How is your Audio?

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We have all heard some pretty marginal audio when listening to both FM and SSB transmissions. Typical problems heard are low audio, no audio, hum, distortion, intermittent audio, noise, and variable amplitude or volume. Sometimes it is hard to differentiate poor audio from what is being produced by band conditions which impact signal strength and also may produce distortion. These latter problems generally sound different in VHF or UHF FM as opposed to HF SSB. Therefore for the purposes of this discussion, we will only consider VHF/UHF FM audio. Also, given the limited space available in the Rocking Chair, we will defer distortion from band related conditions to a future edition.

FM transceiver design has evolved into a pretty robust package. Semiconductor components generally do not decay in performance over time as was typically associated with their vacuum tube counterparts. A well-designed and aligned rig generally holds its specifications throughout its useable life, notwithstanding relatively infrequent component failures. VHF/UHF rigs are approaching a ‘throwaway’ status given the relative cost of repair versus replacement. Consumer.s Reports generally considers replacement to be the most effective method of dealing with a failure whenever repair costs exceed 60% of replacement costs. Therefore when a $150 rig fails, it might be time to replace it, assuming that there is not a simple solution for correcting the problem.

Often problems that develop over the life of the rig are indeed simple and are related to the microphone, power supply or antenna. Confirming the source of these problems can be easily determined by substitution of components, which involves little diagnostic cost to determine a repair strategy. Typical problems can be generally associated with poor connections, broken wires, bad switches, and positioning of antenna cables too close to power supply, audio cords, or control wiring.

For most of us, microphones are the most problematic component of a VHF/UHF transceiver. Periodic evaluation of microphone condition is a good practice and involves checking to see that the cord entering both the microphone housing and the plug is in good condition. Moving the microphone, wiggling the cord, or applying varying amounts of pressure on the push-to-talk switch should not produce noise or changes in audio output.

If the microphone proves to be defective, be careful with selecting its replacement. Microphones have different gain and impedance characteristics as well as plug configurations. Just because you can plug a microphone into a rig does not mean that it will work properly.

Generally the best alternative is to stick with the exact replacement for the original microphone or at least the same brand microphone, albeit Icom, Kenwood, Yaesu, Alinco, etc.

When we purchase a rig, one of our primary considerations is RF power output. However, to transfer the power out of the rig effectively, we must use a load or antenna that matches the magnitude of impedance of the rig and has an opposite component of reactance. In other words, if the antenna is too short, it exhibits capacitive reactance at the operating frequency which inhibits the ability to transfer power to the antenna. Under these conditions, we compensate by adding inductance to the load. That is the reason for using coils (inductive reactance) in HF mobile installations where the wavelengths are longer and it is not generally possible to build a resonant antenna without using impedance elements.

Transceivers today utilize transistorized RF output stages. These stages exhibit low output impedances and it is generally possible to connect an antenna with 50 ohm impedance directly across the output and achieve full-rated power output. However, if you do not place the proper load on the rig, then all of the power cannot be transferred out which causes it, instead, to be dissipated within the output circuit components. The heat associated with this dissipation is death for transistors and putting an improper load on a transistorized output will cause component failures in a matter of seconds.

Virtually all manufacturers today have compensating circuits to deal with this problem. As the SWR (standing wave ratio) goes up (indicative of a poor impedance match at the transceiver output), the voltage is dropped to the output stage (or the current may be limited depending upon the circuits used) to keep the dissipation of heat within safe levels.

Handheld VHF/UHF transceivers have ‘rubber duck’ antennas which are typically shorter than a ¼ wave antenna. These units employ the radio itself as part of the antenna system and may not use the characteristic antenna impedance of 50 ohms. Therefore, when replacing a handheld antenna, it is appropriate to check to see if you must use one specifically designed for your radio

Dropping output power on an FM radio (due to mismatched antenna impedance) should not affect the audio quality since the output stage operates in class C condition, which is a non-linear mode. If you were using AM (SSB), dropping voltage on the output stage could cause you to operate in a more non-linear region of the output transistor stage which will produce distortion.

However, lowering the FM output will not likely produce distortion but may cause your signal to be noisy into the repeater. Under these conditions audio is still clear, but there will be noticeable hiss or significant static on the incoming signal.

Power supplies can be the source of hum or indirectly produce distortion due to low (or high) output voltage. Hum is usually caused by a failure of a regulator or other filtering device. Regulators essentially smooth out the ripple left on the waveform after rectification. This ripple component has frequencies related to the incoming line voltage (60, 120, 180, etc. hertz) which find their way into the audio circuits of the transceiver. Battery chargers are typically not well filtered (they do not need to be for charging applications). Therefore if you use a battery charger on a handheld and concurrently try to transmit, you may have hum on your signal.

Higher frequency noises produced by alternators can also find their way into the audio of FM transceivers. I am sure that we have all heard generator whine on mobile signals although it is not as common as it once was.

Power supply regulators also determine the final output voltage and hold it relatively constant under varying load conditions. If the regulator fails, you will often have high voltage (greater than 15 volts under load) on the output of the power supply. High voltage can cause the audio circuits to operate outside of their optimum linearity. This type of distortion may not be noticed since it is relatively minor unless the voltage excursion is extreme. Using a rig outside of the specified operating voltages is asking for trouble and will usually shorten the life of the unit.

Power supply performance can also be inhibited by stray RF getting into the regulator. This is usually caused by poor shielding or high RF fields near the power supply which causes the regulator to function improperly. RF coupling into the supply can produce a variety of problems including hum, distortion, and high or low voltage. If you suspect this problem, keep the power supply and antenna leads as far away from one another as possible. Well-shielded supplies with a 110 volt grounded power plug should be less susceptible to this problem.

Detachable control heads on rigs are also susceptible to RF coupling. ICOM 706s are somewhat notorious for this problem, especially when operating on frequencies between 40 and 6 meters in a mobile installation. You may think that you are transmitting on 20 meters only to look down at the control display and see that the frequency has jumped to 6 meters. Usually this problem is addressed by using toriods on the control head cable and keeping the antenna lead and control lead as far away from one another as possible. If running mobile, a well-grounded installation without loops is essential. RF coupling into control cable is also possible at VHF and UHF frequencies but does not seem to be as common as it is in HF mobile installations.

There are other sources of audio distortion as well and I am sure that experienced operators can think of examples that I have missed. Despite being incomplete, I hope that this article has caused you to think about your installation and be mindful of the problems that may be lurking in your future. After all, Murphy is alive and well or at least so they say.