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SYSTEMS

White Paper

Effects of Microphone Splitters and Long Mic Level Runs

There are many audio applications that require that a microphone output to be fed to multiple locations. The most typical example is a PA application in which a microphone is fed to the front of house position, a monitor position, a recording position and broadcast link. In order to isolate the microphone signal from any possible ground loops, a splitter transformer has traditionally been used. While this method is effective in preventing ground loop problems, it does have numerous degrading effects on audio quality.

Various types of microphones will be affected in different ways by a splitter system. The most noticeable degradation occurs with dynamic microphones, although all other types will suffer degradation to some degree. To understand these phenomena let's examine a typical scenario: A dynamic microphone split through a transformer three ways with a long total cable length before and after the split.

A dynamic microphone is a motor/generator in which acoustic sound pressure moves a diaphragm (the motor) that drives the voice coil (the generator) through a magnetic field. This results in a voltage output signal. The ability of this motor/generator to faithfully translate the acoustic wave to an electric output signal is highly dependent upon the moving mass of the entire chain. The most ideal circumstances occur when there is virtually no load on the generator output. Any load that may be put on the generator has the same effect on any kind of electrical generator. It essentially "puts on the brakes." In other words the generator will reflect the load back to the motor giving it a greater resistance to movement. This reduces the sensitivity of the microphone and changes its frequency and phase response. Clearly, loading is a serious issue. While the spitter transformer eliminates ground loop problems, it does not isolate the microphone from loading effects, in fact it multiplies the loading problems.

The typical microphone preamplifier has an input impedance of 1500Ω. Using the law of parallel impedances, when there are three preamplifiers the actual load on the microphone is 500Ω. The typical source impedance of a microphone is 150Ω. If this were a situation of just impedances (no inductance or capacitance) there would still be a voltage loss from the microphone that would reduce the output by over 1.7dB in the direct output of the splitter and 3.4dB in a transformer output. Because there is a constant noise floor, there will be a reduction of system noise performance.

The capacitance of the cable run, together with input impedance, forms a low pass filter. As the cable run gets longer the capacitance increases, thus lowering the cut-off frequency.

Inductance is introduced by the transformer in the microphone itself and the mic splitter. A mathematical model could be made to predict the exact effects for a given microphone, splitter and preamplifiers, but it is sufficient to say that the frequency response will be changed. The effect could be anything from a peaked response, a dip, a low pass or any combination.

The 'braking effect' on the capsule also has an audible effect. The ability of the capsule to react to sudden changes or complex waveforms (e.g.- transients) will be diminished. Even its polar pattern can also be affected.

Condenser microphones, while less affected by loading, are also degraded in performance. A potential problem that is unique to condenser microphones is that any line carrying phantom power becomes a microphone itself. A longer line (usually the run from the front of house gets the direct run for the microphone) has a greater possibility of being handled or stepped on, causing signal to appear at the output.

The audible effects of loading the microphone are loss of microphone output level, changes in frequency, phase and transient response. These sonic effects are the sum total of all the electrical (impedance, capacitance, inductive) and physical phenomena introduced by loading a microphone. While many engineers fight to have the direct output of the splitter, it is important to note that the

microphone itself is affected. The direct output will typically sound better (and hotter) than the transformer outputs, but the direct output will still be affected by the additional loading.

The solution to these problems is feeding the output of the microphone into a preamplifier located as close as possible to the microphone. There are products on the market called active splitters that help solve the loading problems, but introduce new problems. They are set to have a fixed amount of gain. That means that they must have sufficient headroom for any anticipated input level plus extra for the unanticipated levels. This, in turn, means that the output of the active splitters has to be put through another preamplifier causing more system noise and degradation of the signal. The solution to that problem is to have an engineer tweaking the levels during a show. Or to have a remote controlled preamp. The Aphex Model 1788 is the only remote controlled preamplifier with the feature set and audio quality to eliminate the problems of loading and provide the flexibility, ease of use, and performance that professionals demand.