nri journal

November/December 1972

CONAR CHRISTMAS SHOPPING GUIDE

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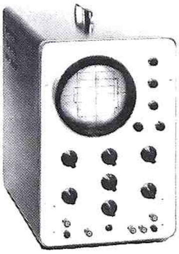

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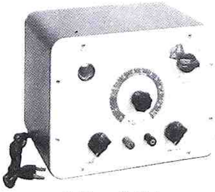

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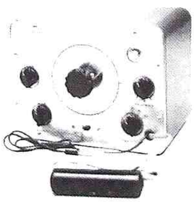

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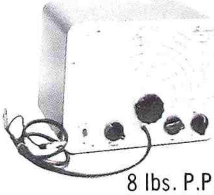

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The entire staff of NRI wishes you and your family a very happy holiday season.

earn more servicing dollars through signal

Do you service home and auto AM broadcast receivers or audio amplifiers? Yes? Then read on and learn how to get these units back into working order quickly.

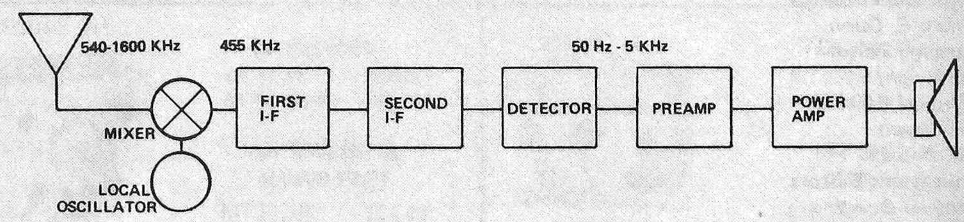
If a receiver or amplifier comes into your shop with the complaint of weak reception or low audio, is noisy, distorted, or hums -- signal tracing will get you to the faulty stage in the fastest possible manner.

Signal tracing is also useful in units that have no sound coming out of their speaker. This problem is often caused by an interruption of the signal path and not by a faulty power supply.

In any case, a quick check of the supply voltages against the typical readings on the schematic will enable you to determine this. If the voltages seem reasonable, signal tracing will help you locate the faulty stages.

What is signal tracing? It's a method of checking each stage of a receiver or amplifier by following or *tracing* a received or injected signal through the complete unit from input to output until the faulty stage is located. In tracing the signal through each stage, you check first for its presence and second for its quality or perhaps its amplitude.

Each section of a receiver or audio amplifier is responsible for performing a specific task. In a superhet receiver, signals from an AM broadcast station on a frequency between 540 and 1600 KHz are intercepted by the antenna. Assume that we are receiving a station broadcasting on a frequency of 1000 KHz. By tuning the receiver, we select this particular signal and send it on to the mixer or converter.



When we tune the receiver to 1000 KHz, we also adjust the frequency of the oscillator to 1455 KHz. This signal and the signal from the broadcast station beat together in the mixer and form two new frequencies, a sum and a difference. We're interested only in the difference frequency or intermediate frequency of 455 KHz. A tuned circuit follows the mixer which selects this frequency and couples it into the first i-f amplifier.

tracing

By Phillip D. Deem

The first i-f amplifier builds up the signal and feeds it to a second tuned circuit. This circuit couples the signal into the second i-f amplifier, where the signal is amplified to a level sufficient to drive the detector.

The detector stage rectifies and filters the 455 KHz signal until only audio signals are left. These signals are fed to the audio preamplifier, where they become strong enough to drive the power amplifier.

The power amplifier builds up the weak audio signals until they are able to drive the speaker. The speaker then reproduces the sounds which modulate the broadcast station's transmitter.

Armed with this basic knowledge of how the signal should be acted upon by each stage, you'll be able to compare the results of your signal tracing with what you know must happen in order for the receiver to work properly.

In order to use the signal tracing method of troubleshooting defective units, you must, of course, have a signal tracer! I would like to recommend an excellent one. It's the CONAR Model 230. This unit was designed by NRI engineers to assist the technician in locating the cause of troubles in home or auto receivers and audio amplifiers.

Like any other piece of test equipment, you must become familiar with it in order to use it effectively.

Let's examine the function of the CONAR Model 230's controls and then its operation.

The volume control is used to adjust the amount of *audio* amplification the signal you are tracing receives. It is adjusted to whatever sound level you wish to hear.

The band selector switch affects the radio frequency (RF) operation of the unit. It is used with the tuning knob to select a particular frequency you may wish to trace. Band A covers from 170 to 500 KHz. Band B covers from 500 to 1500 KHz.

The RF-AF switch, immediately below the tuning knob, determines the basic operation of the signal tracer. If you wish to trace a radio frequency signal between 170 KHz and 1500 KHz, this switch is placed in the RF position. If you wish to trace an audio signal (15 Hz to 15 KHz) the switch must be in the AF position.

The coarse attenuator has five positions labeled 1, 10, 100, 1000, and 10000. Each position reduces the signal before it is fed to the signal tracer amplifier. When set to position 1, the full strength of the signal you are tracing will be amplified. In position 10, only 1/10th of the signal will be amplified, and so on until you reach the 10000 position, where a mere 10 thousandths of the signal reaches the amplifier.

This switch is very important because you will be tracing both very weak and very strong signals. By adjusting the switch, you will be able to feed about the same amount of signal to the amplifier whether it is weak or strong.

The fine attenuator is used to adjust the gain of the first amplifier in the tracer. For example, if the coarse attenuator is on position 10, you will be able to obtain a signal level anywhere between 1/10th (fine attenuator at 1) and 1 (fine attenuator at 10). The fine attenuator is also the on/off switch. As you rotate the control clockwise, the unit will be turned on.

A tuning eye is located at the upper right corner of the panel. When a signal is applied to the tracer, the eye will close, the amount depending upon the strength of the incoming signal and the setting of the controls.

The probe and ground lead are the input to the signal tracer. The ground lead is attached to the chassis or B– in the unit you are servicing. The probe has a sharp metal point for piercing the insulation of wires or working through the rosin around a soldered connection at the point where you wish to sample the signal.

Let's briefly examine a schematic diagram of the Model 230 to get an idea of the basic operation of the tracer.

The probe contains a tube and a few additional components which make up a cathode follower. The purpose of this stage is to get the signal from the point you are testing into the signal tracer without affecting the signal or disturbing the circuit under test in any way. The signal from the probe is fed to a voltage divider network. The signal can be removed at various points along the divider by adjusting the coarse attenuator, SW_1.

The signal from the coarse attenuator is fed to the grid of an amplifier stage, V_2. The gain of this amplifier can be adjusted between 1 and 10 by varying the cathode bias through adjustment of the fine attenuator, R_{12}.

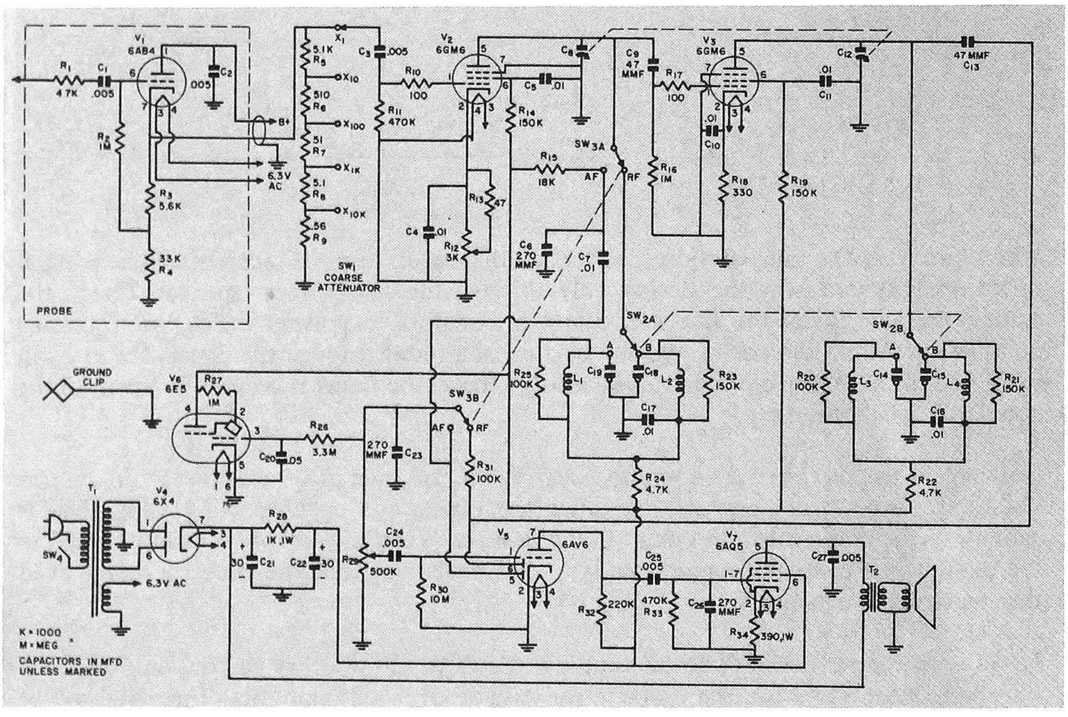
V_2 functions as an audio or rf amplifier, depending upon the setting of the RF-AF switch, SW_{3A}. When the switch is in the RF position, a tuned circuit is switched into the plate circuit of the stage. The resonant frequency of the tuned circuit is controlled by the main tuning knob and the band switch.

The selected rf signal is coupled to the grid of V_3, an rf amplifier. A second tuned circuit serves as the plate load for this amplifier. The signal is removed from the plate of this stage and sent to the detector, pin 6 of V_5.

The detector recovers any modulation on the rf signal. The output of the detector is monitored by the tuning eye, V_6, which closes as the signal becomes stronger.

Any audio information from the detector will appear across the volume control, R_{29}. A portion of the signal will be fed to the grid of the audio preamplifier, V_5. Here the audio signal increases in amplitude and drives the grid of the power amplifier, V_7. V_7 builds up the signal considerably and drives the speaker through transformer T_2.

