RCA RADIOTRON COMPANY, INC.
HARRISON NEW JERSEY

R. J. Cunningham Inc.
415 So. Fifth St., Harrison, N. J.

UNIFIED SALES--ENGINEERING SERVICE
TO
EQUIPMENT MANUFACTURERS

MEADE BURNET, Manager
CAMDEN, NEW JERSEY

APPLICATION NOTE No. 38

April 25, 1934

# APPLICATION NOTE
# ON
# A SIMPLE METHOD FOR CONVERTING PENTODE CHARACTERISTICS

Although vacuum tubes are generally operated with the "typical" electrode voltages recommended by the manufacturer, special circumstances sometimes make it necessary to use tubes at other voltages. In such cases, new operating conditions which will give the best results must be obtained. The new conditions can be readily obtained for pentodes by means of the accompanying chart.

If, for example, the 89 with pentode connection is to be used with a plate voltage of 200 volts, what will be the correct operating conditions? The "typical" values given by the manufacturers are for plate voltages of 250, 180, 135, and 100 volts, none of which quite fits the case. The ratio of the new plate voltage to a known voltage (250 volts) is 200 ÷ 250 = 0.8. This is called the voltage conversion factor and is identified as $F_e$. Multiplying all voltages by $F_e$ gives the new voltages shown in Table I.

By means of the accompanying curves and the voltage conversion factor ($F_e$), the new values of the screen and the control grid voltage, the plate and the screen current, mutual conductance, power output, and load resistance can readily be determined. The factors $F_i$, $F_p$, $F_r$ and $F_{gm}$ are the ordinates read from the curves at the abscissa value of 0.8. The following table gives the calculated values for a plate voltage of 200 volts.

TABLE I

| | 250-Volt Condition | Factor | 200-Volt Condition |
|---|---|---|---|
| Plate Volts | 250 | $F_e$ = 0.80 | 200 |
| Screen Volts | 250 | $F_e$ = 0.80 | 200 |
| Control Grid Volts | -25 | $F_e$ = 0.80 | -20 |
| Plate Milliamperes | 32 | $F_i$ = 0.71 | 22.7 |
| Screen Milliamperes | 5.5 | $F_i$ = 0.71 | 3.9 |
| Mutual Conductance (Micromhos) | 1800 | $F_{gm}$ = 0.90 | 1620 |
| Load Resistance (Ohms) | 6750 | $F_r$ = 1.12 | 7550 |
| Power Output (Watts) | 3.4 | $F_p$ = 0.58 | 1.98 |

In the same manner, operating conditions can be determined for other voltage ratios. This method is particularly adaptable to output pentodes where the plate and the screen current are fairly high and vary according to the 3/2 power law, and where the voltage conversion factor is not over two to three or less than one-half to one-third.

# CONVERSION FACTORS FOR PENTODES

These curves are especially useful for power pentodes in calculating with fair accuracy from published operating conditions, other operating conditions to meet special plate voltage requirements. First, determine the ratio of the new plate voltage to the published plate voltage nearest the desired new conditions. This ratio, the Voltage Conversion Factor ($F_e$), is then used to determine the new screen and the new control grid voltage. It is also used to determine from the curves, factors for the other new operating conditions.