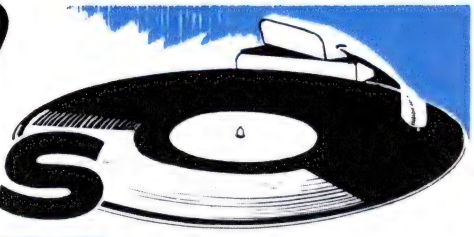
AUDIO TOPICS



ACOUSTIC FEEDBACK — OR WHY P.A. SYSTEMS HOWL!

To the novice audio enthusiast, one of the most puzzling and frustrating situations is to find himself with an amplifier system which is apparently reluctant to amplify — it just howls! Why do amplifiers behave this way?

The situation is a familiar one. The novice audio enthusiast builds an amplifier which performs perfectly, when fed with signal from a radio tuner or gramophone pickup. The sound is quite clean and the amplifier can be turned up to produce adequate sound level for the purpose required.

Thus encouraged, the enthusiast couples up a microphone, turns up the gain and prepares to say a few words by way of test. But, before he can as much as utter a syllable, the loudspeaker emits a whistle or a howl which stops only when the microphone gain control is turned well down toward zero.

A parallel situation occurs fairly frequently with tape recorders. The owner wants to record an item using a microphone, but with the loudspeaker operating so that he can hear the general balance of the sound as it goes on to the tape. But, once again, with any attempt to turn the microphone gain or the loudspeaker level control up far enough to hear things properly, the silence is punctuated by a disturbing howl!

Faced with such a situation, many enthusiasts have assumed that there is something amiss in the amplifier. They have measured voltages, pulled wiring around, perhaps replaced components that they didn't like the look of! Then, having achieved nothing by such measures, they have possibly concluded that the design is a poor one and that they should seek something better — something that doesn't howl when they go to use it!

In fact, the chances are that there was—or is—nothing wrong with the amplifier or with the tape recorder, as the case may be. The enthusiast is up against a basic problem which is very well known indeed to all those involved in sound reinforcement.

It is likely to occur in any situation where sound waves can reach a microphone from the loudspeaker system which it is feeding (through an amplifier, of course).

In an amplifier system, any slight sonic disturbance which reaches the microphone is picked up, amplified and radiated by the loudspeakers. If this **amplified** version of the original disturbance reaches the microphone, a situation arises where an amplifier and loudspeaker is able to energise the microphone which is feeding it — a situation which is defined by the term "acoustic feedback."

If the gain of the amplifier is high enough and/or the microphone is so placed in relation to the loudspeaker system that it can "hear" a substantial proportion of the sound coming from it, the effect of the feedback may be to produce a sustained howl or whistle. Irrespective of the sonic impulse which triggered it, the howl usually occurs at or near a particular frequency where the overall gain of the system is highest, as often as not due to a response peak in the microphone or loudspeaker system or both.

Therefore the problem, as set out in the beginning of this article, is not primarily one of circuit design, or of operating voltages or anything else of a like nature. It is the result of acoustic feedback between a loudspeaker and the microphone feeding it. It may cause a sustained howl, as described, or it may be sufficient only to cause an annoying "ringing" effect during amplified speech.

Using an ordinary inexpensive microphone, and an ordinary loudspeaker in an ordinary room, one should expect acoustic feedback sufficient to cause a sustained howl. In fact, it would be rather surprising if it did not occur!

If the reader should want to test a public address amplifier in a house, or listen to what is being recorded through a microphone, it is virtually essential to operate the loudspeaker and microphone in different rooms and to shut the intervening door(s). Even then, unless the walls, floor and ceiling are acoustically dead, it will still not be possible to turn the gain up too far before feedback again becomes evident.

Even in a larger space, such as in a public hall, acoustic feedback is an ever-present hazard and most people are familiar with amplifier systems which start ringing or howling at the most inopportune moments, when someone helpfully moves the microphone this way or that by a few feet!

Beginners, having come to appreciate the broad cause of the problem, often imagine — or are led to believe — that it is aggravated by the "sensitivity" of various sections of the system; the microphone, the amplifier, or the loudspeaker. The theory here seems to be that if the sensitivity of one, typically the microphone, is reduced and the loss made up in the other sections, the system as a whole will be less prone to the problem.

This is a fallacy. It is the overall gain of the system, including the acoustic link between the speaker and microphone, which determines the point at which it "spills over."

Which is not the same as saying that one system cannot be better than another in regard to this problem. In fact, there can be a very considerable difference and people engaged professionally in sound reinforcement are able to take a number of precautions to minimise the trouble.

One is to use a microphone which is as free as possible from peaks in the frequency response — the kind of peaks around which acoustic feedback will most readily develop into troublesome proportions. With a flat overall response, the reinforcement available over the spectrum generally will tend to be greater before feedback occurs at any one frequency.

Specialists may also select a microphone with directional qualities so that it will pick up sound from the direction of the performer but be less sensitive to sound arriving from the direction of the loudspeakers.

Similarly, professional sound engineers will normally prefer loudspeaker systems which are free from obvious response peaks and which have directional qualities, the sound being radiated towards the audience and away from the microphone position.

In the room of a house, directional properties of microphone and loudspeaker don't help very much because amplified sound, bounced at random from the walls, floor and ceiling, energises the microphone anyway.

However, this brief article is not intended to be one about the installation and operation of sound reinforcement systems. This would demand far more space than is available here. Its purpose has been purely to pose and answer the question as to why amplifiers behave in a particular way.

So, next time you try to operate a microphone and a loudspeaker in the same room, connected to the same amplifier, you will know why the system howls. There's nothing wrong with the circuit or the operating voltages. It's just that it's shouting in its own electronic ear. Isolate one from the other and the trouble should disappear!