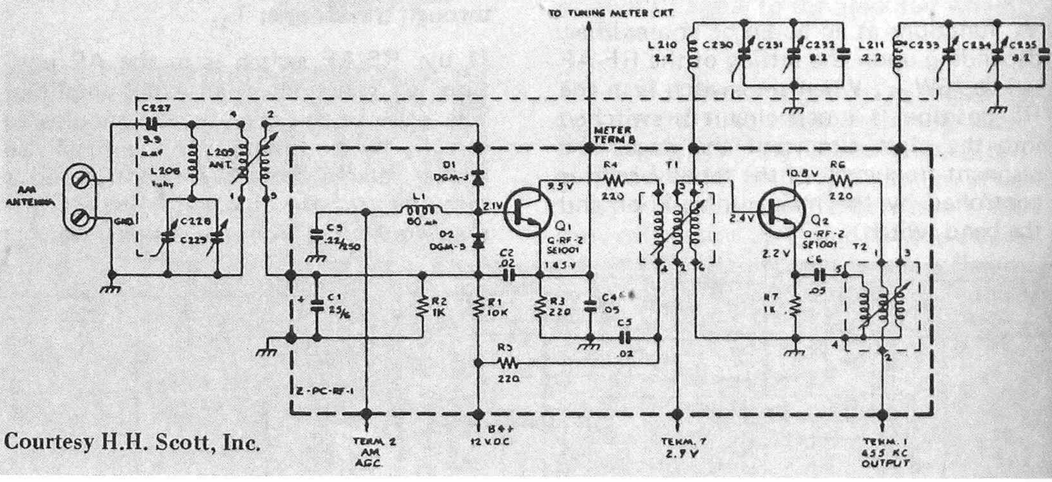
If the RF-AF switch is in the AF position, V_2 functions as an audio amplifier. The plate of this stage is now monitored directly by the tuning eye. The signal also appears across the volume control and is sent on to the speaker, just as the recovered audio from the rf signal was.



Now that we are familiar with the operation of the signal tracer and know how to use its controls, let's trace a signal through a typical AM-FM, FM-stereo receiver, the H.H. Scott Model 388.

The "front end" consists of the AM antenna tuning circuits, rf amplifier, and local oscillator. Turn the receiver on and adjust it to receive a strong local station on the AM broadcast band.

By examining the schematic below we see that the B– connection in this particular receiver is also chassis ground, therefore we can connect the ground lead of the signal tracer to a convenient point on the chassis. Place the RF-AF switch in the RF position, the band switch in position B, the volume control part way up and set the coarse and fine attenuators to position 1. Touch the signal tracer probe to terminal 2 of L209 and tune the signal tracer to the same station you have the receiver adjusted to.



Courtesy H.H. Scott, Inc.

When you have the same station tuned in on the tracer, turn the receiver volume control down so that you hear the station only through the signal tracer speaker. Check the tuning eye and adjust the fine and coarse attenuators to prevent the eye from closing completely. Watch the tuning eye as you tune the tracer through the signal. The eye will open and close. When the eye is most nearly closed, the tracer is accurately tuned to the signal you are monitoring.

Now adjust the receiver tuning control slightly to each side of the station as you observe the tuning eye. Again, you should notice the tuning eye opening and closing. This is caused by the antenna tuning circuit in the receiver. When the receiver is exactly tuned to the station, the eye will be most nearly closed, indicating that the circuit is resonant at that particular frequency.

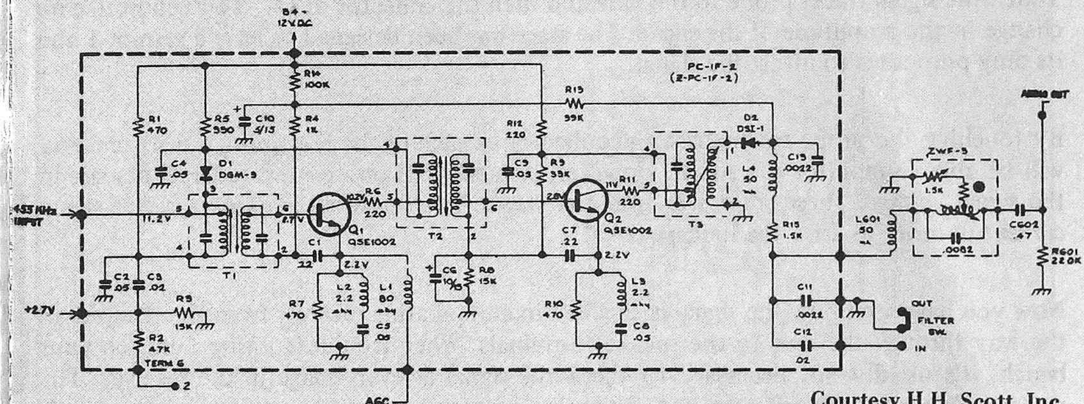
Leave both the receiver and tracer tuning controls in the position where you obtain the strongest signal and move the probe to the base of Q1, the rf amplifier. The signal will be about the same level here. Move the probe to the collector of Q1. You should notice an increase in the level of the signal. Adjust the coarse and fine attenuators as necessary. The exact amount of increase will depend upon the strength of the signal you are receiving and the amount of agc voltage being developed.

Check the signal at the base of Q2, the mixer/oscillator transistor. You'll notice a reduction in the signal level at this point. By referring to the schematic, you'll see that the signal has passed through a tuned circuit. In transistor stages, the relatively high output impedance of the preceding stage must be matched to the low input impedance of the following stage. This will result in a voltage reduction and a smaller signal to the tracer, since it monitors signal voltages. However, transistors are current-operated devices and the signal will experience a current increase in passing through the transformer.

T1 has two high impedance windings and one low impedance winding. The collector winding (1-4) and tuned windings (5-6) are high impedance while the base winding (2-3) is low impedance. The oscillator transformer T2 also has three windings. The emitter winding (4-5) and tuned winding (3-4) are high impedance while the collector feedback winding (1-2) is low impedance.

You should be able to pick up the i-f signal at pin 2 of T2. Set the band switch on the tracer to position A and adjust the tuning to 455 KHz. Touch the probe to terminal 1 and you should hear the signal. From here the i-f signal is sent to another circuit board which contains the i-f amplifier.

The i-f amplifier is shown below. The signal from the AM "front end" is fed to terminal 5 of the first i-f transformer. This transformer couples the signal into the base of the first i-f amplifier, Q1. Touch the signal tracer probe to terminal 5 and then the base of Q1 to check for the signal at both points. Move the probe to the collector of Q1. You'll notice a considerable increase in signal level at this point. Adjust the coarse and fine attenuators to open the tuning eye. The i-f amplifier is responsible for most of the gain in any receiver. Check the signal at the base of Q2, where you'll observe some signal reduction. Then, move the probe to the collector of Q2. Again, you'll see that the signal has been amplified greatly.



Courtesy H.H. Scott, Inc.

The signal flows from the collector through T3 to the cathode of the detector diode, D2. The detector removes the audio information from the signal. Since the detector in the tracer is no longer needed, set the RF-AF switch to the AF position and the coarse and fine attenuators toward position 1. The audio signal at this point will be quite weak. Touch the probe to the junction of C602 and R601. Adjust the attenuators and the volume control on the tracer until you are able to hear the signal. The components between this point and the anode of the detector are used to filter the audio from the rectified 455 KHz signal. Any remaining rf signal is passed to ground, while the audio signal is preserved.

The audio signal is fed through the input selector switch of the stereo amplifier to the loudness control of each channel. Since this is a stereo amplifier, both the right and left channels receive the same signal when you're listening to an AM station. Only one channel of the right channel amplifier is shown in the schematic on the opposite page, because both channel amplifiers are identical. The signal comes from the center tap of the loudness control to the base of Q2, the audio preamplifier. Touch the probe to this point and observe the effect of adjusting the loudness control. The sound from the signal tracer speaker will increase and decrease and the tuning eye will open and close.

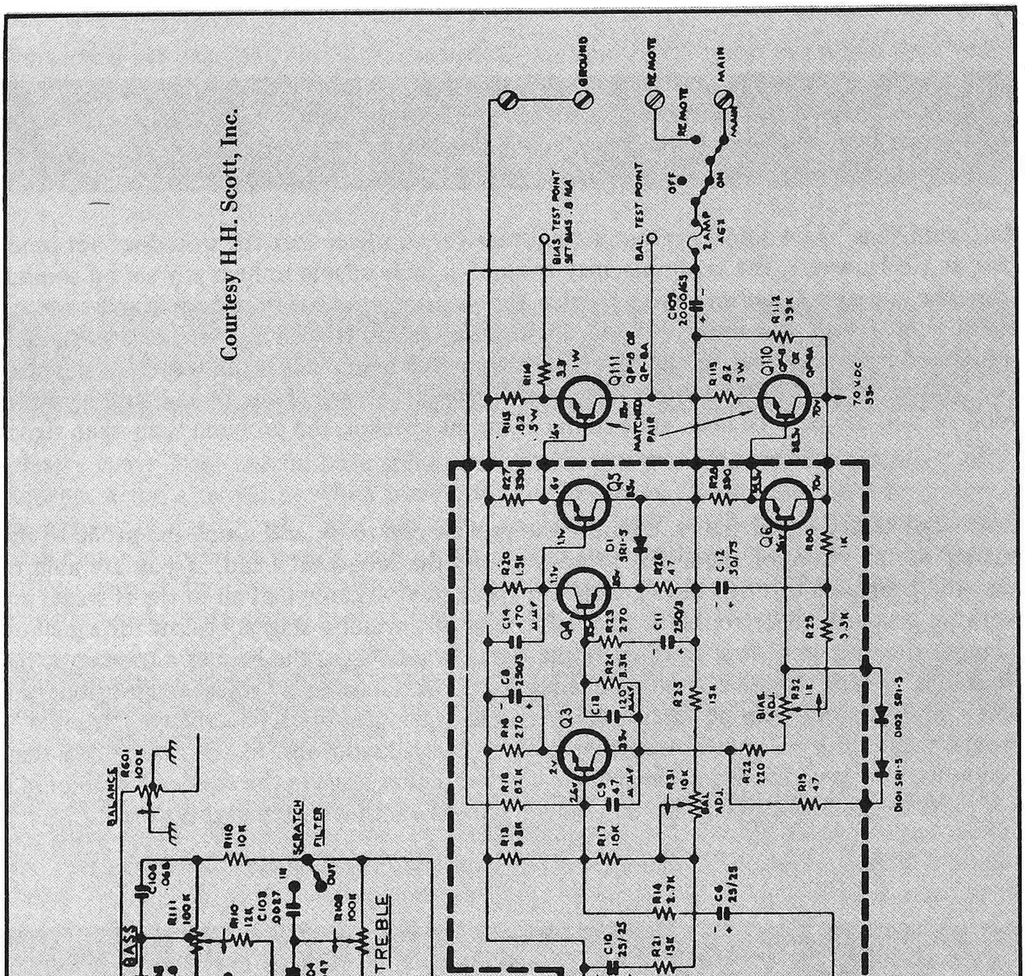
Set the loudness control to a suitable level and move the probe to the collector of Q2. You will notice an increase in the level of the signal. The signal is fed through the bass and treble controls, then coupled into the base of Q1, the second audio amplifier. Touch the tracer probe to the base and collector of this transistor. Again you will notice an increase in the signal level at the collector. The same will be true at the base and collector of Q3, the audio driver transistor.

