Continuously Variable Integrated Analog Resistor – U.S. Patent Pending

Invention
This device is a resistor made of an alloy that can be manufactured in an integrated circuit (IC) and have its resistive value changed dynamically through a series of electrical bursts. It will then hold its resistive value, without applied power, until changed again. It is superior to existing resistor technologies since existing resistor technologies have a fixed resistance or require constant power in order to maintain a resistive value.

Boise State University has invented an integrated circuit variable resistor with the ability to continuously change resistance values and to maintain those values in the absence of applied power.

Application
This invention pertains to an IC variable resistor. Current resistor technologies are either: 1) non-IC, 2) IC with fixed resistance, or 3) IC with variable resistance only under constant power.

• Parties of interest: Integrated circuit manufacturers, Department of Defense, NASA/JPL.

Advantages
• Reduced costs for companies using integrated circuits because the circuits can be reused for multiple purposes and fixed resistors do not need to be assembled onto integrated circuit boards.
• Resistive value changes dynamically through a series of electrical bursts so it can be used in devices that have a requirement for a variable resistor.
• Holds resistive value when power is turned off so it can be part of circuits that have low energy requirements.

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**Patent Application Name**
Variable Integrated Analog Resistor

**Patent Application Abstract**
This invention disclosure describes a materials system and method of operation of this materials system that can be used to create an integrated, on-chip analog resistor. Resistors are currently manufactured in an integrated circuit by doping silicon. This results in a fixed resistance value. Other methods of achieving a resistance include operating transistors such as MOSFETs at certain operating conditions. Both of these techniques require fairly complex manufacturing steps and offer little flexibility in available resistances. With either of these techniques, it is not possible to create a range of available resistance states, referred to as analog resistances that retain their state in the absence of an applied electrical signal.

In the method proposed herein, a chalcogenide material, such as a GeSeAg alloy can be forced into a mode of operation via application of an electrical pulse whereby the specific pulse sequence and potentials determine the resistance achieved. Manufacturing this alloy is simple as the alloy sandwiched between two metal electrodes. No complex doping steps or thermal annealing steps are required and the resistor can be manufactured in the back end of the line.

**The Inventor**

*Dr. Kris Campbell* is an Associate Professor of Electrical and Computer Engineering at Boise State University. Dr. Campbell’s current research interests are focused in the areas of chalcogenide glasses and new electronic memory technologies based on ion-conduction and electron spin zero-field splitting.