VINTAGE RADIO

By JOHN HILL

A look at signal tracing, Pt.3

Last month, we looked at the tuned signal tracer and described how it is used to troubleshoot a typical superhet valve radio circuit. This month, we look at the untuned signal tracer and describe how it is used.

A signal tracer has the ability to intercept both RF and AF signals at many test points throughout a receiver. It can give an indication of stage gain, locate distortion and quickly lead the repairer to the trouble spot where the signal either stops or falters.

And where the problem is intermittent, the ability to trace a signal is sometimes the only way to track down such a fault. The intermittent fault is the bane of every serviceman. It would be easy to write a whole article on this subject but a brief summary must suffice.

The word intermittent tells most of the story. An intermittent fault – be it total loss of signal, a drop in level, distortion, instability, or any combination of these – can appear quite spontaneously, for no obvious reason. And then it will often disappear just as mysteriously.

Often, it will be due to a faulty connection somewhere. Inside an old paper capacitor is a common location but it can be in almost any component in the chassis or simply due to a poor solder joint.

Another characteristic of intermittent faults is that they are often quite sensitive to movement (mechanical shock), temperature and/or sudden electrical changes. Switching the set off and on again will often cure an intermittent fault, for example, if only temporarily.

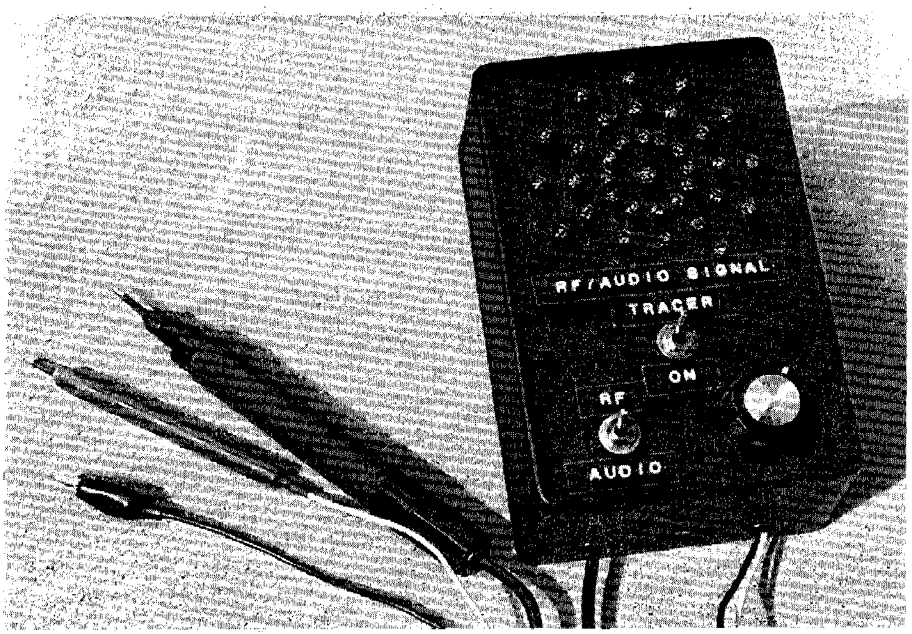
In some cases, the fault is extremely sensitive to even the slightest changes. In this situation, touching a meter prod on almost any part of the circuit can cure the fault. The same applies to a signal tracer probe; connect the probe to troubleshoot the circuit and the fault will vanish. Indeed, this type of fault can be very frustrating.

The only practical solution is to get in first. You connect the tracer probe while the set's behaviour is normal, set the level as appropriate and wait. And the logical spot to start is close to the middle of the set, near the detector or first audio stage.

When the fault occurs, the direction to follow will be obvious. Shifting the probe will probably cure the fault, in which case you simply wait for the next failure. It may take some time but your patience will eventually be rewarded and you will be able to track down the location of the fault.

Generally, the more facilities there are on the tracer, the better are your chances of finding the fault quickly. Unfortunately, there are not many signal tracers like the Healing Dynamic Signalizer described in last month's story. They were mainly bought by service technicians, which is another way of saying that there may not be many around today for vintage radio enthusiasts to find and use.

The old Healing Dynamic Signalizer



This simple untuned signal tracer was constructed by the author from a couple of kits for about $30. Note that it uses separate audio and RF probes whereas the unit described in this month's SILICON CHIP uses a single probe for both jobs.

is a fairly good tracer and is particularly useful because of its ability to accurately tune a wide range of frequencies.

The untuned tracer

There is another type of signal tracer that is quite useful and that is the untuned tracer. Whereas the tuned type can home in on any chosen radio frequency, the untuned tracer simply accepts a much broader range of frequencies.

Reduced to its simplest form, a signal tracer would consist of a pair of high impedance headphones and a small mica capacitor to block high DC voltages. This sort of device could be used to troubleshoot audio circuits by tapping in at various points along the signal chain. Such a simple device would have definite limitations, however. Most signals would be either too low to hear or too high for the headphones to handle, so a tracer of this type really isn't of much use.