The output stage of this amplifier is a push-pull circuit. Notice the Darlington connection is used to achieve high gain in the output stage while maintaining a high input impedance to match the output impedance of the driver transistor. This allows the use of direct coupling for best frequency response.

Since a push-pull stage must be driven by a signal which is 180° out-of-phase, a phase inverter must be used between the base of one of the stages and the driver transistor. Touch the signal tracer probe to the base and then the collector of Q4. You will notice no change in the amplitude of the signal. The stage has been designed to have a gain of 1 and its only purpose is to invert the signal.

By touching the probe to the base and collector of each of the remaining transistors, you will be able to monitor the signal. However, you will not observe a very large increase in the signal *voltage*. These are *power* amplifier stages. Their purpose is to increase the signal *current* in order to drive the loudspeakers.

Now you have seen how the signal is checked in an operating receiver from the rf input all the way through the unit to the speaker terminals. When troubleshooting a unit on your bench, it's usually not necessary to check the signal at every stage in the receiver. The customer's complaint will help you determine where you should begin tracing the signal.



Courtesy H.H. Scott, Inc.

Suppose the complaint is that the set is "dead."

As technicians, we would interpret a dead receiver to mean that the unit does not function at all. However, the customer may mean that he is unable to hear any sound coming from the speaker. It's always best to plug the unit into your service bench and turn the volume control up to see whether you can hear *any* sound (faint hum, transistor hiss, etc.) coming from the speaker. If there is no sign that the audio stages are working, the next best check would be to monitor the power supply voltage. If the power supply seems good or you are able to hear some sound from the speaker, the problem is an open signal path.

Grab your trusty signal tracer, connect the ground clip to B- and touch the probe to the output of the detector. Tune the receiver across the broadcast band. If you are able to hear the programs through the signal tracer speaker, you know that all of the rf stages are working properly. The trouble is located in one of the audio stages. Follow the signal on through the unit until it is missing. If the signal is missing at the base of a transistor, the trouble is probably caused by an open coupling capacitor, a faulty solder connection, or a break in a wire or printed circuit foil. If it is missing at the collector, the trouble is probably caused by a bad transistor or incorrect bias conditions. In any case, in less than a minute, you have localized the trouble to a particular stage in the receiver! With only a few parts to check with your meter, you will have the unit working in short order.

What's that? You found no signal at the detector?

If you found no signal at the detector that means you will have to check the "front end" and i-f amplifier. Use the signal tracer to check for a signal at the receiver's i-f. Touch the probe to the collector of the mixer transistor. Be sure to tune the receiver across the band. If you find no signal at this point, the trouble is probably caused by absence of the local oscillator signal. Tune the receiver to the low end of the dial. Adjust the signal tracer to Band B, touch the probe to the oscillator injection point and tune the tracer across the oscillator signal. For example, if the receiver dial indicates 600 KHz, adjust the tracer tuning knob to this frequency plus the receiver i-f, usually 455 KHz, for a total of 1055 KHz. If you find no oscillator signal, the trouble may be caused by a defective mixer/oscillator transistor or an open feedback path.

A good signal at the mixer collector means that the trouble is in the i-f. Continue tracing the i-f signal by checking at the base and collector of each i-f amplifier. When you reach a point where the signal is missing, you have just passed the defective stage. The trouble may be caused by a bad transistor or open i-f transformer.

When you are checking a unit for distortion, use your signal tracer to sample the signal at each stage, until the distortion is noticed in the tracer speaker. The faulty component is between the last point you tested (where the signal was clean) and the point you are testing now. This same procedure can be used for locating hum or noise on the signal: just find the stage where the hum or noise *first* gets into the signal!

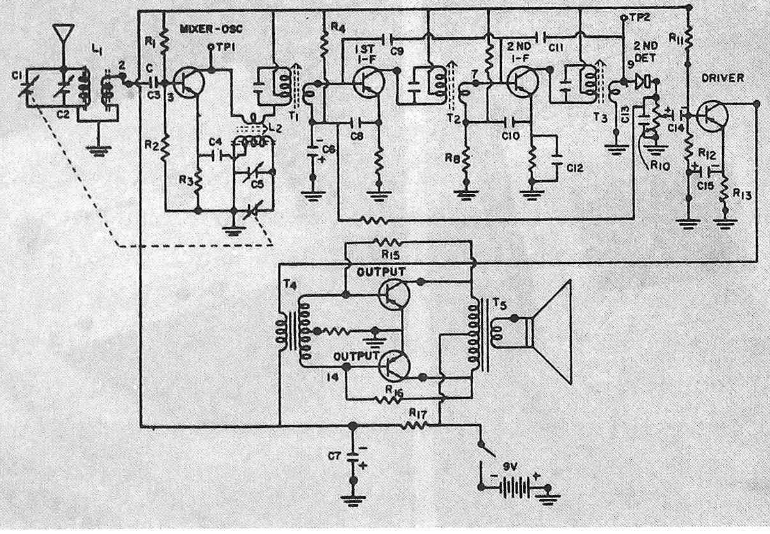
A complaint of weak audio or weak reception requires a slightly different approach.

Nearly every stage should have some amplification or gain. Pay careful attention to the setting of the attenuators when tracing for this problem. Be sure the signal level increase is normal in each stage. You will come to know how much increase to expect after checking the signal in several operating receivers or amplifiers. Problems of this type are often caused by bad transistors, incorrect bias conditions or bad emitter bypass capacitors. An unbypassed emitter resistor can reduce stage gain considerably!

Weak reception can also be caused by poor alignment. This is where the CONAR Model 230 really shines! Since it is a *tuned* signal tracer, you can use it to check the alignment of an operating receiver.

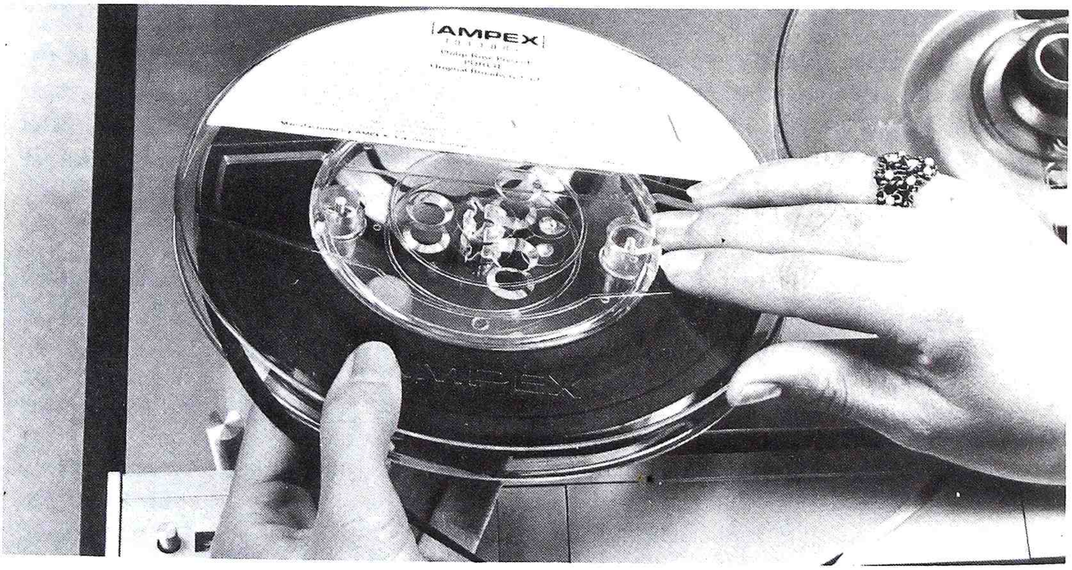
As you read the alignment information, refer to the numbered test points and component identification in the schematic of a typical transistor AM receiver shown below. Adjust the receiver to a strong station at the high frequency end of the dial. Connect the signal tracer ground lead to the chassis and touch the probe to test point 1, the collector of the mixer transistor. Set the tracer band switch to B and tune in the same signal on the tracer. Adjust the rf trimmer capacitor, C_2, for maximum signal strength, as indicated on the tracer tuning eye.

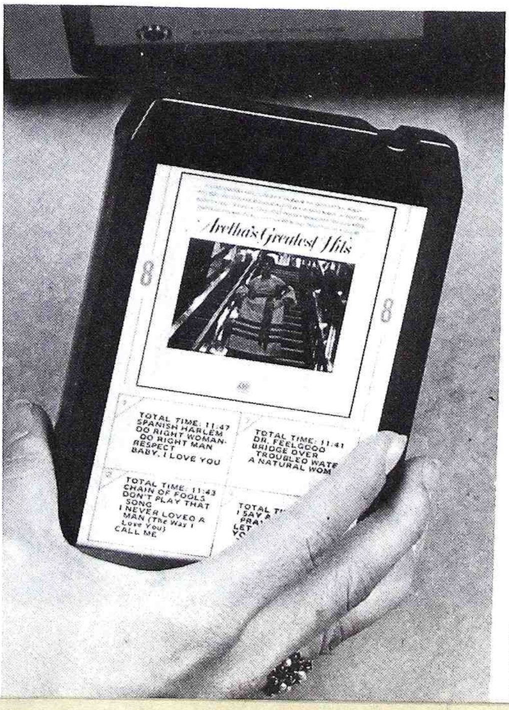
continued on page 29 □



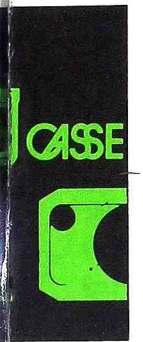
CASSETTE OPEN REEL CARTRIDGE

REEL CARTRIDGE CASSETTE OPEN





which tape for you?




Recorded tapes are suddenly giving records a run for their money. Five years ago, less than 4 percent of all recorded music sold in the U.S. was on tape with the balance on records. In 1971, tape's share was a hefty 33 percent, and further gains are expected this year, according to Ampex Corporation, a leading producer of recorded entertainment and blank tape.

The principal reason for this boom is the emergence of convenient and compact cartridge and cassette tape recorders. The fact that tape is less subject to wear than record surfaces and has the ability to record as well as play music are other factors.

If you are thinking of buying a tape music system today, you may choose among *three incompatible tape formats: open reel, cartridge, and cassette.* Each has advantages and disadvantages compared with records. The following comments are designed to help you decide which format is the right choice for your particular needs.

Since 1967, sales of recorded stereo tapes have grown more than 400 percent, from $122 million in 1967 to $508 million in 1971. There is great consumer confusion, however, over just which tape configuration – open reel, 8-track, or cassette – is best for his particular needs. This article, in time for Christmas gift-buying, shows both the advantages and disadvantages of each format and has been provided as a courtesy by the Ampex Corporation, the first company to produce recorded stereo tapes and the world's largest producer of these tapes.

