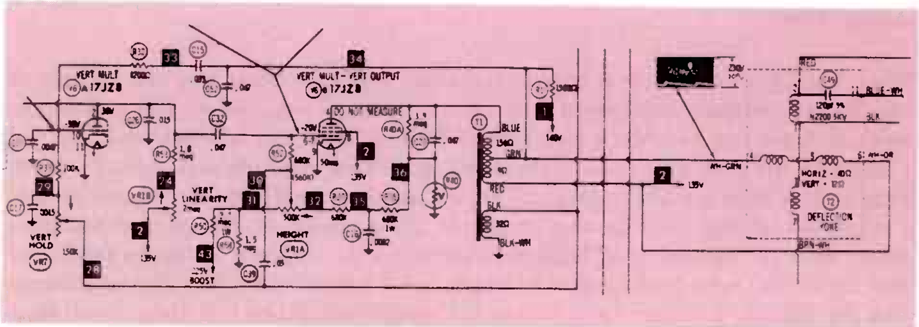
Incidentally, parts such as transformers, yokes, etc. are much cheaper when ordered through the manufacturer's distributor than if you are able to get a replacement made by some other company. I found out about the WATS number after calling the distributor long distance on a previous occasion. This is the only distributor I know that I can call toll free and I cannot say that all GE outfits have such a service. Some Philco distributors have a WATS line but you must be a member of Philco Service to be able to use it. While talking about parts, you can get them for Truetone (Western Auto) by getting your friendly Western Auto dealer to give you the location and phone number of their nearest warehouse.

To return to this GE—much time would have been saved on this job if I had paid more attention to the first point-to-point resistance measurements as they showed there was something wrong in the 23Z9 output plate circuit, but as I said, I was more interested in continuity than in actual readings—I was just looking for a movement of the ohmmeter pointer to show the circuit was not open and was not even reading the measurement!

philco-ford chassis 19P22

This set came in with no vertical sweep. A new 17JZ8 did not help. All the operating voltages checked okay. The *operating* plate voltage of the vertical output tube is never measured for fear of damage to the test instrument. The fact that the other voltages were okay, particularly the negative grid voltages, showed the voltage on plate pin 4 had to be okay and that the circuit was working in a normal manner. The schematic is shown in Figure 2.

These measurements about traced the trouble to the yoke or to the vertical output transformer. The two vertical yoke leads were identified and an ohmmeter check across them gave a low resistance, showing that the secondary of the transformer was not open. The yoke lead at point 4 was disconnected and it was then found that the vertical winding of the yoke was open. The open half was identified and the leads from it were gently pulled. One came loose with a little green corrosion on its end. The enamel was scraped off that end, well back from the green area, and a piece of bare hook-up wire was soldered to the lead and to the lug from which the broken lead was removed. This completed the job and made a nice profit.



Courtesy Howard W. Sams

FIGURE 2. PHILCO CHASSIS 19P22 VERTICAL SWEEP.

One thing to look out for when investigating such opens is anything suggesting the presence of mice which have not been housebroken. A little mouse urine on a wire or connection will soon result in an open with the characteristic green color. Such a part should not be repaired but replaced, and the whole set may have to be junked if the problem has been widespread. I found this out the hard way after repairing three separate opens in the vertical yoke of an Emerson. I have repaired the fourth and last lead and am waiting to see if it will hold up or if I have to install a new yoke at cost.

Sequel

This Philco came back the next day with the original complaint. I checked the yoke, which tested okay. I tried the set out and it played as it did when it left the shop. I let it run and after about two hours the vertical collapsed. The installation of a new 17JZ8 cleared up the trouble.

On questioning the owner, I found that the set had been acting this way for a long time. He would cut it off for a while and it would work again for a couple of hours. I got the job when the "original" complaint became permanent due not to the 17JZ8 but a yoke defect!

After the set had gone home, word filtered back that the picture was blurred. It did have a slight tunable ghost which was present when the set came in the first time. I didn't think it was too bad and didn't do anything about it. Such trouble is generally the result of a slight misalignment in the video i-f amplifier. I told the customer to bring it down sometime and I would see what I could do. I do not have a sweep generator and have learned the hard way not to fiddle with i-f alignment without one. What I plan to do is to try a number of different tubes (same type, of course) in the video i-f amplifier. There is generally enough difference in the internal tube capacity to affect the tuning and frequently a different tube will clear up any slight misalignment. Otherwise, I will have to con one of my wholesaler friends out of a sweep generator so the i-f can be properly set up. A couple of months have passed and the customer, who is a friend I see regularly, has not said any more about the blurring, so it couldn't have been too bad.

rca ksc 144b

When I got this set there was no vertical sweep. I quickly found that the primary of the vertical output transformer was open. The local wholesalers had nothing in stock so I got one to order a replacement from RCA. Weeks later it showed up and I installed the new unit. The vertical sweep worked right off and the set seemed okay except for a few vertical retrace lines when the contrast and brightness were at a minimum setting. So, I let the set go out and a couple of days later it was back again. With the contrast and brightness advanced the outlines of figures tended to tear, as if the horizontal sync were acting up. I fiddled with the sync adjustment and got exactly nowhere. Just before the picture started to tear there were short white horizontal streaks that looked like ignition noise. I had to order a Sam's manual and decided to repair the retrace condition first in the hope it would clear up the trouble. Fortunately, further thought lead me to believe that the retrace was okay, especially since the pulse from the vertical output transformer to the number one grid of the picture tube tested okay.

