

Fig. 7. Amplifier with characteristic input and output impedances.

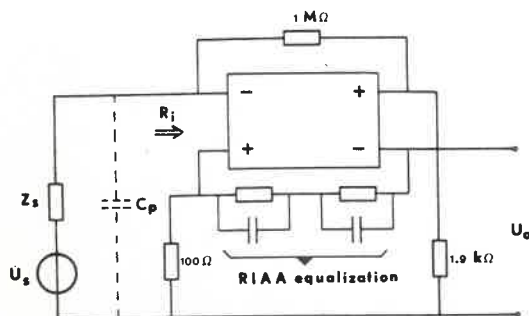


Fig. 8. RIAA equalization amplifier with "electronically cooled" input resistance of 50 kΩ.

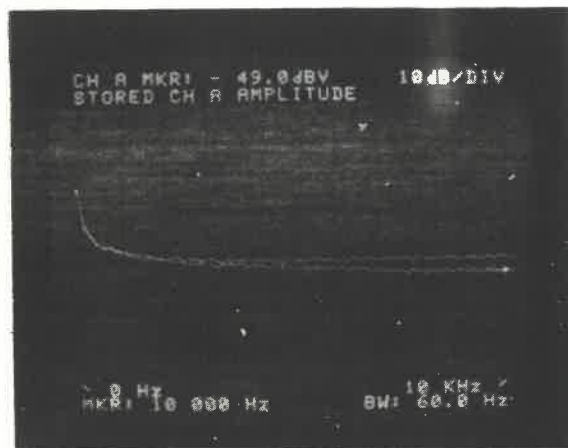


Fig. 9. Measurement of the difference of noise output spectra for active damping (lower trace) and passive damping (upper trace.)

The input and output impedances are equal to 600 Ω within 10 percent up to about 200 kHz.

Finally, configuration 8 can be used for similar purposes though characteristic matching at both sides is impossible without using series resistances [5]. The configuration has been proposed for realizing an RIAA correction amplifier for magnetic phono cartridges, where the damping of the cartridge-cable resonance is obtained by a feedback resistor, to optimize noise performance [7], [9]. Fig. 8 shows the basic circuit diagram, where an accurate electronically cooled input resistance of 50 kΩ is realized with the aid of a 1-MΩ feedback resistor. It should be noted that since the load impedance influences the input impedance a voltage buffer is required for proper operation [8]. The difference of the measured output noise spectra in the cases of the active damping of Fig. 8 and of the conventional passive damping with a 50-kΩ resistor is illustrated by Fig. 9. At high frequencies the output noise reduces by about 5 dB in the case of active damping.

The rather poor power efficiency of the circuit may be a disadvantage in certain applications. Though the op amp itself may operate in class B, the quiescent currents in the zener diodes have to be sufficiently large to supply the maximum required signal current to the load. The complete circuit can therefore be considered to operate in class A.

## V. CONCLUSIONS

A simple technique has been presented for realizing an op amp with a floating output port by making use of a standard op amp and a current-source power supply. An example of an implementation has been described in some detail. The number of realizable fundamentally different negative-feedback circuits is extended through this technique by seven configurations. At least five of these have a practical significance which has been illustrated by representative application examples and documented by some measurement results.

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## Comments on "An Approximation of a Transfer Function by One with Lower $Q$ 's"

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In the above paper,<sup>1</sup> Filanovsky and Stromsmoe have presented a generalization of a method for approximating a given transfer function by one with lower pole- $Q$ 's. According to this technique, hereafter referred to as partial approximation (PA), the second-order subfunctions with the highest pole- $Q$ 's of the original transfer function are replaced by a more complicated rational subfunction whose pole- $Q$ 's are lower than a prescribed value  $Q_{\max}$ . On the other hand, a different approach, hereafter

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<sup>1</sup>I. M. Filanovsky and K. A. Stromsmoe, "An approximation of a transfer function by one with lower  $Q$ 's," *IEEE Trans. Circuits Syst.*, vol. CAS-27, pp. 651-654, July 1980.