OPEN REEL

The oldest form of tape music is open reel, or reel-to-reel, which was the only available format until the mid-1960s when cartridge systems began to appear. It has appealed to critical listeners because of its high quality sound reproduction. It remains a favorite tool of the serious music lover, high fidelity enthusiast, or recording hobbyist.

Most of the open reel recorders sold today are called "decks," i.e. recording and playing mechanisms without amplifiers and speakers. Decks may be joined with high fidelity systems or components. Complete systems, including a tape deck, receiver (amplifier/tuner combination), and speakers may range from $600 to several thousand dollars.

An open reel deck combined with the other system elements is in many respects the finest home music source there is. For long selections, like operas, the extended playing time of open reel tapes is a distinct advantage. An album that may include four discs can be accommodated on only two reels of tape. Automatic reverse features offered with better quality decks permit the playing of both sides of an album without handling, which is impossible with records. The sound quality of a recorded tape is generally equal to the finest discs when played on equipment of comparable quality. Moreoever, stereo separation may be more dramatic with tape than records.

If used solely for playing back professional recordings, the open reel deck has some disadvantages compared with the record player. A good quality recorder deck cost more than a good quality record changer. Tape threading still seems difficult to many people compared with starting a record. With tape, it is less convenient to play a specific part of an album since the tape must be advanced or rewound to a desired selection with the aid of a tape footage counter. With a phonograph, of course, the stylus is simply picked up and placed on the desired spot.

Open reel recordings are much less readily available than records. In fact, as retailers stock increasing numbers of cartridge and cassette recordings, inventories of open reel selections have declined. (To help open reel owners, Ampex offers its 5,000-selection open reel catalog, representing more than 125 recording labels by mail order.)

CARTRIDGE

More recorded tape music is sold in the 8-track cartridge format than any other. The 8-track cartridge is a plastic box about the size of a paperback book containing an endless loop of tape. It should not be confused with the 4-track cartridge, an earlier format which has largely disappeared from the market.

Since introduction by Lear Jet in the mid-1960s, 8-track cartridge sales have grown phenomenally. Primarily for use in auto stereo systems, the cartridge has recently made headway in the home market. In 1971, more than half the 8-track units sold were auto systems.

A major advantage of the 8-track cartridge is operating convenience. The cartridge is merely inserted in the player and begins to play. It plays a complete album over and over again with only brief interruptions while it switches automatically from one pair of tracks to the next. Three such interruptions occur on each album-length tape. Another advantage is cost. Eight-track auto systems range from $50 to $100. Home decks start at $100. Quality systems range from $150 to $300.

There are disadvantages to the cartridge format. Sound reproduction cannot approach that of open reel or good quality phonographs. Because the endless loop design involves constant tape-against-tape movement, 8-track tapes are lubricated to assure continued smooth operation. After many playings, however, the lubricant may begin to wear, and occasionally the tape will jam within the cartridge.

CASSETTE

Cassette tape recorders, developed by Phillips of Holland, were first available in monaural battery-operated portable models for voice recording. Stereo units for home recording and music playback were introduced in 1966. Ampex was the first U.S. company to offer stereo cassette systems in 1967. Cassette auto systems have made only modest inroads in the auto stereo market, where the 8-track cartridge remains dominant.

Cassettes, like cartridges, are no match for open reel tape or phonographs in terms of sound reproduction quality. There is little measurable difference in sound quality between the cassette and cartridge, but new developments in tape and equipment can significantly enhance the quality of cassette sound for additional cost.

One new development is the *Dolby noise suppression system*, which modifies the record and playback signal electronically to reduce significantly the amount of hiss or noise heard when playing the tape. Improvements in the tape itself have been developed for those who enjoy recording on their cassette systems. *Extended frequency tapes and chromium dioxide tapes*, available at extra cost, are specially formulated to permit faithful reproduction of the full range of sound.

Compactness, versatility, and economy are important virtues of the stereo cassette system. The cassette itself is about one-fourth the size of a cartridge, and the recorder or player can be more compact. A cassette consists of two tiny reels of tape encased in a plastic box instead of the endless loop of tape in a cartridge. Cassette tape does not have to be lubricated. Like open reel, but unlike cartridges, cassettes tapes can be reversed at high speed to locate individual selections. Cassette units will play one side of an album without interruption. Newer models include an automatic reverse feature permitting the second side to be heard without handling.

Automobile cassette stereo systems are making some headway in competition with the 8-track cartridge because of smaller size. A glove compartment will hold three or four times as many cassettes as cartridges. Newer cassette auto stereo systems have an automatic reverse system so that both sides of an album may be played without handling, and the cassette can be cued to repeat itself.

Stereo cassette equipment ranges in price from $100 for a simple "deck" to $500 for a top-of-the-line system. Auto players sell from $60 to $130.

FOUR-CHANNEL SOUND

An exciting new development in recorded music is 4-channel or quadraphonic sound, which broadens the musical experience by breaking the performance into four parts rather than the two used in stereo. In the best of cases, listening to quadraphonic recordings is like being surrounded by an orchestra. Four-channel players and recordings are just beginning to become available, but the concept is catching on rapidly and will undoubtedly assume a major role in the market.

Among tape formats, the principal 4-channel activity today is in 8-track cartridges, called Quad-8 or Q-8. The 8-track tape is wide enough to accommodate four separate or discrete channels of music. Four-channel sound can be achieved in cassette systems by electronically combining the four channels into two on the tape by a technique known as the matrix system. Open reel would also lend itself to discrete 4-channel, but there has been relatively little progress in this part of the market to date.

If you are concerned that quadraphonic music may quickly obsolete your new stereo tape system, you can hedge your bet by purchasing one of several new cartridges and cassette decks that are capable of reproducing 4-channel sound but are sold without the additional amplifier and speakers required for 4-channel listening. Thus, a music system can be used for stereo now, then easily updated to 4-channel later on if you wish.

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The five_systems pictured and described will be in the 1973 CONAR catalog. Although there will still be substantial savings over individual component prices, they will be higher than those listed here. To take advantage of these prices, your order must be postmarked no later than December 31, 1972. For complete descriptions of individual components, refer to your May/June 1972 Journal.

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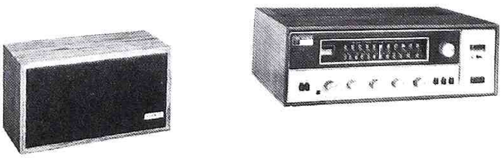

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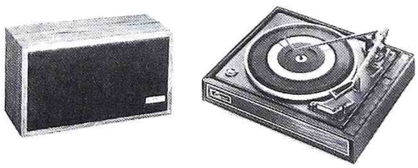

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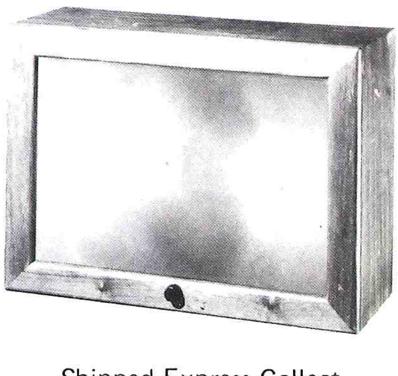

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25.01- 30.00	1.50	4.00		
30.01- 35.00	2.05	4.50		
35.01- 40.00	2.65	4.75		
40.01- 50.00	3.00	5.00		
50.01- 60.00	4.15	5.50		
60.01- 70.00	5.50	6.00	6.40	4.50
70.01- 80.00	7.00	6.50	8.00	5.00
80.01- 90.00	8.00	7.75	10.10	5.00
90.01-100.00	9.00	8.75	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
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C

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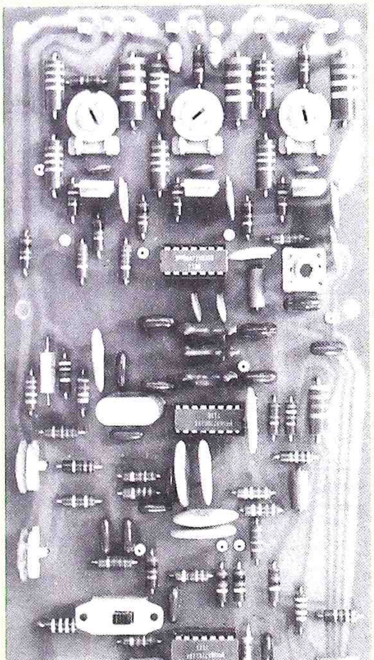
CONFIDENTIAL

One of the latest developments in color TV circuitry is the all-IC chroma processing system. The system that we will examine here is the three-chip system now being used by Zenith and others. All the active components for processing the color signal are contained on three integrated (IC) circuit chips.

ALL-IC CHROMA PROCESSOR For Color Television

by Harold J. Turner, Jr.

These three IC's are known in the trade as the 746 color demodulator, the 780 subcarrier regenerator, and the 781 chroma amplifier. The 746 chroma demodulator has been with us for three or four years now, but the 780 and 781 are brand new. The first color TV receivers to use the three-chip system appeared on the market in late 1971.



Three-chip color system with RGB output stages on one circuit board.

Since very complex circuits can be cheaply fabricated on an IC chip, the performance of the all-IC chroma system is far superior to any previously used system employing discrete transistors or tubes. The same functions are performed by the integrated circuits as have been performed by older circuits, but more sophisticated ways of performing these functions have been devised and built into the new IC's.

what the three chips must do

Figure 1 shows how the three chips are interconnected. Note that there are only two inputs: Chroma and a burst gating pulse (from the flyback transformer). Using only these two inputs, the three chips act together to produce the three color difference signals (R–Y, B–Y, and G–Y) to be fed to the three color video output stages.

The incoming chroma signal is received by the 781 chroma amplifier, amplified by this chip, and then passed on to the 746 chroma demodulator. Note that the 781 consists of two amplifier stages in cascade. (This means simply that the second amplifier amplifies the output of the first amplifier. The total gain is equal to the product of the individual gains.) The output of the first stage is also applied, through a phase shift network, to the 780 subcarrier regenerator chip.

The purpose of the 780 is to generate a 3.579545 MHz (usually shortened to 3.58 MHz) carrier signal for insertion in the demodulator stage. This subcarrier must be generated at the receiver in order to allow demodulation, since the subcarrier is suppressed at the transmitter, and is therefore not present in the signal handled by the chroma amplifier. In the demodulator, the subcarrier must be properly combined with the chroma signal, and this requires that the frequency and phase of the subcarrier be exactly the same as that of the subcarrier back at the TV transmitter. A crystal-controlled oscillator is used for high stability, but this is not enough to keep the frequency exactly right. An automatic phase control is used to keep the oscillator running at the right frequency and also in the correct phase relationship to the original subcarrier.