I replaced the boost capacitor and the 0.001-mf 1-kv (grid return of the horizontal output tube 17JB6) to no avail. When the brightness and contrast were turned down an acceptable picture free from the interference was obtained. It appeared as though increased beam current in the picture tube resulted in the trouble becoming apparent. I decided that the picture tube probably had something wrong with it, but I had no substitute to try and my picture-tube tester was undergoing repairs in my spare time.

I noticed a slight corona discharge sound, and a slight amount of noise from the loudspeaker, when the trouble was present. I checked for poor contacts in the top cap connectors of the 1G3 and 17JB6 tubes as they are often a source of such trouble—nothing!

I removed the insulated screw-on cap covering the base of the 1G3 high-voltage rectifier tube. There was a series filament resistor and a surge resistor feeding the anode lead of the picture tube. Both looked spanking new as they had been protected from dust. Thinking back about the trouble being connected in some way with the beam current of the picture tube, I decided that the 1-kilohm surge resistor might be at fault regardless of its beautiful appearance. A check with the ohmmeter (pix tube first discharged) showed the resistor to have a value of 200 megohms instead of 1000 ohms! This was the cause of the trouble.

Reduced beam current reduced the arcing and when the brightness was turned up, requiring more beam current through the resistor, there was more arcing and tearing of the picture. I expect that when voltage was applied, the resistance of the 1-kilohm resistor dropped to much less than its measured value.

This resistor is used as a protective device to avoid sudden large current demands on the high-voltage rectifier. I thought of just shorting out the offender because I did not have a 1-kilohm replacement in stock; however, I don't like to eliminate protective devices because of past sad experiences. I found a 3.3-kilohm 2-watt resistor and installed it. The fact that the original resistor was a 1/2-watt was of no importance except for physical bulk, and the larger ohmic value of the replacement did not matter. Actually, 3.3 kilohms is a value often used in this circuit.

This was one you had to think on as there were no checks other than a direct test of the resistor which would have shown up the trouble. A little more thought on my part about the faint corona discharge sound, coupled with the fact that reduced beam current minimized the trouble, would have lead directly to the faulty part and saved hours of wasted effort.

philco-ford chassis 17J25

This set came in dead and none of the tubes would light. I had been having a run of defective on-off switches so I decided to check this first by shorting the on-off switch contacts. I have a number of leads equipped with clips at each end, so I clipped one across the switch contacts and plugged the line cord into the wall outlet. The tubes started to light up but smoke arose from a half-watt resistor on the printed circuit board! I decided I had better examine the schematic, which I had on hand.

I found there was a circuit breaker built into the on-off switch, attached to the rear of the volume control. This is common in many Philco receivers and saves the cost of a separate circuit breaker. To reset, you just turn the set off and then on again. There was an apparent overload which was tripping the circuit breaker and I had defeated the latter. I'm glad nobody but me was watching when the smoke curled up.

The schematic showed the burned-out resistor was the 180-ohm rf B supply resistor. A check with the ohmmeter from the end of the resistor going to the tuner showed a low resistance. With the lead going to the front end (tuner) disconnected, the resistance measured became normal. The measured resistance from the B plus terminal of the tuner to the chassis was only 4 ohms. By looking at the circuit, I decided the feedthrough capacitor just had to be shorted. So I proceeded to remove the tuner and then its shield, which, as in all tuners, slips off. The 680-ohm mixer plate load resistor showed signs of overheating and had decreased in value to only a few ohms. From its plate end to the chassis, the resistance measured zero ohms (a direct short).

I pulled the 5GJ7 mixer tube and repeated the measurement from the 680-ohm resistor to the chassis. This time the measurement was normal. This indicated to me that there was a suppressor-grid-to-plate short in the tube. I installed a new tube and replaced both resistors. When I turned the set on it went right off again, the circuit breaker working fast enough to save the parts from damage.

This could only mean that there was an intermittent short in the output of the mixer tube. Both the original 5GJ7 and the replacement checked okay as far as shorts or leakage were concerned in my Conar tube tester. So, I removed the tuner again, this time sending it off to a firm specializing in tuner repairs as, like most service men, I have neither the tools or parts to do much work on tuners, particularly when the trouble is due to a possible short in a feedthrough capacitor. When the tuner came back everything was okay. Unfortunately the tuner repair people don't tell you what they do, but I was nevertheless happy that the trouble had vanished. I personally think the mixer plate coil was shorting out to the chassis.

how to spot a tornado with a tv set

As Civil Defense Coordinator in my county, I am quite concerned with tornados. We have surveyed all of our schools and designated the safest place in the buildings for the children in case a tornado strikes. However we may get a tornado "warning" (one has been sighted) that could last for hours. Obviously you can't keep children in the safety locations for long periods of time. TV can help in giving warning of an approaching tornado. Here is the way it is done:

Turn the channel selector to channel 2 and turn the contrast control all the way up. Turn the brightness down to the point where the raster just disappears. Lightning flashes will cause the screen to light up momentarily. If a tornado is prowling around, the screen will stay lighted up. This is due to the great amount of static electricity produced by the dust particles hitting against each other in the 300 to 400 mile winds in the tornado. I didn't believe that this would happen because the detector in a TV set acts to apply the signal with a polarity which darkens the screen with increased signal level. However, so much signal is produced that the detector cannot function to produce a black going signal and the screen lights up instead of going darker. I hope you never get close to a tornado, but try this sometime and note the effect of lightning.

motorola model 160 ul

The customer claimed that this set had a popping noise and no raster. Trial at the work bench showed this to be correct. After removal of the back and use of a cheater cord, a frying noise was evident. Arcing was apparent around the anode cap of the picture tube. Examination showed this area to be discolored, and wiping it with tissue removed dirty grease (kitchen type), which must have been conductive enough to reduce high voltage to the point where there was no raster. I cleaned the area with rubbing alcohol and wiped all the remaining grease off the glass envelope. This cleared up the trouble.

