AUDIO TRANSFORMERS

FROM

POWER TRANSFORMERS

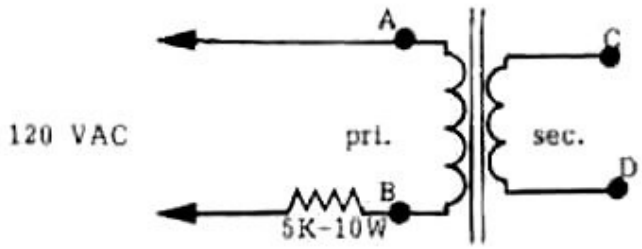
Audio transformers are expensive, and sometimes impossible to find. I have made a discovery that could possibly save Technicians and Engineers thousands of dollars. By actual experience, I have found that **most** cheap power transformers will work perfectly well under even the most critical audio expectations. Due to the new and better materials used in the production of transformers these days, and the automation process, these transformers usually perform very well if the impedance ratio is correct. Any mis-match in impedance can make the best equipment sound like junk! If we first match the impedance requirements in our cheap transformers, we can then do a critical proof of performance test and see if the transformer in question will actually do the job we expect it to do. So then, I am about to show you the easiest way I know to find the IMPEDANCE RATIO.

First of all, IMPEDANCE RATIO ALWAYS REMAINS THE SAME regardless of frequency and power fed through the transformer. The IMPEDANCE RATIO is equal to VOLTAGE RATIO SQUARED.

TO FIND VOLTAGE RATIO, check the transformer with an ohm meter, and find the winding with the highest resistance. We will call this the primary. It may not ACTUALLY be the primary, but for our purposes it will help us obtain our needed information quickly. In series with this winding, put a 10 watt, 5000 ohm resistor and connect the winding to the 120 volt AC power. Now measure the AC Voltage present across the primary. Next, measure the individual voltages across all other windings. This will give the VOLTAGE RATIO. If, for example, the primary voltage measures 100 volts and the secondary measures 10 volts, the voltage ratio is 100 divided by 10, or 10 to 1. The IMPEDANCE RATIO will be this figure SQUARED or 100 to 1. This means that our transformer will reflect 1/100th of whatever impedance is put across the primary, or if reversed, 100 times whatever impedance is fed into the secondary will be reflected into the primary. Thus, if 6 ohms were loaded onto the secondary, 600 ohms would reflect into the primary. By observing the IMPEDANCE RATIO and loading accordingly, it is amazing how well simple power transformers perform at audio frequencies from below to well beyond the range of human hearing. Many 400 Hz. power transformers can be tested this way and converted to high class audio work with no problems whatever.

It is amazing to me when I keep coming across Engineers that do not know that a transformer made to match 600 ohms to 30,000 ohms, will also match 60 ohms to 3000 ohms! The IMPEDANCE RATIO is the same. Now, there are some practical limitations to this, mainly the ability of the windings to carry the currents demanded. If there is too much DC resistance in a winding it may not be able to handle the amperage demands, or if the wire size in a winding is too small, it can be easily burnt out! These things should be taken into consideration before attempting to operate the circuit. With this in mind, I can say that many audio transformer demands can be met by obtaining a transformer at the local Electric Shop. Consultants have at times tackled their emergency repairs this way and no one has been the wiser. The down time saved and the results have been worth every cent paid for their work.

TEST SET UP



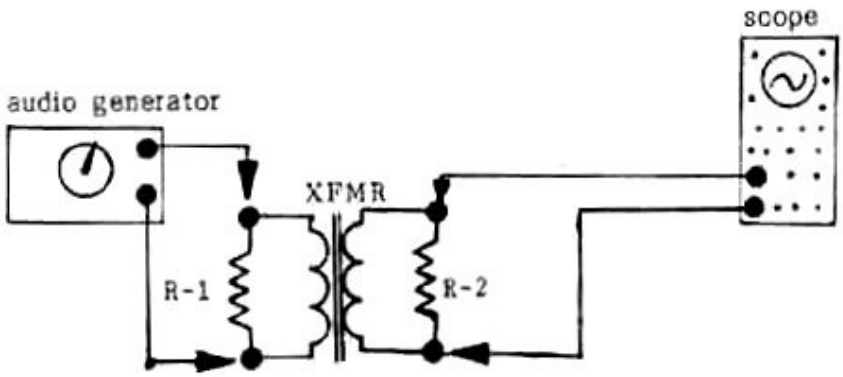
Voltage is measured on primary from point "A" to point "B"
Secondary voltage is measured from point "C" to point "D"

IMPEDANCE RATIO is voltage Ratio SQUARED

Some commonly found power transformers are listed below together with their impedance ratios. These all use 120 volt primaries. The transformers all are available with "center taps" which when used alter the ratios according to the above formulas.