The frequency and phase reference for the subcarrier regenerator is the color burst, which consists of eight cycles of 3.58 MHz subcarrier signal transmitted during each horizontal blanking interval. The 780 compares the frequency and phase of its internal oscillator with the

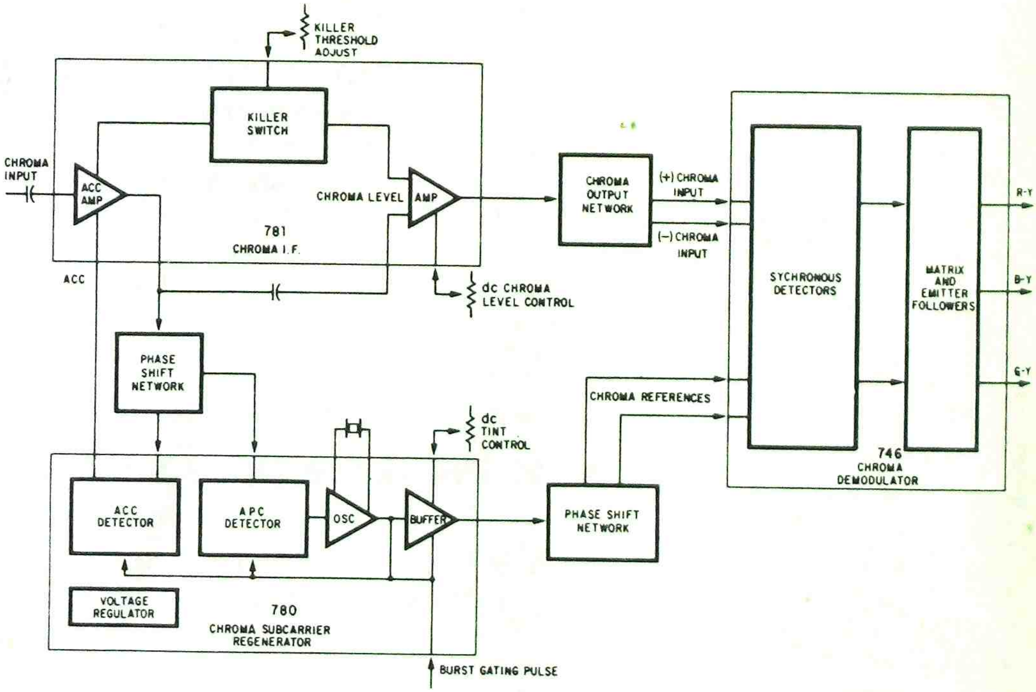


Figure 1. Overall block diagram of the three-IC chroma system. *(Courtesy Fairchild Semiconductor)*

frequency and phase of the incoming burst signal, and automatically maintains the correct oscillator output.

Now that we have an amplified chroma signal and a suitable chroma subcarrier, the job of the chroma demodulator is a relatively easy one. As long as the correct input signals are applied, the three color difference signals will appear at the output pins of the 746. These signals are then applied to the three color video output amplifier stages. Now that we have seen in general how the three chips operate together, let's take a closer look at each of them.

the chroma amplifier

In a typical color TV receiver, the chroma signal is taken from the output of the video detector or first video amplifier. At these points, the entire composite video signal is present, including brightness information, sync and blanking pulses and, of course, chroma. Of these signals, only the chroma is of interest to us here. The other signals are removed from the input to the color circuits by a resonant circuit tuned to 3.58 MHz. Only those frequencies in the neighborhood of the color subcarrier, give or take half a megahertz or so, are allowed to pass. Referring to Fig.2, you can see that the chroma input, after being filtered by the tuned circuit, is applied to pin 2 of the 781, which is the signal input of the first chroma amplifier stage. The gain of this first stage can be varied by a dc voltage applied between pins 1 and 14. This control voltage, known as the ACC (Automatic Color Control) voltage, comes from the 780. More about that later. The output of the

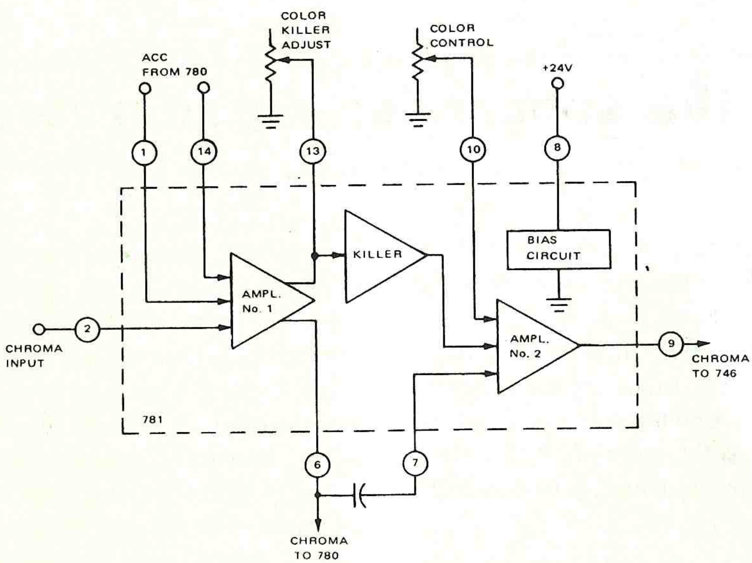


Figure 2. Detailed diagram of 781 chroma amplifier circuit.

first stage is applied to the input of the second, and also to the chroma inputs of the 780 subcarrier regenerator. The 780 will use this chroma signal as a reference in controlling the frequency and phase of the color oscillator and in controlling the gain of the first chroma amplifier stage.

The gain of the second chroma amplifier stage is adjusted by varying the dc voltage at pin 10 of the IC. This control is located on the front panel of the TV receiver and serves as the user's color level control. Minimum positive voltage at pin 10 will produce maximum gain in this stage, and therefore maximum color saturation in the picture. To reduce color saturation, the user rotates the control counterclockwise, increasing the dc voltage at pin 10 and lowering the gain of the second chroma amplifier stage.

In addition to the variable gain feature, the second chroma amplifier stage can be turned off completely by the color killer stage. The color killer samples the chroma level in the first amplifier stage, and if the level of the signal is too low to be usable, the killer simply shuts off the second stage, so the picture produced will be black and white. This means that there will be no color noise on the screen. The color killer adjustment is set so that the second stage can operate when color is present but will be shut off when a black and white transmission is being received.

The output of the second chroma amplifier is passed through a second tuned circuit and fed in push-pull to the inputs of the chroma demodulator. In most receivers using the three-IC chroma system, both the chroma tuned circuits are fixed-tuned, and require no adjustments. So far, the only circuit we have seen which requires an internal adjustment is the color killer, and this is certainly a very simple adjustment to perform.

the subcarrier regenerator

Two more internal adjustments and one front panel control are associated with the 780 subcarrier regenerator chip, as shown in Fig.3. Both internal adjustments are very simple to make; one of them requires no test equipment at all and is as easy to set as the color killer. The other requires a dc voltmeter, but it is still a simple task.

The ACC (Automatic Color Control) and APC (Automatic Phase Control) functions are performed by the 780 by sampling the chroma signal *only during the horizontal blanking interval.* In other words, all these circuits see is the phase and amplitude of the color burst signal at the output of the first chroma amplifier. The remainder of the color signal is simply ignored. These functions therefore depend only on the steady, unchanging burst signal and are not affected by changes in color content of the program being viewed.

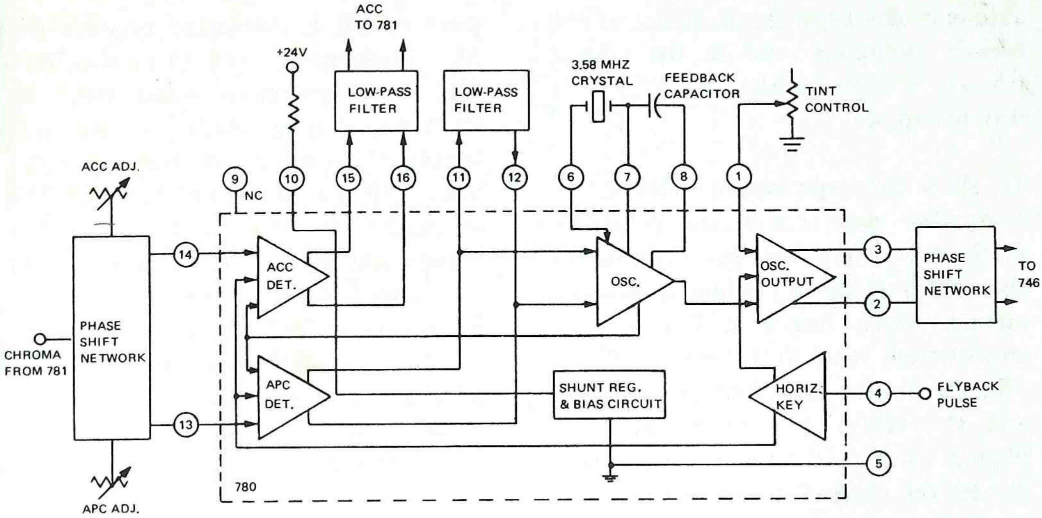


Figure 3. A closer look at the subcarrier regenerator chip (780).

ACC is simply a specific application of AGC, or automatic gain control. Here, the gain being controlled is that of the chroma amplifier, and the effect is that the chroma level is kept constant, hence the name "automatic color control." The 780 senses the amplitude of the burst signal at the output of the first chroma amplifier and uses this signal to generate a dc control voltage which is applied through a low-pass RC filter to the gain control pins (1 and 14) on the 781. Then, for example, if the color level starts to increase for some reason, the circuit will sense this change and act to reduce the gain of the first chroma amplifier, thus keeping the output of this amplifier at a constant level.

The circuit connected to pins 6, 7, and 8 of the 780 is the color oscillator circuit, which operates at 3.579545 MHz, the same frequency as that of the color subcarrier at the transmitter. A crystal oscillator is used for stability, but further stabilization of the oscillator frequency is needed since the oscillator at the receiver must at all times keep *exactly* in step with the subcarrier oscillator at the transmitter. The subcarrier is suppressed at the transmitter to prevent interference with the chroma and luminance signals, but an 8-cycle sample of the subcarrier is transmitted during each horizontal retrace time. This precisely known frequency is used as a standard by the 780 to control the frequency and phase of its own oscillator. This is accomplished by the phase detector built into the 780. The output of the phase detector is a dc voltage which is filtered by the network connected across pins 11 and 12 and then applied to the oscillator circuit. The oscillator used here is especially designed so that its frequency can be slightly changed by varying a dc control voltage. So, the output of the phase detector can affect the oscillator frequency. Since the detector compares the burst signal with a sample of the oscillator signal, it will automatically keep the oscillator at the correct frequency and in the correct phase relationship needed for demodulation.