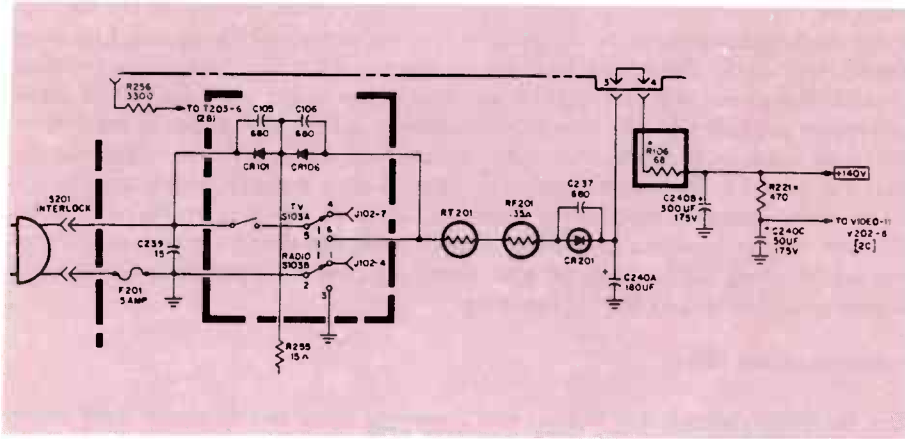
Since the entire operation only took about half an hour, I charged the customer $6.50, which pleased both of us.

rca chassis krt4b

This set came in with a complaint that after it had been on for a while, the picture would roll vertically. I tried it out and verified the complaint. The customer said he had the set in another shop for the same trouble and that after replacement of a tube the set was okay for some time. I figured the vertical tube was probably gassy, so I installed another 17JZ8. The set played for a while and then lost vertical sync, and then the picture folded up from the bottom.

I decided some resistor was changing in value or that there was a leaky capacitor in the vertical feedback or in the coupling circuit. I pulled out the printed circuit board and proceeded to check the resistors and capacitors under suspicion. I had no success, although no new capacitors were tried.

I didn't think new capacitors were necessary because of the way they checked out. What I do is to remove the capacitor from the circuit board and check it for leakage with the ohmmeter section of my vtvm, which has a top range of 1000 megohms. This charges the capacitor up to the 1.5 volts used in the vtvm for ohmmeter tests. The capacitor is set to one side while other work is done. After several minutes the ohmmeter is again connected to the capacitor leads, but this time the test leads are reversed; if the capacitor is still charged it has no leakage. This is indicated by a sharp (large) swing of the meter pointer to the left, due to the residual charge in the capacitor, and the pointer then moves all the way to the right showing infinite



Courtesy RCA

FIGURE 3. POWER SUPPLY IN RCA KCS 176.

resistance. The easiest way to make this test is to always connect the clip lead to the left-hand side of the capacitor. After making the first test, lay the capacitor down so when connecting the ohmmeter test leads the connections will be reversed.

To get on with the story, I pulled the "new" 17JZ8 out of the set to put the old one back in. However I noticed the tube just pulled had no marking as to manufacturer, although it came out of an RCA tube box. I remembered that I had put a tube from another set (Philco 19P22 described above) in this box, leaving the new tube in the other set, as there was no difference in operation and I believed the tube to be okay. I got another 17JZ8 and installed it. The trouble vanished, showing both the original tube and the first replacement to be at fault. While the tube may have worked in some circuits okay, I discarded both so I would never meet them again! This will be policy from now on.

I turned the set off before going to sleep (my shop is still in the bedroom). Since I couldn't reach the on-off knob because the chassis was still pulled, I removed the cheater cord. The next morning I plugged in the cheater cord and noted a small arc in the chassis. The tubes lit but nothing else! After saying several choice words, I found that there were two power resistors mounted on a terminal strip over the circuit board. This strip was anchored in its middle by a rivet. The terminal strip could pivot around its mounting point and had done so, allowing one resistor lead to touch a shield, shorting out the B supply. I was quite concerned because this is a hybrid set with lots of transistors and I had visions of replacing all of them. I had no schematic, but located an RCA KCS176, which seemed to be identical except that it used a solid-state high-voltage rectifier instead of the tube in the set on hand. I located the 68-ohm resistor shown in Figure 3; its junction and that of the 470-ohm resistor having touched the chassis, the 68-ohm unit was open, but I couldn't see where this should have damaged the transistors. The installation of a 70-ohm 10-watt replacement solved the problem. Moral: When a tube is replaced, throw the old one away or give it to the customer to discard.

HAM NEWS

By Ted Beach K4MKX

I'm beginning to think that everybody just evaporates during the summer months. The number of letters and cards received from you guys since the last issue of the Journal is just about zilch. What gives? Nobody out there doing anything interesting? I find that hard to believe. Let's hear from you so we can pass along what's happening to everyone else.

