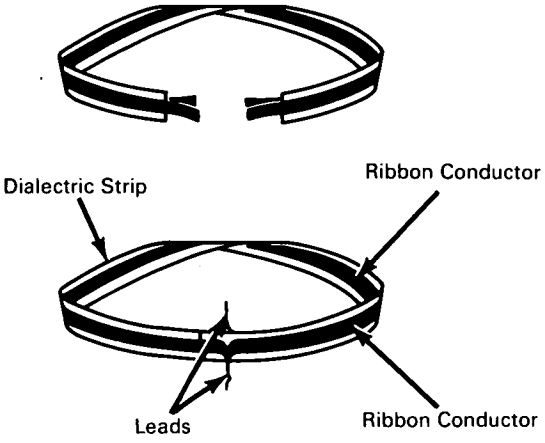
# AEC-NASA TECH BRIEF



## Moebius Resistor Is Noninductive and Nonreactive




**The problem:**

To develop an electrical resistor that has no residual mutual- or self-inductance and is nonreactive at high frequencies.

**The solution:**

A Moebius strip made of insulated resistive materials with electrical leads attached directly opposite one another provides a noninductive, nonreactive resistor which is simple, inexpensive, and flexible in usage, and can be made to almost any desired size and shape.

**How it's done:**

Two ribbon conductors of equal length are affixed on opposite sides of a strip of dielectric. The assembly is then given a single twist and the ends are joined to form a Moebius surface. The ends of the conductors are soldered together and the resistor terminals are attached to the directly opposed solder joints. Current applied to the terminals will travel in opposite directions, so that the electromagnetic fields cancel each other, resulting in an essentially noninductive, nonreactive resistor with a low time constant. Bifilar wire may be used instead of resistive ribbon, eliminating the need for a center dielectric strip. Thin film conductors on flat substrates can also be used to make Moebius resistors.

Two or more sets of resistive wire may be mounted laterally on the same nonconductive strip, with about 1/16-inch spacing, and connected to form multi-Moebius resistors in one unit. There is no change in the

(continued overleaf)

time-constant of the individual resistors, nor does one in any way affect the operation of the others, even when they are assembled in parallel or in series.

The performance of the Moebius resistor is unaffected by its form, size, or length. Once it is connected into a Moebius shape, it can be folded or wound around a cylindrical core or a card, or even into a ball, resulting in compact packaging of the resistor for use in miniaturized circuits. The Moebius resistor does not couple to metallic objects, external fields, or itself. When the bridge is nulled the resistor can be handled or changed in form without disturbing the balance. The conductors must not be touched and the spacing between them must not be altered.

Inductance and reactance are virtually eliminated in this resistor because the Moebius strip is topologically a single-sided surface. The pulse divides at the terminals equally, since the impedance is the same in both directions. One pulse travels with a right-handed orientation and the other opposite to it in all respects; therefore, the pulses do not cancel. The polarity is reversed when the pulses have traveled one-half the resistor's length where the DC resistance is one-half the total value. At this point, the potentials of the separated pulses are equal and of opposite phase. They continue until they reach the terminals again where they have decreased to zero. As with other resistors, the Moebius resistor uses the entire conductor length to dissipate the pulse energy; however, the dielectric of the Moebius resistor is used more efficiently, since two equal pulses travel throughout its volume between the conductors.

**Notes:**

1. If the terminals are not directly opposed, the resistor becomes inductive, with maximum inductance when the terminals are separated by one-half the length of the loop.
2. Inquiries concerning this innovation may be directed to:

   Sandia Office of Industrial Cooperation
   Org. 3413
   Sandia Corporation
   Post Office Box 5800
   Albuquerque, New Mexico 87115
   Reference: B68-10267

**Patent status:**

Inquiries about obtaining rights for commercial use of this innovation may be made to:

Mr. Dudley W. King, Chief
Albuquerque Patent Group
U.S. Atomic Energy Commission
Post Office Box 5400
Albuquerque, New Mexico 87115

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