Speed Transistor Radio Service

HERE ARE TEN effective ways to help you locate transistor radio faults faster. They are usually obvious (though often unremembered) ideas that have been used and proved profitable. By Terry L. O'Connor.

1. Check Battery Voltage and Current.

Make this a regular procedure. Test receiver battery voltage with it turned ON. Check the current drain with the volume control turned down. The current drain may be checked by placing a milliammeter (most VOM's have a milliamp range) across the receiver's on/off switch terminals (set off). The average transistor radio may draw some 5 to 15 mA if it uses Class B output stages and somewhat more if the output stage is Class A.

Excessive current drain may be caused by shorted or leaky bypass capacitors, incorrect biasing of one or more transistors or by a defective transistor.

2. Find the Obvious Faults

Possibly more than anything else, transistor radios suffer from broken wires and terminals usually caused by the owner dropping the radio. Broken wiring may be quite difficult to analyse, either by signal tracing or voltage readings. A lot of time can be saved by eyesight checking. The use of an illuminated magnifier will help find broken conductors.

Try slightly flexing the printed circuit board to find tracks that are broken or intermittent. The small ¼ and 1/8 watt resistors are easily cracked and often go open circuit.

Heavy components, such as transformers, often pull away from the printed board and break their connecting leads in the process. Try moving each part from side to side gently and listen for a pop in the speaker. Use a jumper wire with needle point probes at each end to check if the printed track is open.

3. Don't worry about transistors or IC's.

Not at first anyway. It is just an advertising agency's dream — bad transistors or IC's *do* account for only 2 to 3% of all transistor radio defects — check other things first.

4. Don't rely on transistor gain checks.

Unless there is laboratory equipment available your chances of learning anything from a gain check are nil. The DC gain has almost nothing to do with the manner in which a transistor will perform in a practical RF circuit. There are too many other factors involved, such as input and output impedance or biasing.

5. Check transistors with an in-circuit transistor.

As the transistors used in portables usually are not plugged in we must have some exploratory method for checking that does not mean unsoldering the transistor. The quickest way is to use an in circuit transistor tester, available from many radio components retailers. However, if you do not own a transistor tester (in circuit variety) you can use a VOM instead.

With the radio off, place an ohmmeter (20,000 ohms per volt or better) across the Base and Collector of the transistor; and reverse the test leads. There should be more resistance in one direction than in the other. Do the same from Base to Emitter. Typical readings may be 3,000 ohms in one direction and 20 ohms in the other. This usually indicates that the transistor is good, as there is evidence of diode action.

A transistor can also short circuit from Collector to Emitter, without affecting the apparent diode action of the Base-Collector, Base-Emitter paths.

6. Signal Trace or Signal Substitute

You can use a signal generator for signal tracing. Start with the audio and successively trace backwards towards the front end. Never be tricked, though, by the low-impedance base circuit of a transistor. It will greatly attenuate the signal generator's output. Always inject the signal into the higher impedance collector circuit, if possible.

7. Never Be Tricked by Gain of Receiver.

A transistor radio may appear to be operating normally especially on strong local stations, but refuse to work when taken to a fringe area. If you work quite a lot on the same kind of radio, you may set up tests with an output meter and your signal generator to determine if the gain is up to scratch. If it is not, check the tuning and tracking (as detailed in Step 10). Use a substitute capacitor and *shunt* each and every bypass and coupling capacitor in the radio.

Capacitors and IF transformers can cause more weak radio faults than anything else. Transistors often short or open. Try to check IF's by retuning them. If they cannot be peaked, they

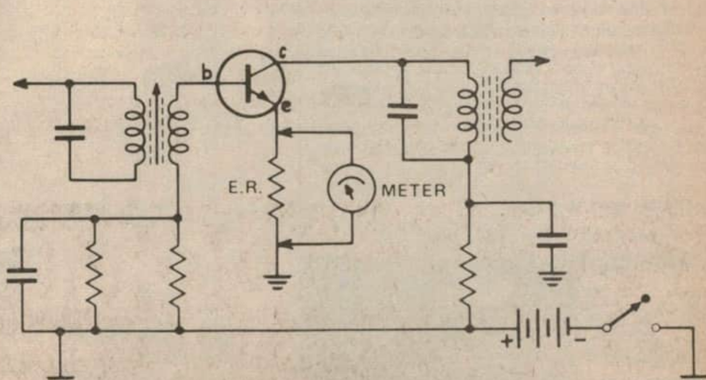

Fig.1. Base and collector of different polarity means transistor is cut off.

are faulty. If the tuning has to be changed drastically (unless the radio has been tampered with by someone), it is likely the IF transformer is defective and will have low gain, even though it may appear to peak at some position of the slug.