I have done a little work on the filter project I mentioned in the last Journal, and as promised I will pass along the results of my efforts so far. Actually, after sorting through the CB crystals I was rather discouraged to find the very wide variety of crystals were not quite so ideally suited to lattice filter use. However I was able to make a bandpass filter for an fm i-f strip and a fairly narrow cw filter which gives quite good single-signal reception.

Before we go on to describe the filters, let's take a look at the crystal itself to see just how it can be used in a filter application. Figure 1 shows the electrical equivalent of a quartz crystal. As you can see, there is a resistance, an inductance and two capacitances involved. The resistance represents the losses in the crystal and limits the Q of the circuit. The inductance itself has an extremely high Q and can series-resonate with C_1 to provide one operating mode. At some frequency above the series resonant frequency, L and C_1 together form an

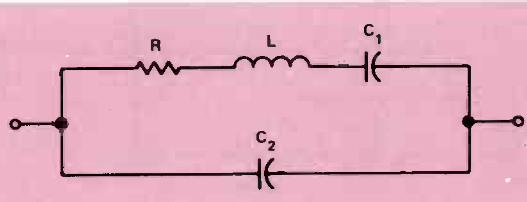


FIGURE 1. ELECTRICAL EQUIVALENT OF A QUARTZ CRYSTAL.

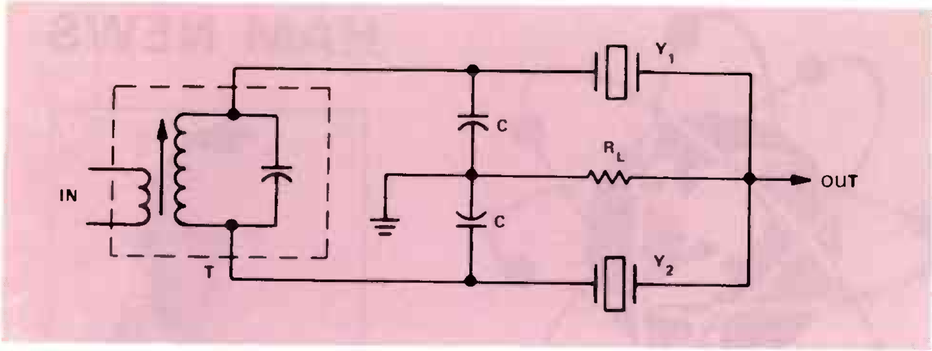


FIGURE 2. SIDEBAND FILTER

equivalent inductance which can resonate with C_2, the parallel capacitance. We can add more capacitance to C_2 externally to effectively lower the parallel resonant frequency, but we cannot alter (without difficulty) the series resonant frequency. The usual separation of the series and parallel resonant frequencies is on the order of a few kilohertz at the most. If we had two crystals cut so that the series resonant frequency of one was exactly the same as the parallel resonant frequency of the other, we could build a very fine sideband filter as shown in Figure 2. Unfortunately I could not get a pair of my junkbox crystals to cooperate so instead I used a single crystal and a trimmer capacitor in the circuit of Figure 3 to make a nice sharp cw filter. The trimmer capacitor is adjusted to just equal the parallel capacitance (C_2 of Figure 1) so that the push-pull signals applied to the output resistor cancel out, giving a very sharp null at this frequency as shown in the accompanying bandpass chart.

The transformer used in all of these circuits is a 10.7-MHz i-f transformer padded down to the desired 9 MHz by the external capacitors. In Figure 3 these capacitors also provide a virtual center-tap for the transformer.

Figure 4 shows the bandpass circuit I used for the fm strip. This one uses two i-f transformers to couple the signal in and out of the filter. The crystal is used as a mutual coupling between the two high impedance transformer windings

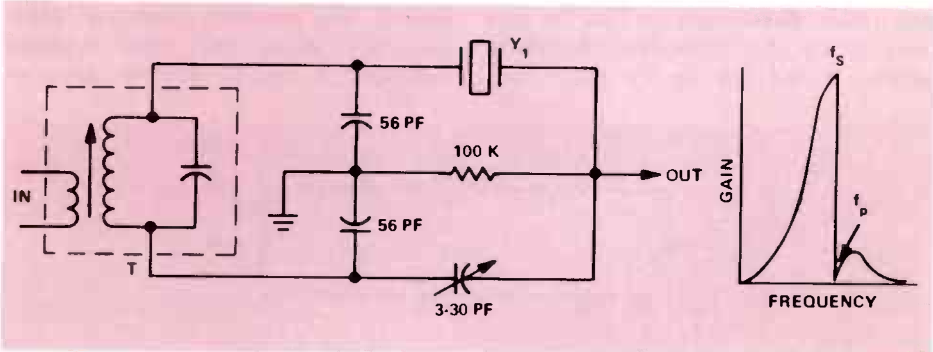


FIGURE 3. CW FILTER AND RESPONSE.

