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Kenwood TS-520/TS-820 IP Meter current and voltage test and disproving the myth that the final amplifier cathode resistors acting as fuses to protect the final amplifier and that the final amplifier cathode resistors will blow if the final amplifier is improperly tuned.

I performed some IP Meter voltage and current tests using a actual TS-520/TS-820 meter and the actual IP meter circuit. Power source to provide the final amplifier cathode voltage was provided by a Heathkit IP-27 LV regulated variable output power supply.

I used two new 10 ohm 1/2W resistors connected in parallel that measured 4.9 ohms.

I used a new 3.3K meter multiplier resistor that measured 3.27K.

The actual Kenwood TS-520/TS-820 meter's internal resistance was measured and found to be 570 ohms. Two separate methods were used to determine the meter's internal resistance:

1. Direct Ohm meter measurement
2. Total series resistance consisting of the 3.27K meter multiplier in series with the meter to ground.

Method 1 used a DMM set to 200 ohms. The meter probes resistance was obtained and subtracted from the direct meter resistance measurement to ensure as accurate as possible resistance measurement.

Method 2 measured the total series resistance of the meter and the 3.27K meter multiplier to ground and found to be 3.840K. I then subtracted 3.27K from 3.840K resulting in the meter's internal resistance to be 570 ohms.

The IP meter circuit, including the meter, was built just as shown in the 520 and 820 final amplifier cathode schematic circuit.

The IP-27 power source was connected to the cathode resistors as though the IP-27 was the final amplifier cathodes.

The IP-27 was powered up and the voltage adjusted to produce the following "IP" meter indications. The "current through the meter" values were calculated using Ohms Law formula and the actual voltages listed for each meter's current level. The Ohms Law formula used is:

I = E / R

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Cathode voltage at 60ma (actual current is 60.8ma)
+0.298VDC
Meter voltage at 60ma
+0.046VDC
Current through meter at 60ma indicated is
80.7ua

Cathode voltage at 100ma (actual current is 103ma)
+0.508VDC
Meter voltage at 100ma
+0.076VDC
Current through meter at 100ma indicated is
133.3ua

Cathode voltage at 200ma (actual current is 209ma)
+1.028VDC
Meter voltage at 200ma
+0.152VDC
Current through meter at 200ma indicated is
266ua

Cathode voltage at 300ma (actual current is 317ma)
+1.554VDC
Meter voltage at 300ma
+0.235VDC
Current through meter at 300ma indicated is
412ua

Cathode voltage at 350ma (actual current is 367ma)
+1.803VDC
Meter voltage at 350ma
+0.274VDC
Current through meter at 350ma indicated is:
480ua

The meter itself is not very accurate. While a low current level of 60ma appears to be correct, higher actual current levels were found to be between as high as 4.5% to 5.8% above the IP meter indications.

As to the myth that the cathode resistors act as fuses to protect the final tubes and that the final amp cathode resistors will blow when the final amplifier is improperly tuned, at no time during any of the above measurements did the two cathode 10 ohm resistor feel warm to the touch nor did the cathode resistors "blow" at FS 350ma indicated IP current. This proves that the final amp cathode resistors are NOT fuses to protect the final amplifier and that the cathode resistors do NOT blow if improper final amp tuning occurs. Resistors do not react the same way fuses do. Any belief that the cathode resistors are acting as fuses to protect the final tube is pure nonsense.

The total power rating of the cathode resistors used in these voltage and current test is 1 watt (2 x 1/2W in parallel = 1W).

73
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