8. Check the Oscillator With Another Radio.

Position a working radio, tuned to a station at the high end of the band, near the radio with a suspected oscillator stage. Sweep the defective radio through its tuning range. At some point a whistle or squeal should be heard in the good radio if the defective radio's oscillator is operating. This whistle or squeal should be heard at approximately 455 KHz below the station tuned in on the good radio, if the good radio uses a 455 kHz IF. This allows you to know that the oscillator tuning circuit on the defective radio is operating.

It is also possible to use a peak-to-peak meter or a wide-band oscilloscope (even some narrow band scopes) to test oscillator action. Most radios should develop approximately 0.2 to 0.8 volt pp at the base of the oscillator transistor.

9. Take Accurate Voltage Readings and Reason Out the Fault.

More than half of the tough transistor radio faults may be diagnosed by voltage readings. Remember, with respect to the Emitter, the base is the *same* polarity as the Collector. If the collector is positive then the base will be positive; if it is negative the base will be negative, unless there is a fault. The bias voltage between the emitter and base is often 0.2 volt or less, but the base must have the same polarity as the collector. In a typical example: Base to Emitter 0.2 volts, Collector to Emitter 3.5 volts. Another example: Base to Emitter – 0.4 volt, Collector to Emitter –5.5 volts.

Now let us suppose that these readings were obtained:—

Base to Emitter	plus 0.2 volts
Collector to Emitter	minus 6 volts

It is obvious that the base and the collector are not of the same polarity. The transistor cannot operate; it is cut off. Figure 1 illustrates how this may be detected.

An open transistor can be found because there is no voltage drop across the emitter resistor. Of course, you shall always check the bias first, as incorrect bias will cause the emitter resistor voltage to drop to zero. Figure 2 illustrates how a leaky capacitor may cause this.

CAUTION: When taking bias readings, watch out, for some receivers will have practically no (or even reverse) DC bias on the converter stage, when it is also used as an oscillator. You may think that the transistor cannot operate, but it does so because of the AC bias developed by the oscillatory circuit.

10. Use a Noise Source to Align Oscillator and Antenna Circuits

Firstly align the IF's with an accurate signal generator to their specified frequency.

Second, use a Noise Generator (or a fluorescent lamp), and placing the radio close to the noise source, tune in to the low frequency end of the band and adjust the oscillator coil for maximum noise.

Third: now tune the radio to the high frequency end of the band and adjust the antenna trimmer for maximum noise.

If calibration is off somewhat, you can touch up the oscillator trimmer, then repeat the above steps.

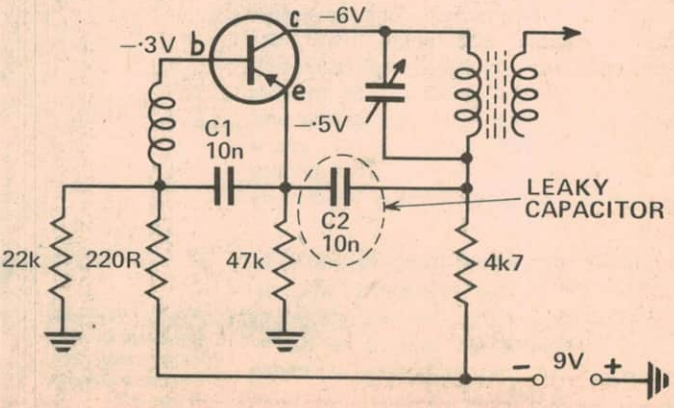

Fig.2. Leaky capacitor pulls emitter negative, cutting off transistor.