USING LINE TRANSFORMERS

Due to their apparent simplicity, 70-volt and 25-voltlines have become the standard wiring method in sound systems. Superficially, it is assumed that a line load can be matched to an amplifier by merely adding the wattage rating of the primary taps on 70-volt line transformers. Using this reasoning, if 20 transformers tapped at 5 watts each are used, a total of 100 watts is thought to be the load. Therefore, a 100-watt power amplifier is selected to equal the line requirement. While few experienced sound installers would fall into this trap and burn up their amplifiers, other load considerations are often overlooked with disastrous consequences.

Contrary to prevailing impressions, the "simple" transformer is one of the most complex electronic components. It is completely understood by fewer engineers than almost any other part of circuitry. However, there are several basic characteristics, which can be appreciated and will assist practitioners in their system designs.

First, the transfer of current and voltage between the primary and secondary windings is accomplished at the expense of losses, which can amount up to 30 percent of the power watts. For example, a 10-watt transformer with a 1.5 dB "insertion loss" would require over 14 watts of power at the primary to deliver 10 watts at the speaker. To confuse matters further, some manufacturers adjust their transformer windings internally to compensate for this insertion loss so that the stated primary wattage reflects the additional impedance required by the amplifier. Thus, it is necessary to determine (1) the true amount of insertion losses and (2) whether the windings are compensated or uncompensated.

Second, the majority of smaller line transformers are reactive at the lower and higher frequencies. This means that the impedance of the transformer will fall, often dramatically, as the program material being fed to the speakers moves either side of the 1000 Hz reference frequency conventionally used by manufacturers. Ohm's Law shows that the power required rises as the impedance decreases ($P = E^2/Z$; e.g., 5000 volts^2/500 Ohms – 10 Watts, but 5000 volts^2/250 ohms = 20 watts).

Third, the inductive and capacitive reactance of line transformers may significantly affect the frequency response of the loudspeaker. This may be particularly noticeable in the bass frequency ranges. The alternatives are to "buy more iron" by purchasing a larger transformer or to tap a smaller line transformer at its lower wattage ratings (a 10 watt tapped at 2.5 watts). Great caution should be exercised before trying to compensate for the poor low frequency response electronically by raising the bass control of the amplifier.

When using transformers in 70-volt and 25-volt lines, it is essential to consider these characteristics and make proper allowances for their effects during the system design. In most instances, the added cost of higher quality components is small relative to the benefits.

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