1. 6 volts - 400:1 ratio
2. 10 volts - 144:1 ratio
3. 12 volts - 100:1 ratio
4. 18 volts - 44.5:1 ratio
5. 24 volts - 25:1 ratio
6. 32 volts - 14:1 ratio
7. 50 volts - 5.76:1 ratio
8. 100 volts - 1.44:1 ratio
9. 120 volts - 1:1 ratio
10. 240 volts - 1:4 ratio

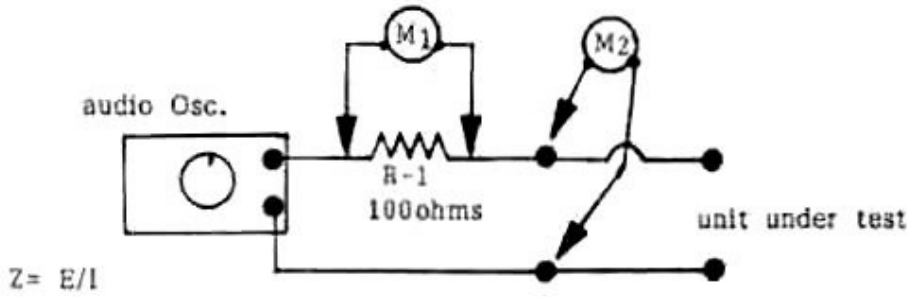
SIMPLE TRANSFORMER TEST



In order to perform a simple audio test on the transformer in question, the test equipment shown can be hooked up to the transformer. The transformer is loaded on both primary and secondary with the desired impedance through R-1 and R-2. These are carbon (non-inductive) resistors of 1/2 watt rating such as found in any technician's resistor box. The generator is turned on and adjusted to the lowest desired audio frequency of test, while the output of the transformer is viewed on the scope. The generator is swept through the entire audio spectrum while the waveform is viewed for distortion or non-linearity. A good transformer will remain nearly flat in response from less than 20 Hz. to 20,000 Hz. Of course, the linearity of the audio generator should be tested first. If it is off, this should be noted and subtracted from the transformer performance. If the transformer passes this basic test, it is usually good enough to use in your equipment. If you still are not sure, you can make a full test using a Distortion Analyzer such as the B&W 400 or a Spectrum Analyzer. If this is done, proper resistive pads should be constructed first to achieve a perfect impedance match with the Audio Generator and the Analyzer used. You will find, as I have, that many power transformers work very well at audio frequencies. The object of this is to open the door of possibilities for those not able to find an exact replacement for an audio transformer. A lot of fine equipment has been thrown in the junk pile because someone didn't know the way around a problem. Hopefully, this information will be of use to someone else, as it has been to me.

IMPEDANCE MEASUREMENT

To measure the impedance of a speaker or other audio device, use the following test rig. The audio oscillator must be capable of providing enough output to hold a steady current through R-1 throughout the test.



R-1 is not used if M-1 is an audio frequency AMP METER. R-1 is used in order to calculate amperage flow through the tested device by dividing the Reading of this meter by the value of "R" (100 ohms). With the current held steady at all frequencies of test (usually 20-20,000 Hz.) the impedance of the device under test may be calculated at each frequency by means of the formula: Z= E/I. M-1 gives the "I" and M-2 the "E" in the formula.

It is common to make this test at one frequency only. This may be either 400 Hz. or 1000 Hz. With this test rig, it is possible to easily check the audio impedance of any device.

It is important to use a HIGH IMPEDANCE METER at both of the Meter locations shown or else your meter will load the circuit and give false results.

Be sure to hold the current steady throughout the duration of the tests. Record the voltage (M-2) and frequency each time the test oscillator is changed. A chart or graph may be made showing the impedance of the tested device at each and every audio frequency.

There are various other methods of measuring impedances at audio frequencies, but I believe this is the most straight forward giving acceptable results if done as shown.