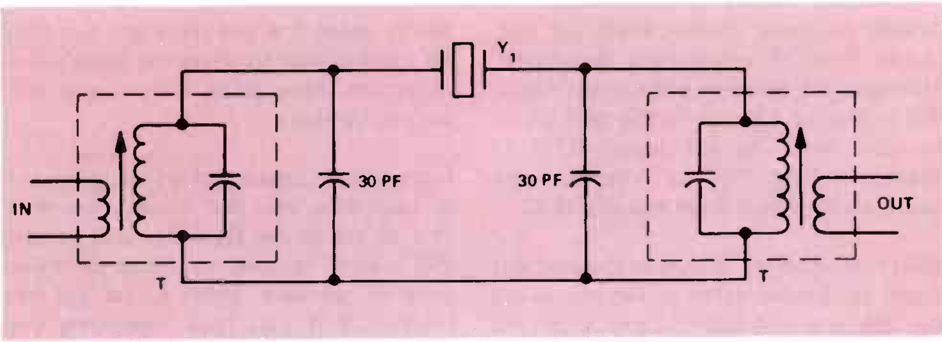


FIGURE 4. NARROWBAND FM FILTER.

and, in combination with the transformer characteristics, provides about a 15 kilohertz passband. I'm not too sure exactly how this one works, but who am I to fight success?

And that's the filter story as far as I have been able to go. I guess the next step would be to unsolder some of the crystal cans and try to etch or plate the crystals to come up with the lattice type filter of Figure 2. But that's a lot of work and I have many more interesting things to do. Besides, there are quite a few manufacturers who sell very fine business filters for this purpose at a reasonable price. Right now I'm working on the two-meter synthesizer I mentioned some time ago, and have almost gotten it to the hardware stage. At the moment I'm awaiting some ICs from a supplier. More about that later.

Now, on to the few people we have heard from:

Harry	WN2MDX	N	Woodstock NY
Robert	WN3UMI	N	Oxon Hill MD
Dick	W6NAL	A	Los Angeles CA
Bill	WB8BMU	–	Copperas Cove TX
Larry	WA1RUC	–	Fairfield CT
Jim	WN5JKC	N	Tulsa OK
Ron	WA6WTF*	G	San Jose CA
*ex–KL7HJE			

As you can see, a very short list. The first four are students in the Amateur Course and the other three rogues are taking other NRI courses.

Harry and Robert have their calls here as a result of submitting the report on Training Kit 3R, the Novice transmitter, and there was no other information from them (I'm sure they won't mind my mentioning that they both got "A" on the report!).

W6NAL has been licensed since 1959, starting out as K4WRQ, then K1ROZ and on to his present 6 call. Dick says he took the Advanced test in March and passed with flying colors thanks to the Amateur course. He plans to go all the way and get Extra as soon as he gets the time to resume his studies. Nice going Dick, we're sure you will have no trouble at all.

Bill, WB8BMU, writes that he is in the Army stationed at Ft. Hood where he has charge of three closed-circuit TV networks from an engineering standpoint. Having put in fourteen years in the Army, Bill is looking forward to the next six so he can retire to his home QTH in Clarkston, West Virginia. After fourteen years, six shouldn't seem too long Bill!

WA1RUC recently moved to Connecticut from his former QTH in Indiana where his call was WA9SDP. Larry likes vhf operation and stays mostly on six and two meters. This may be the reason he has a complete Novice station for sale (See HAM-ADS).

WN5JKC got his Novice license recently and says the Communications course theory made the test real easy. Jim likes 40 cw and also 10 when the band opens up for dx. Nice going, Jim; maybe we'll see you up there.

I guess that's about it this time, gang. Let us hear from you and let us know what you all are doing. As we've said before, this is *your* column, so tell us what you want to see here. Don't forget the free HAM-ADS if you have something you want to buy, sell or swap, remembering that publication will run about two months after receipt at NRI.

See you next time.

Vy 73 – Ted – K4MKX

Ham Ads

FOR SALE: Complete Novice station in mint condition. Drake 2NT transmitter; Drake 2C receiver and speaker; 4B-TV 10 through 80 vertical antenna; SWR bridge; telegraph key and 100-foot coaxial cable; $250 FIRM for entire station.

Larry Sougham – WA1RUC
119 Catherine Terrace
Fairfield, CT 06430
Phone (203) 255-4308

FOR SALE: 80-40 meter AMECO transmitter, 15 watts, Model AC-1 in good condition with coils, $20. Heath shortwave receiver Model GR-64 in good condition for $37. Sorry, only money orders and you pay for shipping. School forces sale.

Gary Chan – WA6LZC
343 South 8th Street
El Centro, CA 92243

A Reminder

Always be sure to include your student number whenever you contact NRI. This will help to ensure that we can serve you promptly and efficiently.

NRI HONORS PROGRAM AWARDS

For outstanding grades throughout their NRI courses of study, the following January and February graduates were given Certificates of Distinction along with their NRI Electronics Diplomas.

