(NASA-CR-140850) GANGED SERIES POTENTIOMETER MIXER NETWORKS (Ohio Univ.) 5 p HC $3.25 CSCL 09A

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# GANGED SERIES POTENTIOMETER MIXER NETWORKS

A ganged potentiometer with a single linear section and two opposite log tapered sections is rediscovered for providing a simple series resistor control element for mixing of audio frequency signals. An application is for bench evaluation of detector signal to noise ratios with Omega receivers.

by

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## PREFACE

A brief Project Note submitted for publication in the Journal of the Audio Engineering Society and originally intended for use in audio systems, also has application as a laboratory measurement method for Omega or VLF receiver bench testing. A preprint of the paper is reproduced here for the benefit of those concerned with evaluation of Omega receiver front-end systems. The device consists of a unique combination of linear and log tapered potentiometers which provide a simple series resistor attenuator for mixing of low frequency signals.

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## I. INTRODUCTION

During the course of looking for a rapid means of making signal to noise ratio measurements with a signal source and noise generator, some surplus 3 gang potentiometers were found which have the interesting property of a constant 10k ohm or greater series impedance for all rotations of the shaft. The device provides a versatile passive mixer circuit when used with most signal sources and can be used as a variable series input summing resistor in operational amplifier networks. While mixer networks are very well known art, the particular potentiometer "rediscovered" here may not be so well known and it can provide simple solutions to mixing problems with a single control knob.

## II. CIRCUIT

A diagram of the 3 gang potentiometer circuit is illustrated in Figure 1. One section consists of a linear 10k ohm pot. An end section is a combination of a linear variable resistor for the first half of rotation to 5k ohms and a clockwise log taper to 1 megohm for the last half of rotation. The other end section is reversed to provide a counterclockwise log taper from 1 meg to 5k for the first half of rotation and a 5k linear pot for the last half of rotation.

The mechanical arrangement of the particular potentiometer used is illustrated in Figure 2. It should be possible to provide a similar ganged pot from the snap-on variable resistor sections available from other potentiometer manufacturers.

## III. OPERATION

The net result of using this potentiometer is a variable series resistor element as shown in Figure 3. The resistance from A to C is constant at 10k ohms for the first half of rotation, 0 to 50%, and the resistance from B to C is constant at 10k ohms for the last half of rotation from 50% to 100%. Correspondingly, the resistance B to C decreases exponentially to 10k ohms for the first half of rotation and the resistance A to C increases exponentially for the last half of rotation. Thus a two input series mixing device to a single output can provide a range of attenuation of ±40db with a 0db center position and a single control knob.

## IV. USES

Figure 4 illustrates some alternate ways of using the network as a variable series element with operational amplifiers. In some cases the operational amplifier may not be necessary if the output of the mixer is used only for relative level adjustments such as in blending for tape recording from audio signal sources. The single output mixer circuit of

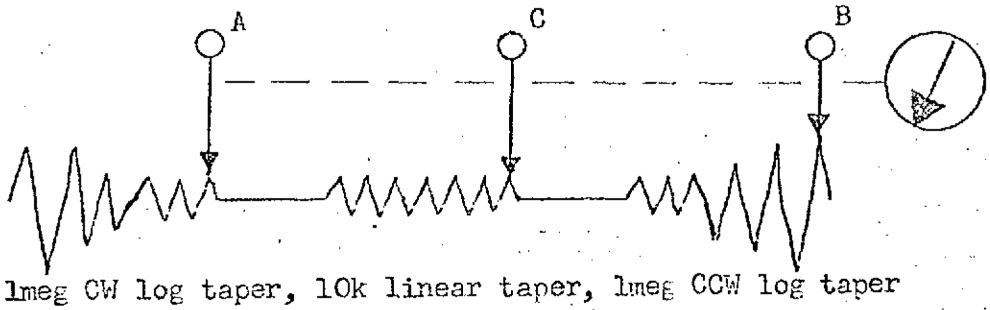


Figure 1. Circuit of Potentiometer.

