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RADIO SECTION

SIGNAL TRACING IN TRANSISTOR RADIOS

by Sol Libes Editor

Signal tracing procedures in transistor radios, as a means of isolating the stage where a trouble exists, are basically the same as the methods used in vacuum tube receivers. However the low circuit impedances, low bias voltages and the transistors themselves require that our methods be revised somewhat.

The "click test" has been a standard troubleshooting procedure for vacuum tube radios for what seems like centuries. Here the technician momentarily shorts the vacuum tubes control grid to chassis ground with a screw driver. This upsets the tube's bias causing its conduction to increase momentarily (this is because a vacuum tube grid usually operates with the control grid at a small negative potential with respect to chassis ground). Hence, a signal is developed and a click will be heard from the radio's loudspeaker, provided all stages are operating between this point and the loudspeaker. This test is begun at the control grid of the audio output tube and then each tube is checked in succession up to and including the converter stage.

This "screw driver" method however can prove very dangerous in transistorized circuits. For example, look at the circuit in figure 1. The emitter of the audio driver transistor is 0.1 volt positive with respect to the base. The transistor (PNP type) is thus biased in a forward direction so that a small amount of current flows from base to emitter with no signal.

If the "screw driver" method of signal tracing were now attempted, observe what would occur. The base is momentarily shorted to ground with the screw-driver blade. Zero volts potential is now on the base. The emitter is 7.5 volts positive with respect to the base. ***7.5 volts forward bias!*** The base-to-emitter current flow will instantaneously damage the crystal lattice structure of the transistor destroying its ability to operate as a transistor.

SIGNAL TRACING WITH A NOISE GENERATOR

A *quick* method of signal tracing in a transistor radio is the use of a noise generator. Noise generators provide a signal at an audio frequency which is rich in hormonics. It can therefore be made very compact with only an on-off switch to manipulate. The only commercially available unit we know of is shown in figure 2. It is called the "Mosquito" and is manufactured by **Don Bosco Electronics Co., Hanover, New Jersey ($9.95 dealers' net, available through local distributors).**

The Mosquito, and it's almost as small as one, consists of a transistor oscillator powered by a single tiny pen light cell. Its signal is a 2KC square wave with a sharp spike. This wave form results in a rich supply of harmonics in both the audio, IF and RF spectrums.

Signal tracing with the Mosquito is begun at the speaker. Connect the generator across the speaker winding