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Jacob G Baker, Chesapeake, VA
Richard A. Holmquist, Horicon, WI
Frank J. Hoppe, Massapequa Park, NY
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Donald R. Kinsley, Keota, OK
Norman Meyer, Columbia Falls, MT
W. P. Morse, Lake Charles, LA
Charles Ory, Flushing, NY
John Edward Przybyla, New Bedford, MA
George F. Quick, New Milford, NJ
Charles E. Rambo, Elkton, MD
Bill G. Reeves, New Orleans, LA
F. Michael Reilly, Hoboken, NJ
Brian Roberts, East Lansing, MI
Robert A. Rounds, Kansas City, MO
Virgil B. Scalf, Louisville, KY
Lawrence M. Silva, Fall River, MA
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Robert L. Crawford, Omaha, NE
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Carl E. Falconer, Scotia, NY
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Graham C. Gould, Scottsdale, AZ
Robert Granger, Boulder, CO
Lawrence Gray, San Dimas, CA
Ronald A. Henderson, Washington, DC
Lionel Hill, Camp Pendleton, CA
Robert E. Holmes, Watertown, CT
Lawrence B. Hopper, Millinocket, ME
Francis R. Jones, Beale AFB, CA
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James J. Kelley, Detroit, MI
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Nolan Mott, Lake Arthur, LA
Charles L. Muckin, Spotswood, NJ
Keith Murk, Bellingham, WA
V. R. Narayanan Nair, Kuwait, Arabia
Robert Newton, Boston, MA
Frank R. Orant, Woodbury, NJ
Edmond R. Paquette, Enfield, CT
John V. Pascale, Middletown, RI
Donald W. Patton, Wytheville, VA
Lee Randon, Evanston, IL
Gordon Edward Reid, Wheaton, MD
Ralph L. Richardson, Lakewood, CO
Leland Rodgers, Pottsboro, TX
Pasquale Q. Rubino, Camden, NJ
William Michael Rutledge, FPO New York
Roland V. Schlief, Yakima, WA
Allen J. Schuh, Hilbert, WI
William L. Simmons, Whitman, MA
Ronald Slota, Wanaque, NJ
Randall W. Stearns, Berkeley, CA
Joseph P. Stanish, Detroit, MI
Joe Stegall, Steele, MO
Truett L. Stroup, Portales, NM
Lawrence E. Taylor, Silver Spring, MD
John V. Tennant, San Diego, CA
H. E. Thornhill, Jr., San Diego, CA
James M. Truluck, APO New York
Dave Trytko, Aurora, IL
George H. Tubell, Jacksonville, FL
Ronald James Tucker, San Francisco, CA
J. C. Vandeventer, Midland, TX
Chris Vattaks, Bronx, NY
J. C. Vaughn, Wichita Falls, TX
Frank Joseph Viscardi, Brooklyn, NY
David T. Warshaw, Albany, NY
Greely Webb, Jr., Fort Worth, TX
William M. Webb, Olla, LA
Maurice E. Wisecup, Madrid, IA
Jack Zimmerman, Grabill, IN

NOMINATIONS OPEN FOR ALUMNI OFFICERS FOR 1974

The members of the Alumni Association may send in nomination suggestions for one candidate for President and four candidates for Vice-President of the NRI AA. Nominating suggestions must be submitted by September 15. The names of the two men who receive the most nominations for President and the names of the eight men who receive the most nominations for Vice-President will then appear on the Alumni Election Ballot in Tom's Technical Flyer. From this ballot, you will then select your one choice for President and four choices for the Vice-Presidents who are to serve for the 1974 term. The final election results will be announced in the November/December issue of the NRI Journal.

Only members of the NRI Alumni Association are eligible to vote or to serve as officers of the association. In considering whom to nominate, members should keep in mind the restrictions on the reelection of incumbent past Presidents as set forth in Article 6, Section 2 of the Constitution, quoted as follows:

The President shall not be eligible for reelection until after expiration of at least eight years following his last term of office and, further, may be a candidate for Vice-President only after expiration of at least a year following his term of office as President. Vice-Presidents may not serve more than two consecutive terms; when reelected for second consecutive terms shall not thereafter be candidates for Vice-President until after expiration of at least three years following the second term of office.

Of the present officers, the President, George Stoll, is affected by two of the above restrictions. All of the Vice-Presidents for 1973 are ineligible for reelection to Vice-President but they are eligible for election to President. You may nominate any NRI AA member you wish, but please get your ballots in very early.

Thomas F. Nolan
Executive Secretary
NRI Alumni Association
3939 Wisconsin Avenue
Washington, D.C. 20016

1974 NOMINATION BALLOT
(Polls Close September 15)

I am submitting this Nomination Ballot for my choice of candidates for the coming election. The men below are those whom I would like to see elected officers for '73.

MY CHOICE FOR PRESIDENT IS ______________________

City ______________________ State ______________________

MY CHOICES FOR FOUR VICE-PRESIDENTS ARE

1. ______________________ 3. ______________________

City __________ State __________ City __________ State __________

2. ______________________ 4. ______________________

City __________ State __________ City __________ State __________

Your Signature and Student Number ______________________

Your Address ______________________

DIRECTORY OF ALUMNI CHAPTERS

CHAMBERSBURG (CUMBERLAND VALLEY) CHAPTER meets at 8 p.m., 2nd Tuesday of each month at Bob Erford's Radio-TV Service Shop, Chambersburg, Pa. Chairman: Gerald Strite, RR1, Chambersburg, Pa.

DETROIT CHAPTER meets 8 p.m., 2nd Friday of each month at St. Andrews Hall, 431 E. Congress St., Detroit. Chairman: James Kelley, 1140 Livernois, Detroit, Mich. 841-4972.

FLINT (SAGINAW VALLEY) CHAPTER meets 7:30 p.m., 2nd Wednesday of each month at Andy Jobaggy's shop, G-5507 S. Saginaw Rd., Flint, Mich. Chairman: Stephen Avetta, 239-0461.

LOS ANGELES CHAPTER Chairman: Graham D. Boyd, 3177 Virginia Ave., Santa Monica, Calif. 90404. (213) 828-8129.

NEW YORK CITY CHAPTER meets 8:30 p.m., 1st and 3rd Thursday of each month at 199 Lefferts Ave., Brooklyn, N.Y. Chairman: Steve Kross, 381 Prospect Ave., Brooklyn, N.Y.