To allow for slight phase errors in the transmitter and receiver, all color TV receivers provide a front panel control for the user to set the tint or hue of the color picture. When this control is set for correct flesh tones in the picture, all the other colors fall into their proper place, and the viewer is satisfied with the picture. In the 780, provision is made for varying the phase of the oscillator output signal very slightly by means of a dc control voltage. Since only dc voltages are handled by the tint and color controls, and no signals are fed to or from these controls, lead dress is not at all critical and no shielding is needed.

The output of the oscillator at pins 2 and 3 of the 780 is a push-pull signal which is adjusted by an external L-C phase shift network to provide exactly the right subcarrier phases needed by the demodulator. The ACC adjustment is made with the aid of a dc voltmeter. The meter is connected to pin 6 of the 780, and a short circuit is connected between the ACC input pins (1 and 14 of the 780). The meter reading is noted, then the short circuit is removed. Now the ACC adjustment is turned to bring the meter back to the previously noted reading. The jumper between pins 1 and 14 of the 780 is then reattached, and the meter should not move at all. If it does, another slight adjustment of the ACC control is made. When the control is set just right, no difference in the voltage at pin 6 will be noted when the short circuit is connected and disconnected from pins 1 and 14.

A special switch is built into most receivers using the three-chip chroma system to enable easy adjustment of the APC system. To make this adjustment, the switch is thrown to the "set-up" position, then the APC potentiometer is rotated until the color is almost in sync, and colors slowly "float" across the screen. After this is done, the switch is thrown back to its "normal" position and color sync is established. As those of you who are experienced color TV servicemen know, this adjustment closely parallels the setting of the reactance coil in older televisions.

the chroma demodulator

As far as the service technician is concerned, the 746 chroma demodulator, shown in Fig.4, is simplicity itself. There is almost nothing to go wrong here; if normal input signals are present, yet the color outputs are wrong, the only likely cause is a faulty IC. Fortunately, IC's are highly reliable, so this isn't likely to occur very often. Older versions of the 746, though identical to the newer version inside, were housed in a different type of package that could be plugged into a standard 9-pin tube socket. We have heard many times that this IC is prone to failure, but the new dual in-line package should solve that problem.

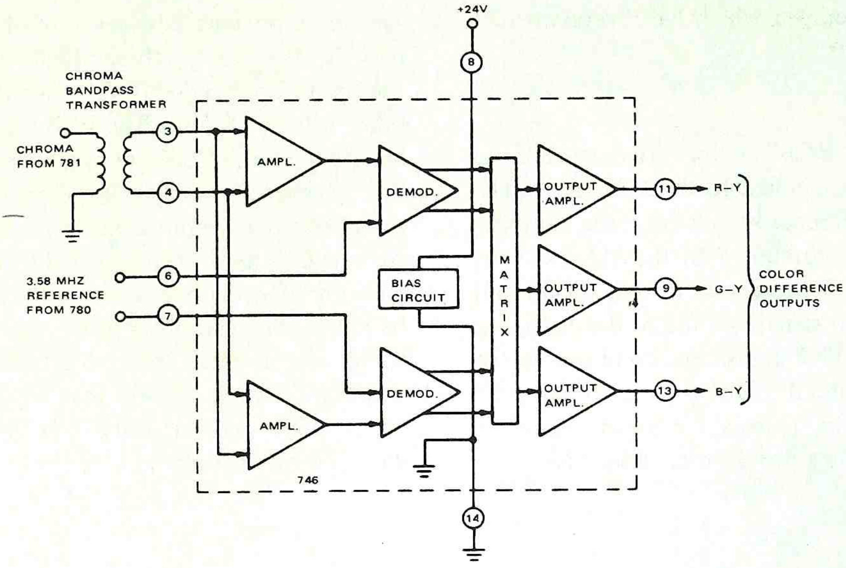


Figure 4. The 746 chroma demodulator.

Inside, the 746 consists of two balanced demodulators to which the correct phases and amplitudes of amplified chroma signal and 3.58 MHz subcarrier reference signals from the 780 are applied. The outputs of the demodulators are applied to a resistive voltage divider network, called a matrix, and R–Y, G–Y, and B–Y color difference signals are derived. Each of these three signals is then amplified by the chip to the level required to drive the color video output stages.

crt drive systems

That's all there is to the three-chip chroma system, but we still have one important topic to cover: the method used to drive the picture tube. Older receivers, including all tube-type receivers, use the color-difference drive system. In this system the combination of the color difference signals with the brightness information (Y signal) is performed by the picture tube itself, since beam current in each of the three guns is determined by the difference in potential between grid and cathode. This method of driving the picture tube, shown in Fig.5, has proved satisfactory over the years. But a newer system, shown in Fig.6, has been developed which has several distinct advantages.

In the "RGB" color drive system no signals are applied to the CRT grids. The color difference signals from the demodulators are combined in the video output stages, and the resulting red, green, and blue video signals are fed to the cathodes. A single PNP transistor, common to the emitter circuit of the three color outputs, supplies the Y signal for comparison with each of the color difference signals.

The most obvious advantage of this system is that only three high voltage transistors are needed to drive the picture tube instead of four. The PNP transistor need be rated at only 60 volts or so, so this system is less expensive to manufacture. Another, perhaps more important, advantage is that since the CRT control grids are effectively grounded, they serve to shield the cathodes from any arcing which might occur inside the CRT. This makes it much less likely that any of the color video output transistors will be damaged by CRT arcing.

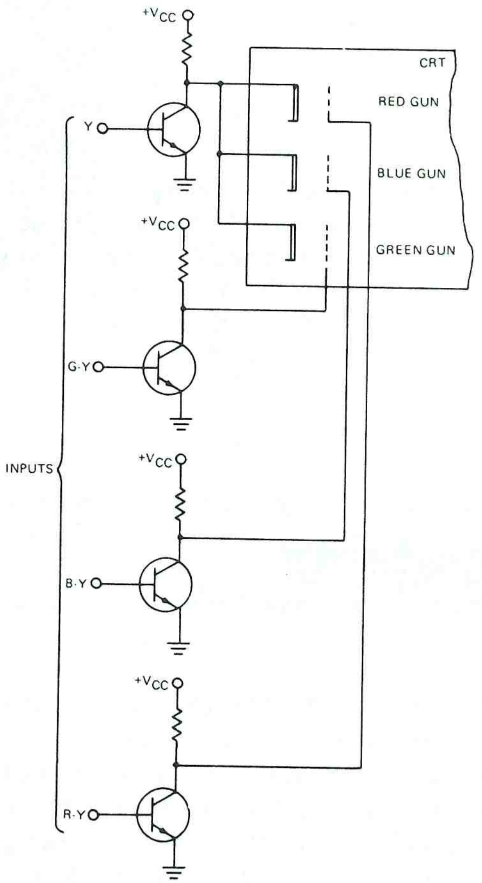


Figure 5. Simplified diagram of CRT-matrix drive system.

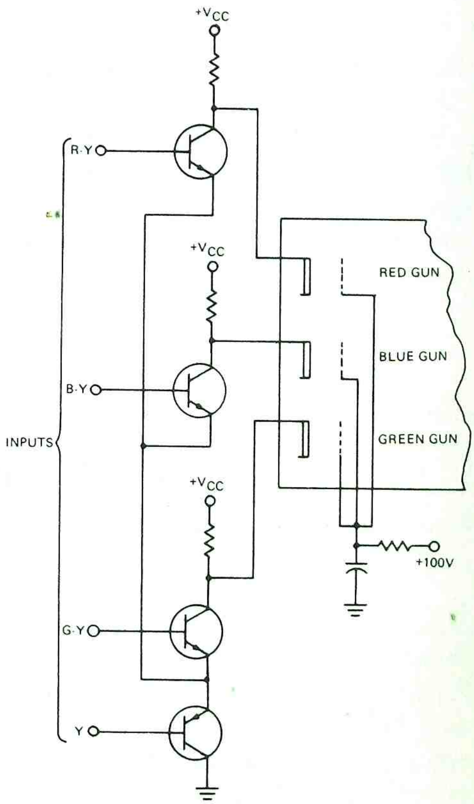
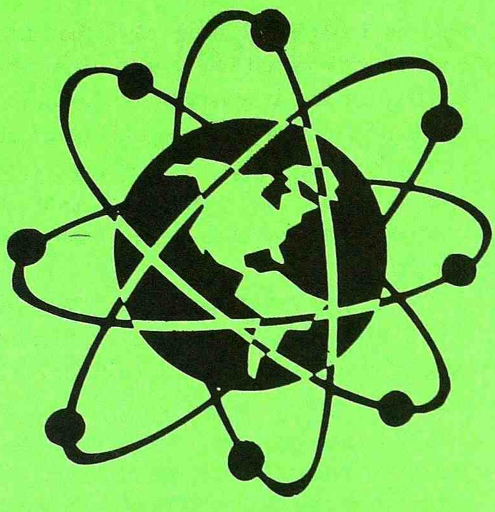


Figure 6. "RGB" color drive system.



HAM NEWS

By Ted Beach K4MKX

One of the comments I got as a result of the two previous columns in which we were talking about 2 meter FM was: "Why all the excitement about 2 meters? If you're interested in vhf and experimenting, try 220 or 440. Two meter gear is expensive and just not worth it." Well, I don't know about that.

As indicated last time, a simple modification to an FM receiver puts you in business for very little money. Surplus gear (both tube and transistor type) is readily available and at very reasonable prices. Also, there are a lot of good new rigs on the market.

After much soul searching and researching, we ordered a GTX-2 rig for mobile use. This little unit is all solid-state and puts out a nice 30 watts of rf. It is small (9" X 6½" X 2½") and doesn't take up much room in the VW. It has provisions for ten push button channels (94 simplex supplied) and is very convenient to use. We'll have to give you a performance report later. It has only been in the car two days and we have not gotten any other crystals for it so we're stuck on 94.

One of the effects that FM and repeater operation have had is to cause the FCC to drastically modify Part 97 regarding amateur operation. Most of the modifications are directed specifically toward operation and specifications of repeaters. However, some of the modifications affect *all* operators.

For example, there are now several different classifications for amateur stations. Everyone must have a *primary station*. In addition, one may have one or more *additional* stations which are categorized as being a *secondary* station, *control* station, *auxiliary link* station or *repeater* station. Section 97.3 defines all of these, and when you apply for a new, renewed, or modified station license you must specify the type of station on Form 610.

