Microphone pre-amp using a THAT 120 transistor array

The high-quality microphone preamp shown in the accompanying schematic uses a THAT120 with two transistors paralleled on each half of the differential input. Q1A and Q1B is a general purpose matched pair configured as current sources, which bias the differential input.

R_G is the equivalent resistance derived from the values of R12-16 and the position of the elements of SW2. R17 and R18 equal 2.67 kΩ. The open loop gain of each half of the differential input is

$$A_{OL} = \frac{2.67\,k\Omega}{\dfrac{R_G}{2} + r_e}$$

At the highest gain setting, $R_G = 10\,\Omega$, and

$$A_{OL} = \frac{2.67\ k\Omega}{5\,\Omega + 30\,\Omega} = 76$$

This gain allows the noise of U2A and U2B to be swamped by that of the differential pair, which results in about $0.94nV / \sqrt{Hz}$ when the gain is programmed to 1000. U2A and U2B provide a level shift and negative feedback to program the closed loop gain through R23 and R24. The resulting gain equation is:
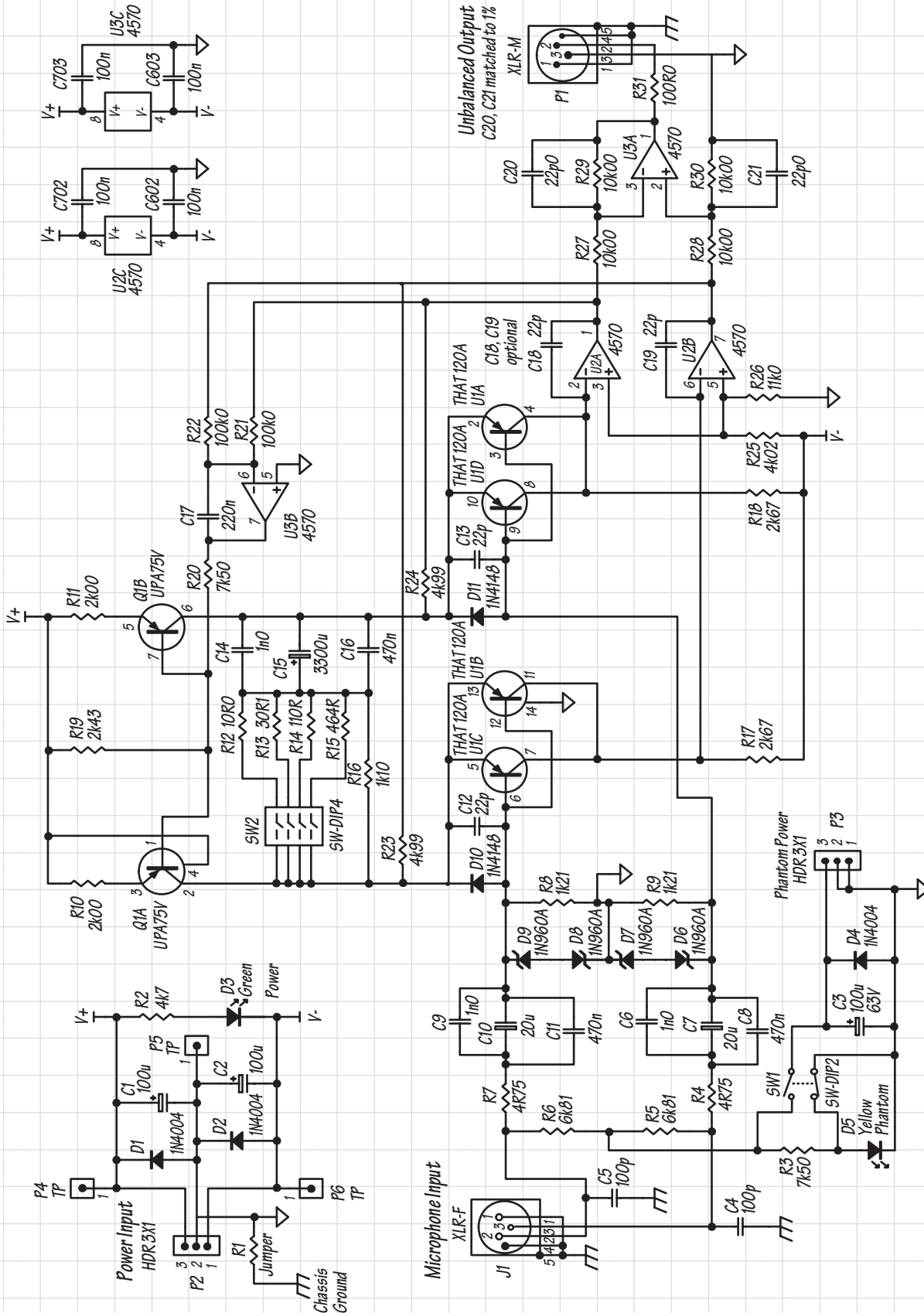
$$Gain = \frac{2 \times 4.99\,k\Omega + R_G}{R_G}\ , or\ Gain = 1 + \frac{2 \times 4.99\,k\Omega}{R_G}$$

Feeding the signal back in this manner eliminates the effect of r_e, and makes the gain purely dependent on external, passive components.

U3B samples the common mode voltage at the input to U3A, and servos the current sources formed by Q1A and Q1B to center the ac signals at the outputs of U2A and U2B around zero volts. Filtering keeps this servo from nulling out the actual signal or causing distortion. This maximizes the amplifier's internal headroom.

U3A is a differential amplifier that converts the balanced signal at the output of U2A and U2B into an unbalanced signal.

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Mic pre-amp circuit with THAT 120 transistor array

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