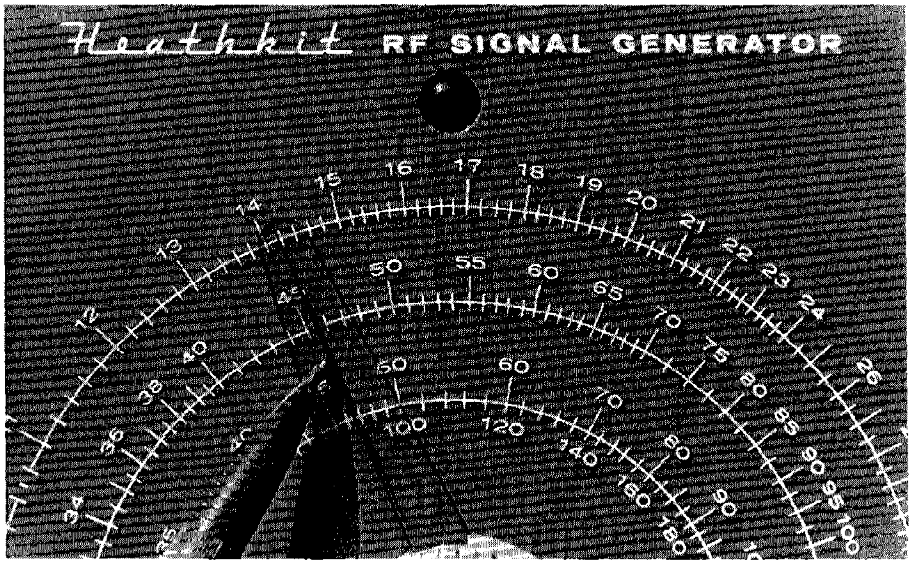
The simple tracer just described can be made a little more versatile by adding a diode to the probe. It could then be used to detect radio frequency RF) signals in radio circuits. Once again, some receiver test points may not produce enough energy to make audible sounds in the headphones, while others may be too high for comfort. The low input impedance of such a tracer would also load RF circuits and detune them, thereby giving misleading results.

However, during the early days of radio, the few signal tracers in use would have mostly been simple home-made devices, just as described above. Another type was constructed in much the same way as a 1-valve headphone receiver, with the probe connecting to the grid of the valve via a small coupling capacitor. While this arrangement would provide some amplification, it was still very crude and had many limitations.

To sum up, such simple signal tracers are frustrating to work with and leave much to be desired because of their inadequate design.

Design requirements

To be really useful, a signal tracer must have an RF probe that does not unduly load the circuit to which it is connected. It should also have amplifying stages (both RF and AF), a gain control and a loudspeaker. These would be the minimum specifications for a simple signal tracer.



A radio frequency (RF) generator can be used in conjunction with a signal tracer to identify the frequency of an unknown IF transformer. You simply couple the signal generator to the primary winding of the IF transformer and the tracer to the secondary. The signal generator is then adjusted for maximum response from the tracer and the frequency read directly from the dial. This photo shows the generator's dial set on 455kHz, a common IF.

Building such an outfit is relatively easy, especially if one builds a transistorised version rather than the traditional valve type. I recently had a go at making a unit from a couple of kits (an RF probe kit and a low-power amplifier kit) and a reasonably effective tracer was produced for about $30.

The construction details for this simple untuned signal tracer are given in this month's SILICON CHIP. It can trace both audio and RF signals in valve and solid state circuits.

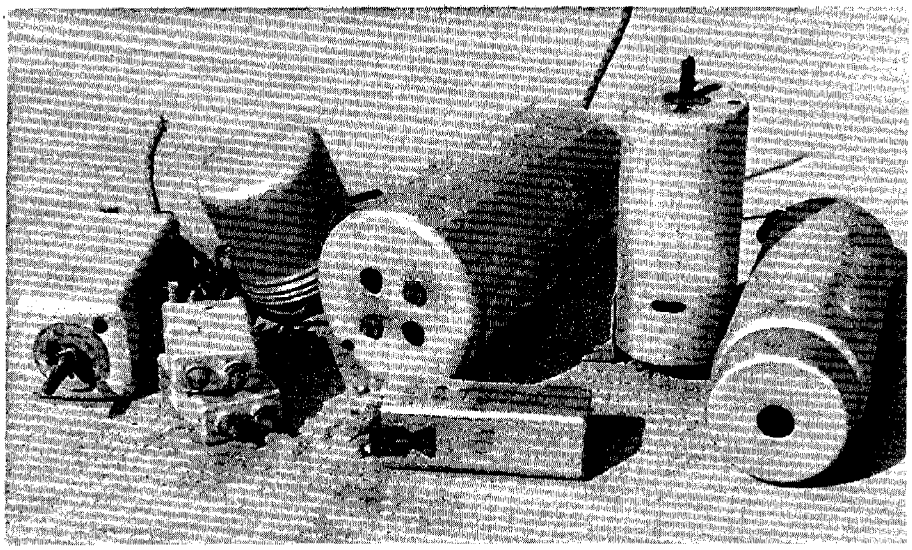
However, as an adjunct to this series on signal tracing, SILICON CHIP has developed a complete signal tracer and the design is in this month's issue. This untuned unit is based on a couple of low-cost ICs and is suitable for tracing both RF and audio signals in old valve receivers. It is also suitable for tracing signals in modern circuitry.