NORTH JERSEY CHAPTER meets 8 p.m., 2nd Friday of each month at The Players Club, Washington Square, Chairman: George Stoll, 10 Jefferson Ave., Kearney, N.J.

PHILADELPHIA-CAMDEN CHAPTER meets 8 p.m., 4th Monday of each month at K of C Hall, Tulip and Tyson Sts., Philadelphia. Chairman: John Pirrung, 2923 Longshore, Philadelphia, Pa.

PITTSBURGH CHAPTER meets 8 p.m., 1st Thursday of each month in the basement of the U.P Church of Verona, Pa., corner of South Ave. & 2nd St. Chairman: Charles Kelly.

SAN ANTONIO (ALAMO) CHAPTER meets 7 p.m., 4th Thursday of each month at Alamo Heights Christian Church Scout House, 350 Primrose St., 6500 Block of N. New Braunfels St. (3 blocks north of Austin Hwy.), San Antonio. Chairman: Robert E. Bonge, 222 Amador Lane, Antonio, Tex. 78218, 655-3299

SOUTHEASTERN MASSACHUSETTS CHAPTER meets 8 p.m., last Wednesday of each month at the home of Chairman John Alves, 57 Allen Boulevard, Swansea, Massachusetts.

SPRINGFIELD (MASS.) CHAPTER meets 7 p.m., 2nd Saturday of each month at the shop of Chairman Norman Charest, 74 Redfern Dr., Springfield, Mass. 734-2609

TORONTO CHAPTER meets at McGraw-Hill Building, 330 Progress Ave., Scarborough, Ontario, Canada. Chairman: Branko Lebar. For information contact Stewart J. Kenmuir (416) 293-1911.

PITTSBURGH CHAPTER ENTERTAINS NATIONAL SECRETARY AT DINNER AND MEETING

Tom Nolan, the National Secretary, was entertained at a yearly dinner given by the club in his honor. After the dinner, the regular meeting was held and Tom gave a talk on troubleshooting the color section of a color TV receiver.

As usual there was a very good turnout for this yearly meeting with 26 members and 11 visitors present. (The Executive Secretary wishes to thank the club for their hospitality and for the interest shown in the visit.)

At the July 1973 meeting, Mr. Jack Gilbert, Director of Public Affairs for Channel 11, WIIC-TV, gave a talk on the dimensions of television.

Jack told us that in the near future (within the next ten years) we will no longer have television the way we know it today. As much as we don't like to think of it, cable TV is coming and we can't stop it. There are good and bad points about it. We will have more stations and more programs to watch; also, cable TV is regulated by the FCC so that they must

Alumni News

NRIAA OFFICERS	
George Stoll.	President
Morris E. Anderson . . .	Vice-President
Charles L. Graham. . . .	Vice-President
John Rote	Vice-President
Bailey Mark	Vice-President
Tom Nolan	Exec. Secretary

guarantee a certain number of channels within a period of ten years.

The chapter feels that all of this sounds good but it is possible that all TV will eventually be paid TV. Once we start paying the cost will be small, but eventually it will get greater and greater as these things always seem to do.

Jack Gilbert, Director of Public Affairs for Channel 11, WIIC-TV, at the July meeting of the Pittsburgh chapter.

NORTH JERSEY CHAPTER CONTINUES TROUBLESHOOTING

At the June meeting the club spent most of the meeting on a combination radio and record player and an Admiral TV, both of which were repaired by the members at that time.

Due to a sudden hot spell the meeting was shortened. Also, the July and August meetings will be cancelled and work will resume in the fall.

SPRINGFIELD MASSACHUSETTS CHAPTER APPOINTS NEW OFFICER

At the May, 1973 meeting, it was suggested that a new officer be elected to the chapter to be known as a program arranger. After a brief discussion, it was found that Mr. Arthur Byron had had extensive experience in the Federal Government, having held a similar post for the past 29 years and holding a Third Class FCC License and for the last twelve years was in a supervisory position.

The members put off further action on the subject until June's meeting, during which time the election of officers will be held and the post will be created at that time.

The Pittsburgh chapter during the recent visit by National Secretary Tom Nolan.

During the meeting an RCA 14" TV with damper problems was checked out and a visual diagnostic survey indicated a capacitor to be at fault.

The meeting was adjourned at 9:30 PM after which refreshments were served. The chapter wishes to thank Mr. Charest and his mother for the very fine food.

The chapter is suspending the July/August meetings for a summer vacation. We will be starting off in the fall with the programs that we are already working on.

SAN ANTONIO CONTINUES LECTURE SERIES

At the May 1973 meeting, another tape and slide show by Howard W. Sams Company entitled "Transistors Series" was presented. It was a very instructive program and well received by all members. The chapter welcomed a new member, Mr. Marcelino Rios, and the return of an old member, Mr. William Whittaker. Welcome to both of you fellows.

At the June, 1973 meeting Mr. Eugene Close, the Motorola Company technical representative, gave a talk on TV remote controls and the current Motorola TV chassis.

Mr. Close's program was very well received and the chapter wishes to thank the local Motorola distributor and especially Mr. Harold Strosta, the service manager.

DETROIT CHAPTER DISCUSSES FINANCES

At the May, 1973 meeting there was a discussion on our chapter finances and as to how we could increase them. Also, we discussed the possibility of increasing the quality of our programs presented each meeting.

