MAR08-2007-001410

Abstract for an Invited Paper
for the MAR08 Meeting of
the American Physical Society

50 Years of "Scaling" Jack Kilby's Invention

ROBERT DOERING, Texas Instruments

This year is the 50th anniversary of Jack Kilby's 1958 invention of the integrated circuit (IC), for which he won the 2000 Nobel Prize in Physics. Since that invention in a laboratory at Texas Instruments, IC components have been continuously miniaturized, which has resulted in exponential improvement trends in their performance, energy efficiency, and cost per function. These improvements have created a semiconductor industry that has grown to over $250B in annual sales. The process of reducing integrated-circuit component size and associated parameters in a coordinated fashion is traditionally called "feature-size scaling." Kilby's original circuit had active (transistor) and passive (resistor, capacitor) components with dimensions of a few millimeters. Today, the minimum feature sizes on integrated circuits are less than 30 nanometers for patterned line widths and down to about one nanometer for film thicknesses. Thus, we have achieved about five orders of magnitude in linear-dimension scaling over the past fifty years, which has resulted in about ten orders of magnitude increase in the density of IC components, a representation of "Moore's Law." As IC features are approaching atomic dimensions, increasing emphasis is now being given to the parallel effort of further diversifying the types of components in integrated circuits. This is called "functional scaling" and "more then Moore." Of course, the enablers for both types of scaling have been developed at many laboratories around the world. This talk will review a few of the highlights in scaling and its applications from R&D projects at Texas Instruments.