The controls simply consist of two 3-position switches. One is a sensitivity switch, while the other selects between Audio, RF and Off. The probe plugs directly into a banana socket on one end of the case and you can use a short probe as shown in the article, or a probe at the end of a wire lead.

Using an untuned tracer

An untuned signal tracer is used in much the same way as a tuned tracer, as described last month. And although a simple untuned tracer can be used with a signal generator, a radio station usually makes a much more convenient signal source.

For this reason, it is necessary to connect an aerial to the receiver to obtain suitable signals. In addition, the receiver must be tuned to a station if a signal is to be traced through the



These IF transformers have tuned frequencies which vary from 175kHz to 460kHz. An untuned signal tracer and an RF signal generator can accurately sort them out.

set. In fact, it's a good idea to have a few dry runs with muted working receivers to find the best test points.

Although a tuned tracer can follow a signal from the aerial terminal on, one cannot expect that sort of a performance from an untuned tracer. In my locality, a 5kW transmitter just a few kilometres away dominates the scene. The receiver under test may be tuned to another station but when an RF probe connected to an untuned tracer is placed anywhere in the aerial coil circuit, the local station overrides the tuned signal.

If the strong local station is used as the tuned signal, the probe will pick it up no matter where it placed. This is one disadvantage of the untuned tracer – unlike the tuned type, it is not selective.

In most locations, however, our simple tracer would not be so overpowered and should pick up the tuned station at the control grid of the converter valve. In fact, if this section of the receiver is working, then quite a few stations should be heard at this test point. It is only a matter of tuning them in on the receiver.

The next test position is at the plate of the converter valve. The signal should be much stronger here, due to the gain through that particular stage.

Misleading results

If a tuned tracer is being used it can also be tuned to the receiver's intermediate frequency (IF) and this too should be present at the converter plate. This check indicates that the local oscillator is functioning but this is something that an untuned tracer cannot do. If the oscillator is out of action, it will not be apparent until the probe is moved to the secondary of the first IF transformer where the signal will stop.

This could easily lead you to believe that the IF transformer was defective, whereas it could be the local oscillator that was at fault. For this reason, a thorough check of both circuit sections would be required.

As one can see, the untuned signal tracer has its drawbacks. But this little quirk only applies to superhets. Any regenerative or TRF receiver would be straightforward to test.

Moving on, the signal should be heard at the control grid of the IF amplifier valve and it should be louder again at the plate connection. The tracer should then be able to follow the signal through the second IF transformer to the detector.

As mentioned last month, a noticeable loss of volume through the first IF transformer is normal and is caused by the loading effect of the RF probe.

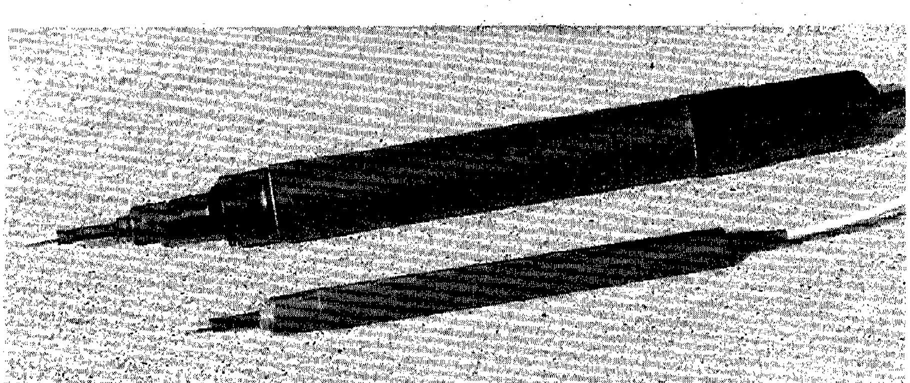
Once the signal has been traced to the detector, the tracer is switched to the Audio position. Remember that the audio signal first goes to the volume control and if this control is fully backed off it will go no further. In fact, the receiver's volume control is a convenient way of controlling tracer overload while probing the audio test points.

The valve control grids and plate connections are the obvious places to probe the audio stages. After checking a few working receivers it doesn't take long to get the feel of things and develop a systematic routine.

Identifying IF transformers

Provided you have an RF signal generator, a signal tracer can also be used to identify the frequency of an unknown IF transformer. To do this, you couple the signal generator to the primary winding of the IF transformer and the tracer to the secondary. The signal generator is then adjusted for maximum response from the tracer, at which point the frequency can be read directly from the generator's dial.

And that brings us to the end of this 3-part series on signal tracing. If you build the tracer described in this issue, just remember that it is a relatively simple test instrument and has its limitations. However, provided that it is used correctly, it is a very useful troubleshooting tool. **SC**



Old pen cases are ideal for making audio and RF probes. The unit at top uses a case from a "Texta" marking pen, while the unit at bottom is from an old ballpoint pen.