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Physical Description and Experimental Characterization of the Resistive Switching Filament ANDREW LOHN, PATRICK MICKEL, CONRAD JAMES, MATTHEW MARINELLA, Sandia National Laboratories — We derive an analytical, steady state solution for resistive switching from the heat equation. Fitting our equation to a single hysteresis loop (the most fundamental experiment in the field), provides experimental determination of the filament radius, conductivity, temperature and the thermal conductivity of the surroundings. These parameters are determined continuously and show excellent agreement with the detailed experimental work to date. This approach enables every researcher with a current-voltage sourcemeter to experimentally characterize their filament. The analytical nature of our equation also elucidates the relation between materials, design parameters, and performance metrics. We generalize the empirical relation for uniting resistive switches and we show that our steady state solution is valid over all relevant timescales by fitting to a hysteresis loop taken within 10 nanoseconds. Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

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