Mr. Berus brought in an old Grebe radio type CR9 built on December 6, 1914. It was a four-tube set with the old variocoupler and the old-type tuning capacitors, plus jacks in each audio stage. It was a very interesting antique and a lot of members had never seen such an instrument.

At the June 1973 meeting, we had one of the Howard Sams Company color slide programs and after the program had a technical discussion of the material involved. This was our last meeting until September 14, 1973, when we will start our fall season.

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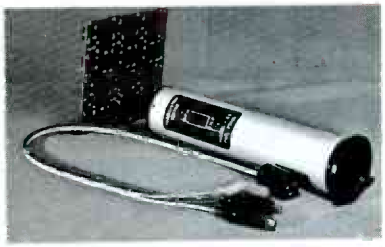

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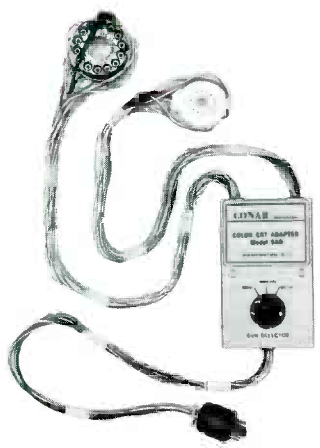
Conar's new 9AD adapter lets you test color picture tubes in the receiver or in the carton. Tests include checks for cathode emission and for shorts between elements.

will not test special tube types such as Sony Trinitron or GE's Portacolor. To use the 9AD, you must have both the 3AD and 5AD.

9AD	for 70°-90° color tubes	$12.00
3AD	for 70°-90° B/W tubes	3.00
5AD	for 110° B/W tubes	3.00



**Each of the above adapters is compatible with previous models including Models 70, 71, 220, 221, and 223.*

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20 01- 25.00	1.05	3.50		
25.01- 30 00	1.50	4.00		
30.01- 35.00	2.05	4.50		
35.01- 40.00	2.65	4.75		
40.01- 50 00	3.00	5.00		
50.01- 60.00	4.15	5.50		
60.01- 70.00	5.50	6.00	6.40	4.50
70.01- 80.00	7.00	6 50	8.00	5.00
80.01- 90.00	8.00	7.75	10.10	5.00
90 01-100 00	9.00	8.75	12 60	5.25
100.01-110 00	10.00	9.75	14 80	5.50
110 01-120 00	11 00	10.75	16.20	6 00
120.01-130.00	12.00	11.75	17.60	6.50
130.01-140.00	13.00	12.75	19.40	7.00
140 01-150 00	14 00	13.75	21.60	7.50
150.01-160 00	15.00	14.75	23.20	8 00
160.01-170.00	16.00	15.75	24.80	8.50
170 01-180.00	17.00	16.75	26.20	9.00
180.01-200.00	18 00	17 00	27.90	10 00
200 01-220.00	20.00	18.50	29.80	11.00
220.01-240 00	22.00	20.00	32.40	12.00
240.01-260 00	24 00	22 00	35.20	13.00
260.01-280 00	26 00	24 00	38.20	14.50
280.01-300 00	30.00	24.50	41.20	15.50
300.01-320 00	32.00	25.50	44 20	17.00
320.01-340.00	35 00	27 00	47 80	18.00
340.01-370.00	38.00	28.00	52.40	18.50
370 01-400.00	42 00	29.50	57.20	20 00
400.01-430.00	46 00	31.50	62.20	21.00
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NOTICE TO THE BUYER: (1.) Do not sign this agreement before you read it or if it contains any blank space. (2.) You are entitled to a copy of this signed agreement. (3.) The Finance Charge will be waived if the unpaid balance is paid within 30 days. If paid within 60 days, the Finance Charge will be reduced by ⅔; if paid within 90 days, the Finance Charge will be reduced by ⅓. Accounts extending beyond 30 days will pay up to $3 in Credit Service Charges before the above reductions are made.

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A ➔

WHERE DO YOU LIVE?

PRINT FULL NAME .... Age ....

HOME ADDRESS .... CITY .... STATE .... ZIP CODE ....

HOME PHONE .... HOW LONG AT THIS ADDRESS ....

( ) OWN HOME ( ) RENT .... RENT OR MORTGAGE PAYMENTS $ .... PER. MO.

WIFE'S NAME .... MARITAL STATUS ( ) MARRIED ( ) SINGLE

NUMBER OF DEPENDENT CHILDREN ....

PREVIOUS ADDRESS .... HOW LONG? ....

B ➔

WHERE DO YOU WORK?

YOUR EMPLOYER .... POSITION .... MONTHLY INCOME $ ....

EMPLOYER'S ADDRESS .... Street .... City .... State .... HOW MANY YEARS ON PRESENT JOB? ....

PREVIOUS EMPLOYER .... Name .... Address .... HOW LONG? ....

WIFE'S EMPLOYER .... Name .... Address .... MONTHLY INCOME $ ....

C ➔

WHERE DO YOU TRADE?

BANK ACCOUNT WITH .... Street .... City .... State .... ( ) CHECKING ( ) SAVINGS ( ) LOAN

CREDIT ACCOUNT WITH .... Street .... City .... State ....

CREDIT ACCOUNT WITH .... Street .... City .... State .... TOTAL OF ALL MONTHLY PAYMENTS INCLUDING CAR $ ....

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