Another change made was that Technician class holders may now operate in the top megahertz of two meters (147 to 148). Mobile stations no longer are required to record the call of stations worked. This greatly simplifies mobile operation (making for safer driving, too!) since now all that must be recorded is the time the mobile station is put into service and the time of the last transmission! Of course the station call sign, operator signature, frequency, emission and power input must also be on the log, but no longer do you have to record each transmission. Wow! I would suggest (actually it's the law) that everyone get a copy of Part 97 or perhaps wait for the ARRL to revise their License Manual and latch on to one of them. You'll be amazed at the changes.

Well, once again we haven't heard from many people this time, and there were very few comments. We'll list all people in one list this time, the Amateur Course students first.

We did receive one nice long, newsy letter from WB5BVH. Dave was a ham before enrolling with NRI, and that's part of his story. Seems as how he entered a contest sponsored by *Electronics Illustrated* magazine and won his choice of courses from NRI! Dave says that this was exactly what he went into the contest for and was very pleased with the results. So now at the ripe old age of 18 he is taking our Color TV servicing course and is also starting his first year in college. Very fine business, and welcome aboard.

Also received a card from Maurice, VE2SV (listed previously), saying that his wife now has a call also – VE2DU. Both are interested in SSTV and Maurice is presently working on making a camera. We'll be very interested to hear the progress of this project, Maurice, so keep us informed.

Well, that's about it. The Ham Ads are listed on page 29 of this issue. If you have anything that you want to sell, swap or buy, drop us a line – it's free!

Vy 73 K4MKX – Ted

Here's the list of Hams we've heard from since last time.

John	WB4WHQ	A	Americus, GA
Edgard	WN4WSH	N	Dunwoody, GA
Tom	WN8MXP	N	Kalamazoo, MI
Lawrence	WN8NDU	N	Geneva, OH
Nelson	WBØ FPG (EX – WB6BFX)	–	Kansas City, MO
Dave	WA1JSP	–	Perry, NH
John	WB4ASC	A	Warrenton, VA
Al	WB5DAE	–	Beeville, TX
David	WB5BVH	A	Tulsa, OK
Bob	W5PXW	C	Richardson, TX
John	WB6CKN	G	Gonzales, CA
Buzz	WB6ZVD	A	Dixon, CA
Earl	WNØ DXQ	N	Cherryvale, KS

NRI HONORS PROGRAM AWARDS

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

With Highest Honors

Joseph Belanger, Campbell's Bay, PQ, Canada
James E. Bennett, St. Paul, MN
Gerald C. Bonk, Chicago, IL
Thomas J. Bowie, Sr., Lakewood, NJ
Ronald R. Fousek, Griffiss AFB, NY
Willard T. Burney, Lincoln, NE
Park H. Hall, Jr., Miami, FL
Wallace P. Heller, Concord, CA
Kenneth Hilgers, Boulder, CO
Larry J. Hilton, Chicago, IL
Steve W. King, Greenville, OH
Joseph R. Kramer, Jr., Rochester, NY
Norman M. Peterson, Richmond, VA
George Pevny, Jr., Brooklyn, NY
Phillip W. Roberts, APO San Francisco
Heinz Schewe, Algonac, MI
Alan Wayne Smith, Hanover, PA
Anthony B. Smith, Virginia Beach, VA
Billy Pat Thaggard, Philadelphia, MS
Robert F. Werley, Titusville, FL
William A. Wright, Spokane, WA
Robert T. Zbuska, Torrington, CT
William James Zizka, Parma, OH

With High Honors

Thomas C. Beljan, Poland, OH
William R. Bell, Daly City, CA
M. O. Benson, Severna Park, MD
Edward C. Bergamini, Levittown, PA
William C. Bohren, Concord, CA
Donald W. Bossick, Latrobe, PA
Raymond W. Boyles, Hampton, VA
Robert M. Browder, Norfolk, VA
Pedro L. Candelario, Levytown Catano, PR
Rocco Ciaravolo, Astoria, NY
George B. Clark, Jacksonville, FL
David R. Coats, Fort Meyers, FL
Albert B. Coffey, Ferguson, MO
Frederick L. Davis, APO New York
Robert G. Davis, Griffiss AFB, NY
Tom Disque, Mayfield, KY
Cecil A. Eikhard, Oshawa, Ont., Canada
Niels P. Frandsen, Potomac, MD
Waylin Orville Goodman, Chesapeake, VA
William F. Gray, La Pryor, TX
Percy Hebert, Cut Off, LA
M. L. Irwin, Bethel Springs, TN
Robert W. Jones, Kaneohe, HI
James F. Kingsland, Congers, NY
Edward Koback, Mahanoy City, PA
George W. Lake IV, Hatboro, PA
L. Mitchell Lawrence, Jr., Penllyn, PA
Frank J. Leonard, Lynn, MA
Louis A. Le Piane, Missoula, MT
Charles L. Liebert, Oshkosh, WI
Clyde E. Lucas, Huntington, IN
Frank Lucas, Mingo Junction, OH
Everard Martinez, Jr., Salisbury, MD
Thurman T. McGough, Hollywood, MD
Henry Roger Milton, Seattle, WA
Emil J. Misiaszek, New York Mills, NY
Kenneth M. Myhren, Hurst, TX
Russell T. Nakano, Aiea, HI
D. P. Nikiforuk, Bangkhen Bangkok, Thialand
William R. Patterson, Garland, TX
Oren W. Piper, Altus, OK
Jeremy Pope, Ashland, OR
Dennis E. Rau, Windsor Locks, CT
John M. Reed, Travis AFB, CA
John M. Rosier, Cocoa, FL
Tom Scheibner, Clifton, NJ
Frederick H. Scheuter, Staten Island, NY
Paul Schroer, Laurel, MD
Willie Sedor, Thomas MB, Canada
John W. Sheffield, III, Americus, GA
Earl A. Skidmore, Suitland, MD
Verl D. Spendlove, Brigham City, UT
Edward W. Staples, Granada Hills, CA
Norman C. Taylor, Miami, FL
Zvonko A. Vukasovich, Philadelphia, PA
Bernhard R. T. Wichmann, Port Alberni, BC
Dennis J. Wieschowski, Alpena, MI
John On Chung Wong, Staten Island, NY
Robert A. Wurm, Orlando, FL
Flouris Volney Wurth, Jr., APO San Francisco

With Honors

David C. Alther, West Los Angeles, CA
Lyle A. Anderson, Minneapolis, MN
Kenneth Baldridge, Valparaiso, IN
Rolf Sanford Bale, Granada Hills, CA
Paul T. Bathe, Muskegon, MI
Paul E. Beam, Jr., Hyde Park, MA
Edward H. Belanger, Regina, SK, Canada
Andrew Bistline, Colorado City, AZ
Earl R. Brazee, Vandenberg AFB, CA
John Breyer, Philadelphia, PA
Larry W. Bridges, Harrisonburg, VA
J. E. Brinker, Tucson, AZ
Darrell L. Brookman, Federal Way, WA
Paul Daniel Broussard, Kaplan, LA
Gerald Brunning, Ft. Lauderdale, FL
Gerald M. Callahan, Hammond, IN
Daniel L. Carey, Nitro, WV
Roger W. Carlson, Havelock, NC
Gordon Ale Carnell, Fremont, CA
Thomas Carrion, Jr., FPO San Francisco
Matthew E. Carswell, Rock Hill, SC
Norman H. Carter, Springfield, OH
George J. Caverly, Fenton, MI
James D. Chacon, Pico Rivera, CA
James T. J. L. Charles, Johnson City, TN
Robert F. Chiovaro, Long Branch, NJ
Harrison Clair, Kalamazoo, MI
Vernon M. Clifton, Rantoul, IL
Carmen H. Colston, Klamath Falls, OR
Henry J. Converse, Santa Susana, CA
David L. Daniel, Lawrence, KS
John Day, Washburn, WI
Thomas E. Dixon, Harvard, NE
Robert Gary Donaldson, Tomas River, NJ
Robert S. Dudley, Commerce City, CO
Ralph J. Effner, Jr., Wayland, MI
Warren K. Foran, Chesapeake, VA
Herman J. Frey, New Fairfield, CT
Joseph P. Frommel, Thayer, MO
Kenneth D. Funke, St. Clair Shores, MI
S. A. Giovanazzi, Cedar Rapids, IA
John L. Goding, Jr., Aurora, CO
Thomas J. Gorzoch, Philadelphia, PA
William Grebenchinko, Driftwood Bay, AK
Jerry L. Hale, Glen Burnie, MD
Charles H. Hansen, San Francisco, CA
James T. Hargrove, Minot AFS, ND
Philip J. Harrison, Las Vegas, NV
Ruth Anne Hentschel, Watervliet, MI
Paul C. Hill, Hammond, LA
Charles R. Hinson, High Point, NC
Roger W. Housman, Hampton, VA
Paul W. Hubbard, Frankfurt, Germany
Terry Huber, Hammond, IN
Darryl E. Hyink, Orland Park, IL
Jimmy E. Johnson, Russellville, AR
William F. Jordan, Fort Worth, TX
Donald W. Keathley, Little Rock, AR
Raymond J. Langerud, Lemay, MO
Morrie Lightman, Laval, PQ, Canada
Bradford L. Mangan, Ames, IA
Louis Walter Martin, Arlington, VA
John E. Maslar, Chicago, IL
Eddy Isaac Mattinson, Codette, SK, Canada
Fred J. McClain, El Paso, TX
James R. McClellan, Grand Chain, IL
Thomas D. McDonald, Russellville, AR
Howard M. Mills, Jr., Huachuca City, AZ
Aseet Mukherjee, Baltimore, MD
Ludwik J. Myszkowski, Lowell, MA
Clifford E. Newton, Wathena, KS
William A. Nickerson, Bucksport, ME
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Walter W. Patterson, Spokane, WA
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William L. Poucher, El Paso, TX
Frank Reneau, Ft. Worth, TX
Gary J. Reynolds, Manchester, MI
Joe Ribaudo, Richmond Heights, OH
Ernest W. Richards, St. Clair Shores, MI
Gary W. Rogers, Senecaville, OH
Robert E. Roos, Oceanside, NY
Vincent Runci, Utica, NY
William E. Ryon, Jr., Mesa, AZ
Walter Schmid, Lethbridge, AB, Canada
Orville W. Schulz, Oshkosh, WI
Robert M. Shaw, Kernersville, NC
Lloyd W. Sittler, Martell, NE
Bobby F. Smith, Americus, GA
Frank E. C. Smith, Qualicum Beach, BC, Canada
David L. Spraker, Canajoharie, NY
Marvin Stein, Brooklyn, NY
Russell S. Sterling, San Pablo, CA
Thomas O. Suttle, Pasadena, TX
John A. Vandertoolen, Salt Lake City, UT
Charles Vanderzander, Casnovia, MI
Oliver M. Voelkel, Belleville, IL
Mahlon J. Watkiss, Hunker, PA
Edgard R. Wiklund, Atlanta, GA

□ continued from page 11

Choose a second strong station at the low end of the tuning dial. You will be using both of the stations while you align the oscillator. Switch the tracer to Band A and tune it to 455 KHz, the i-f in this receiver. If you are working on an auto receiver, you may find that the i-f is 262 KHz. This information will be given on the schematic. Touch the probe to test point 1 and adjust the slug in L_2 for maximum i-f signal. Tune the receiver to the selected station at the high end of the dial and adjust the oscillator trimmer capacitor, C_5, for maximum i-f signal. Repeat these last two adjustments at least three times, until no further increase in the signal is noticed. Remember to adjust the oscillator slug in L_2 when the receiver is tuned to the station at the *low* end of the dial. Adjust the oscillator trimmer capacitor when tuned to the *high* end of the dial. Now you are ready to align the i-f transformers, T_1, T_2, and T_3.