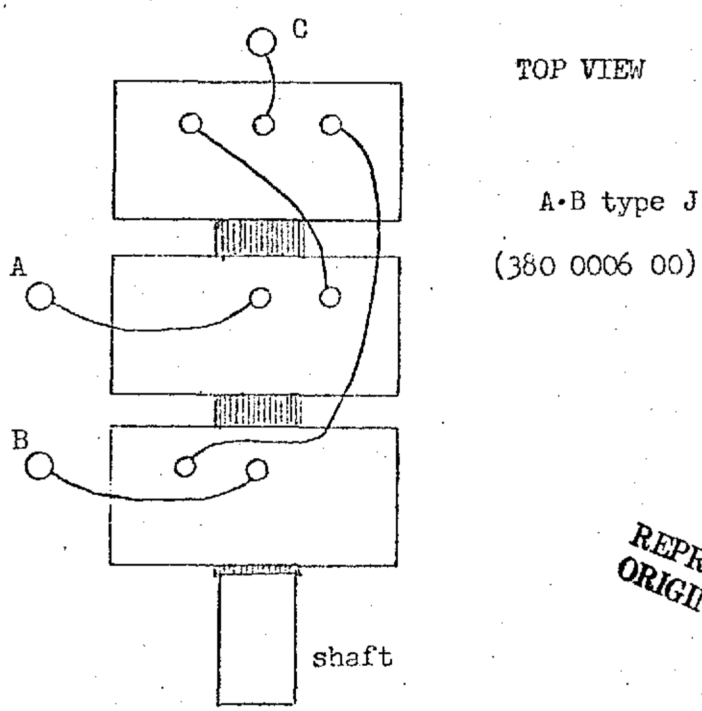




Figure 2. Mechanical Arrangement of Potentiometer.

Figure 4 has been useful in making relative signal to noise ratio measurements from low output impedance signal sources where a single control knob can be calibrated in terms of the inputs for S/N ratios of $\pm$ 40db. Thus if the signal generator is at the A input, rotation of the shaft to A will provide a +40db S/N output at C, when the noise source is connected to B with the same RMS input levels from the respective signal and noise sources. Correspondingly a 50% rotation of the control shaft would provide a 0db S/N output and a 100% rotation to B would provide a -40db S/N output at C. Combinations of these devices are useful in mix-up, mix-down, and laboratory measurements over the frequency range to 500kHz.

## V. ACKNOWLEDGEMENTS

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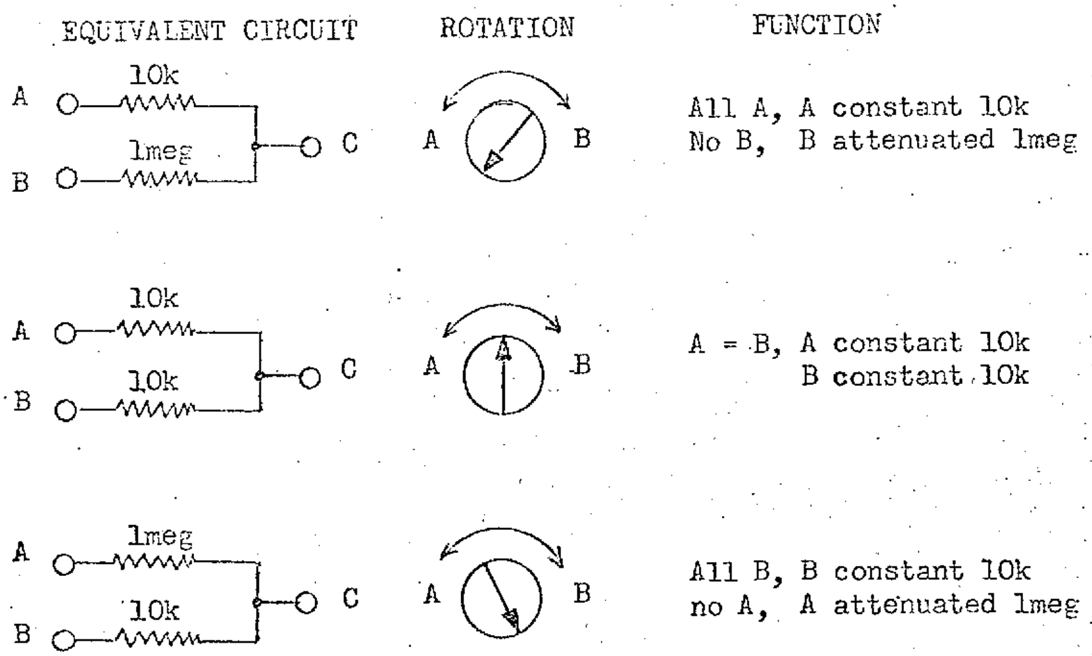


