RATING POWER TRANSFORMERS

By DARWIN H. HARRIS

USUALLY, the most important rating of a power transformer is the maximum B plus current it can supply. Here is a simple yet reliable method for measuring that current. It is especially useful for checking surplus transformers, which are often rated optimistically, to say the least; or for checking those beautiful hermetically sealed military-surplus jobs which most of us find irresistible, and then wonder what to do with, because no one seems to know their specifications.

The first step is to measure the resistance of the high-voltage secondary winding. (One side of a center-tapped winding is enough, but it's a good idea to check both sides to make sure you don't have an open winding.) Then, with all secondaries unloaded, connect the primary across the power line and measure the voltage (be careful!) across the half-secondary. If the transformer is already installed and wired into a piece of equipment, remove all the tubes, and take resistance and voltage readings at one of the plate pins of the rectifier socket.

Divide the open-circuit voltage by the measured resistance. This gives a figure (called here the V/O ratio) which is the formula for current; however as used in this case, it is meaningless. (If we wished to apply Ohm's law, we would use V/Z.) To get the figure we want, multiply the V/O ratio by the factor 25 for a capacitor-input filter, or by the factor 35 for a choke-input filter. The answer is the current capacity in milliamperes.

The principle is simple: The resistance of the secondary is a function of the size and length of the wire in its winding, while the voltage is a function of the length of wire alone. The V/O ratio is then a function of the size of wire only, and this is a measure of the allowable current. Of course, a number of other factors contribute to the development of heat, which is the basic limitation to the current drawn; all such characteristics that are a part of the transformer are assumed to be of average value, that is, their net effect is considered constant.

This would not be true over a wide range of transformer sizes. The factors given are known to apply to small and medium sizes, up to about 200-ma ratings. The author has had little experience with larger units, and the application of this method in that range is uncertain.

It is important to take account of the difference in load resulting from the type of filter input used, by employing the appropriate factor.

Here are three examples showing how to use this rating method:

1. A small replacement type transformer is rated "700 volts c.t. at 50 ma." The secondary measured 650 ohms and 840 volts open-circuit. The V/O ratio is 1.3; 25 times 1.3 equals 33 ma for capacitor input, and 35 times 1.3 equals 46 ma for choke input. It appears that the advertised rating applies only to choke input, and the high secondary voltage confirms this. The extrapolated regulation line would intersect zero current at roughly 560 volts d.c. (half secondary unloaded r.m.s. voltage times 1.33) and assuming purposely poor regulation of 2,000 ohms, voltage at the filter output with a 50-ma load would be 460 volts (560–2,000 × .05) approximately. With choke input, assuming 1,000 ohms regulation and a 50-ma load, the corresponding voltages would be about 380 and 330 respectively.

2. A husky-looking good-quality surplus transformer was rated by the seller at 125 ma. This was wired into a circuit without checking the current rating (before this method of checking was adopted), and the transformer ran very hot when operated at the supposedly conservative load of 50 ma. Later measurements of the secondary gave 550 ohms and 550 volts. The V/O ratio is 1.0, and ratings become 25 ma and 35 ma for the respective inputs. This is an extreme example of misrating; usually surplus transformers turn out close to the listed current figure.

3. The power transformer in my oscilloscope was running hot and I was interested in comparing the actual current with the V/O rating. The secondary readings were 1,300 ohms and 850 volts. This gave a V/O ratio of 0.65. The filter is capacitor input, so the rating is 17 ma. The measured current also showed exactly 17 ma—a rather surprising agreement. The overheating was due to inadequate ventilation. This was remedied by punching ventilating holes in the case and by covering the bright aluminum interior with flat black paint, resulting in a markedly cooler ambient temperature. This system may not be foolproof, but it's a step in the right direction. END