Leave your signal tracer tuned to the receiver's i-f and move the probe to test point 2. The i-f alignment in most receivers usually consists of adjusting the slugs in each transformer for maximum output. Check the alignment instructions for the receiver you are working on and proceed with the adjustment.

Signal tracing is a good procedure for tube type equipment too. We don't have room to demonstrate it here. Just pretend the tube grid is a transistor base and the tube plate is a transistor collector!

As you have learned, a tuned signal tracer is a powerful servicing tool. You will find that it considerably shortens the time you spend troubleshooting receivers and amplifiers. Since time saved is more money in your pocket, the tracer should pay for itself in a very short time.

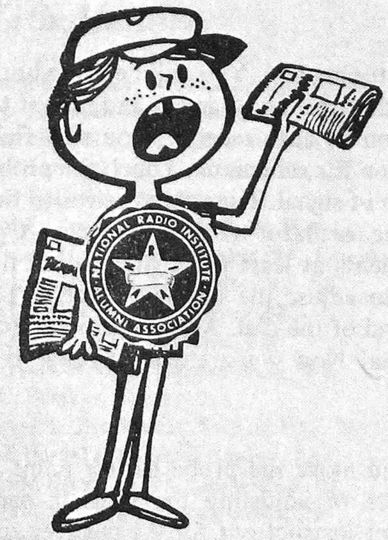
The CONAR Model 230 tuned signal tracer has one additional bonus. By attaching a short lead to the probe tip, you will be able to tune in your favorite local station! Yes, it even doubles as your shop radio when it is between jobs!

HAM ADS

SELL: Heath HW-100, HP23A power supply, factory aligned and with SSB/CW filters, front panel select, $285.00. Also, unique 80-10 meter random length wire antenna tuner, like new, $50.00. I will pay shipping on these items anywhere in the continental U.S.
Dave Lambert — WA1JSD
Whispering Pines
RFD 3
Derry, NH 03038

WANTED: Diagram or information on ELDICO TR-1TV transmitter, modulator, and power supply.
Ronald Howard — WB4MOU
Route 4, Box 271
Pickens, SC 29671

WANTED: Manual for Heathkit transceiver Model HW-29. Buy, borrow or rent.
Peter Turchi — K2PIK
1420 Maple Avenue
Haddon Heights, NJ 08035



Alumni News

Andrew Jobbagy	President
Charles Graham	Vice-President
John Rote	Vice-President
William Simms	Vice-President
Andrew Perry	Vice-President
T. F. Nolan	Exec. Secretary

Meet George Stoll. . .

. . . who has been elected to serve as President of the National Radio Institute Alumni Association for 1973. George is a member of the North Jersey Chapter and served as its Chairman in 1972. He is a graduate of the NRI Radio-TV Servicing course.

George moved from Newark to Kearney in 1933. He attended the University of North Carolina for two years but "was forced to quit due to lack of the wherewithal during the Great Depression." He went into the hardware business with his father during the time of the depression.

"People took odds that we would last two months – but I'm still holding out after forty years."

He worked on the MANHATTAN project for the Dupont Company during the war and received a commendation from Secretary of War Stimson for his efforts.

"I had always been fooling around with things mechanical and electrical, but when television was in its infancy, I decided to study it."

After trying a few schools, none of which gave him what he thought he needed, George finally enrolled with NRI. He was "completely satisfied with their method of teaching and study."

He tried to tie in TV and radio repair with his hardware business, but found this rather hard to do. So, he stuck to the hardware business and started working in radio-TV servicing jobs in his spare time.

George suffered a serious heart attack four years ago but has nevertheless recovered to work a full day. He still maintains his interest in the servicing field and continues to study this "fascinating subject." This fascination has been passed on to his three year old grandson, who "thinks he can help granddaddy change the batteries in a transistor set."

Congratulations on your election, George. We know you will make a fine President of the NRIAA.

We also extend our congratulations to the men who have been elected to serve as Vice-Presidents for the 1973 term. They are:

Morris E. Anderson, Rock Springs, Wyoming
Charles L. Graham, Norfolk, Virginia
John Rote, Fairmont, West Virginia
Bailey Mark, West Sacramento, California

NORTH JERSEY Chapter Entertains Executive Secretary

Tom Nolan, the National Executive Secretary, visited the North Jersey Chapter before the summer holidays. The meeting was opened by Chairman George Stoll, who immediately turned the evening over to Tom. Tom, who is certainly no stranger to the Chapter, was very warmly welcomed by the members.

Tom's program was "Electronic Trouble-shooting." It covered phases from early radio to the very latest in present-day electronics. Using a scope and vacuum tube voltmeter, he demonstrated the testing of diodes and transistors and explained how to troubleshoot with a VOM. It was, as Tom's programs always are, a very interesting and educational program, reaching everyone in the audience.

At this meeting the Chapter celebrated its 9th anniversary. The Chapter received its charter from the late Ted Rose on May 24, 1963. Originally known as the Hackensack Chapter, the name was changed to North Jersey Chapter in 1966. At the first meeting Mr. J. B. Straughn held a program on transistor radios. Some of the charter members are still very active in the Chapter. The door prize at that meeting was won by Mr. George Roos of Berkley Heights, New Jersey.

PITTSBURGH Chapter is Entertained By Telephone Company

One of the few Chapters that did not take a summer holiday was the Pittsburgh Chapter. At the July meeting the program included a motion picture supplied by the Bell Telephone Company entitled "Molecular Magic." This film was about the endless probe into the mysterious world of atoms and electrons.

At the August meeting George McElwain, GE technician, and James L. Wheeler, independent serviceman, presented a troubleshooting program for the Chapter. Using the Chapter's specially equipped TV set, they would throw a switch to introduce a particular trouble, then the members were to determine which stage was affected.

An RCA demonstration is scheduled for September and a B&K demonstration for November. The annual Chapter party will be in December.

SAN ANTONIO Chapter Entertained by Motorola

Mr. Jack Reagor, field engineer for Motorola's Dallas, Texas office, presented a very instructive program concerning general TV repair and particularly the repair of Motorola products.

Jack, who has spoken to the Chapter previously, is always welcome. The Chapter wishes to express their thanks to Mr. Harold Strosta, the local Motorola distributor, for arranging this program.

DIRECTORY OF ALUMNI CHAPTERS

CHAMBERSBURG (CUMBERLAND VALLEY) CHAPTER meets 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: Samuel Antman, 1669 45th St., Brooklyn, N.Y.

NORTH JERSEY CHAPTER meets 8 p.m., last 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 Kelley.

SAN ANTONIO (ALAMO) CHAPTER meets 7 p.m., 4th Thurs. 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, San 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. 734-2607

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.

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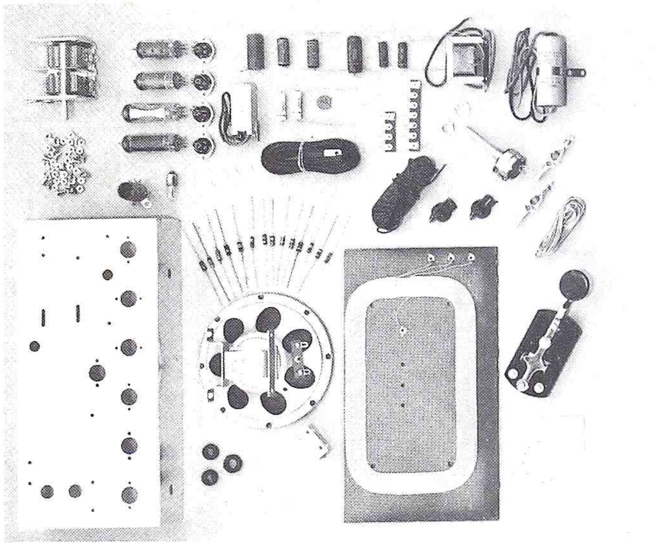

Ten *fascinating* and *safe* educational projects. This kit is used by teachers in many school classrooms to introduce students to electronics—help them toward satisfying and profitable careers. Here's proof positive of its sound educational value and thorough training.

Kit contains over 100 top-quality parts—name brands you'll recognize. This is not the *"plastic-cardboard-battery"* type experimenter's kit usually found on store shelves. IF PURCHASED SEPARATELY, THE PARTS USED IN THE ADVENTURES IN ELECTRONICS KIT WOULD RUN WELL OVER $30.00.

You learn about electronics and *have fun* doing it. Each project graphically demonstrates a number of electronics principles. You're shown "why" and "how" these principles work. You need *no previous electronic training or experience*. Just follow the simple, concise instructions and large diagrams in the 48-page project manual. The manual includes a glossary of common electronics terms for quick and easy reference.

The projects cover a seemingly endless variety of activities:

- **You build a Radio Receiver** which performs exactly like a manufactured set—picks up local broadcasts and distant stations.
- **You learn about Testing Radio Sets.** In this project you build a signal tracer and use it to find the exact point in a circuit where the signal stops. The signal tracer is a test instrument used by professional electronics technicians.
- **Then you become a Radio Announcer.** You set up a broadcast station, and with the speaker as your "mike," transmit your voice through your radio or a neighbor's set.
- **Now you assemble a "Secret Listener."** The speaker becomes a concealed microphone. Put it in one room and hear any conversations through a receiver without being present. Use it as an electronic "baby sitter." Mother can place the "Listener" near baby's crib and hear cries while she's in another room.
- **You'll experiment with sound.** In one project you build an Audio Oscillator and produce a wide range of sounds. Another experiment teaches how sound is magnified. After putting together an Audio Amplifier, you amplify sounds from a phonograph pick-up.

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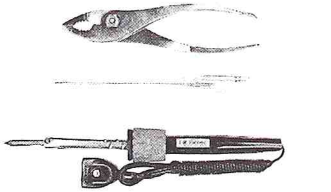

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