Figure 3. Series Control Operation.

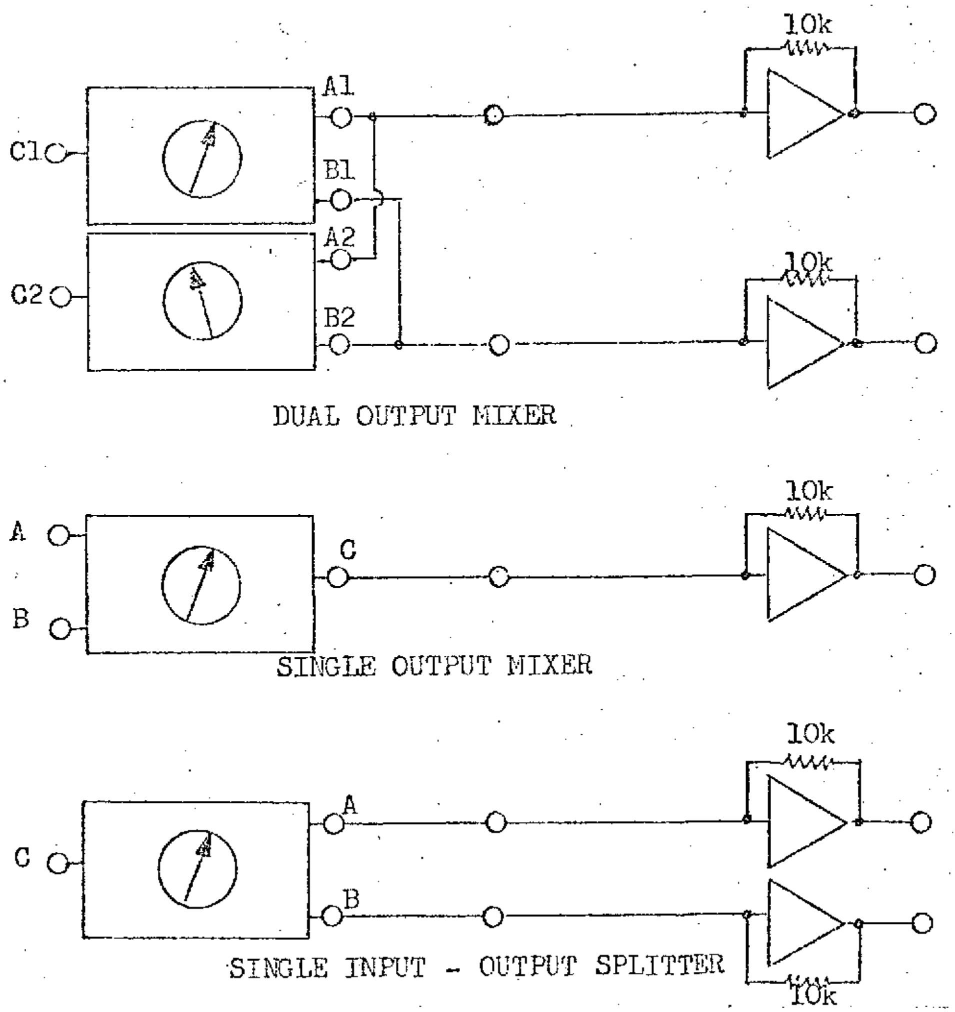


Figure 4. Series Network Uses.