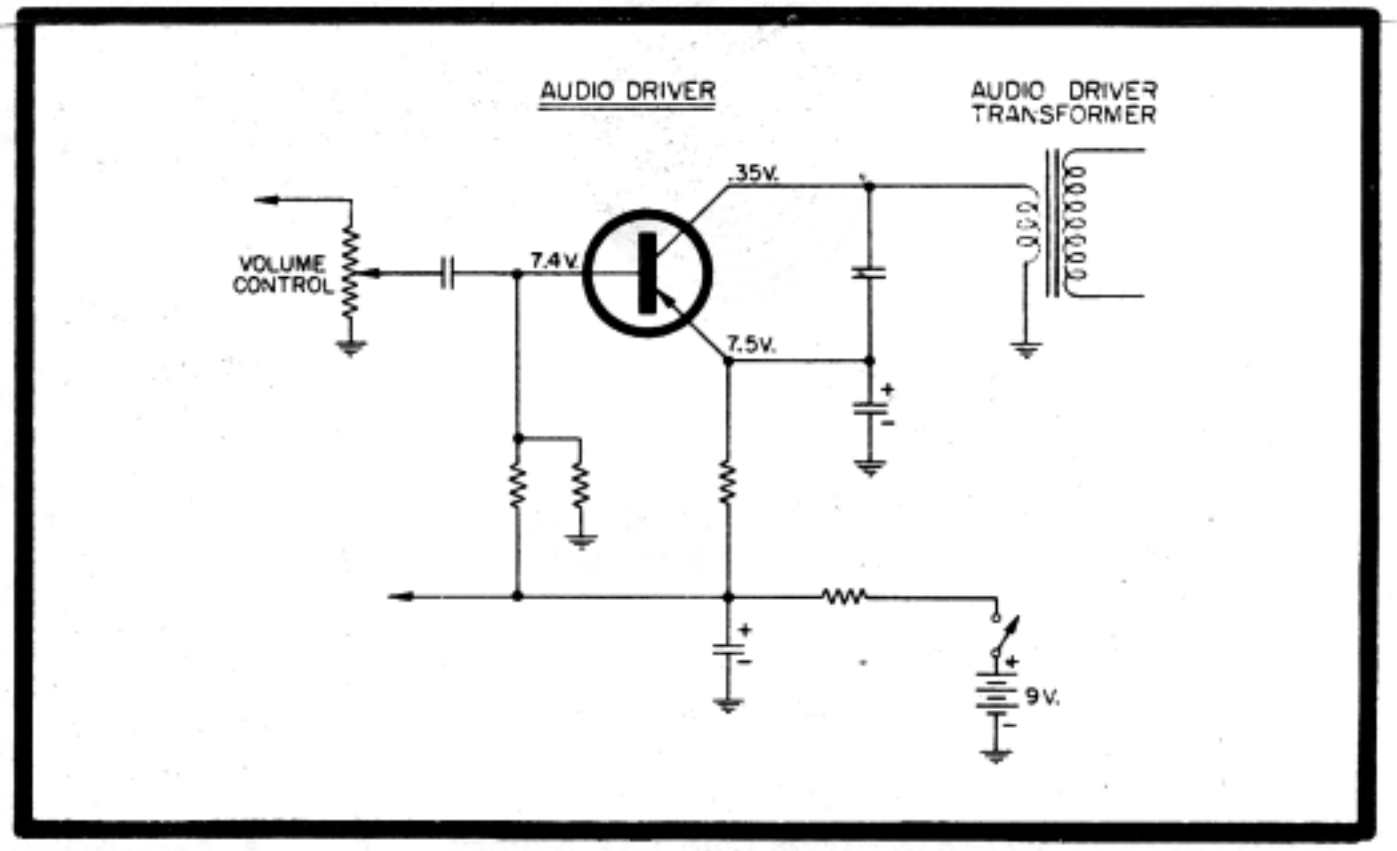

Figure 1 – Voltages existing on the elements of a typical transistor circuit.

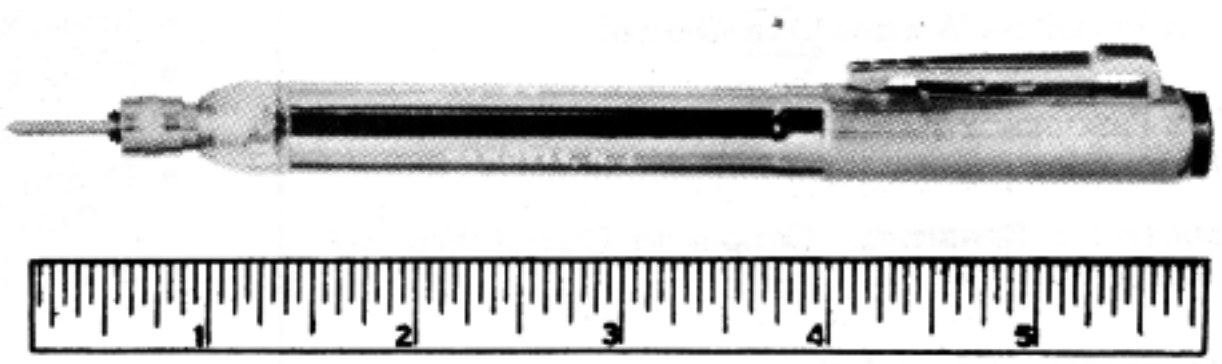

Figure 2 – The "Mosquito"; a commercially available miniature noise signal generator for signal tracing radios.

with a jumper from the metal clip of the holder (generator ground) to one terminal of the speaker. Touch the probe tip of the Mosquito to the other speaker terminal. A tone will be heard from the speaker if it is operating properly. The intensity of the tone depends on the impedance of the speaker. High impedance speakers will yield a louder tone than low impedance speakers.

If the speaker is operating then connect the Mosquito ground to the radio chassis ground and proceed to touch the base element of the audio output, audio driver, detector and IF amplifier transistors in turn. The volume of the tone will be just barely audible when injected at the base of the audio output and 2nd IF transistors since a minimum amount of gain for the audio and IF frequency signals is present at these points. As the generator probe is moved to the audio driver and detector transistors the tone will appreciably increase in loudness. Likewise, as the generator probe is moved to the base of the 1st IF amplifier and converter, the tone's loudness will greatly increase.

A check of the antenna can be made by forming a 6 to 8 turn coil of ordinary hook-up wire and connecting it from the generator probe tip to probe ground. The diameter of the coil should be just large enough to fit over one end of the antenna's ferrite core. As the coil is brought near the antenna (holding it parallel to or over one end of the ferrite core) the generator tone will be heard.

Failure to hear a signal at any point in the signal tracing procedure indicates that a circuit malfunction exists between the point where the tone was last heard and the point at which it is no longer heard.

The technician should first use the noise generator on a transistor radio which is in good working order to become familiar with this instrument. For example the user should know, from experience, the approximate loudness of the tone at all the test points in the standard transistor radio. This will then indicate if the relative gain of the various stages is up to par.

The local oscillator section of the transistor radio can be checked with the noise generator using the following procedure. Using the loop coupling system previously used to check the antenna, couple the noise signal into the antenna. Rotate the tuning gang to minimum capacity (full open). Touch the oscillator trimmer adjustment screw, on the tuning gang, with your finger. This will cause the oscillator to cease oscillating. The tone will also cease. Now, with the finger still on the trimmer, rotate the tuning capacitor fully closed (maximum capacity). A tone will now be heard. This indicates that the converter stage is now passing the IF frequencies but not the RF frequencies with the oscillator inoperative. In other words conversion is no longer taking place. If the noise generator's signal is passed at both high and low ends of the tuning capacitors range then the oscillator is working. If the signal is passed only at the low end then the converter is operative at IF frequencies but not RF frequencies due to the oscillator not oscillating. If the tone is not heard at either end the converter circuit is not operating at all.

Needless to say this generator can also be used in a similar manner to check vacuum tube radios, high fidelity amplifiers, and the audio and video sections of television receivers. In these cases however, a ground lead to the Mosquito is not required. This is because the high impedances of the vacuum tube circuits do not load down the generator output and more signal is injected into the circuits.