Multi-voltage power supply systems are discussed in Part VIII. These systems are commonly used in heterogeneous mixed-signal integrated circuits, such as systems-on-chip. Design strategies are therefore required for these multi-voltage networks. The interactions among the decoupling capacitances and multi-voltage systems are also reviewed. The following two chapters discuss the design of multi-voltage power systems.

In Chap. 40, systems with multiple power supply voltages are described. Several multi-voltage structures are reviewed. Primary challenges in integrated circuits with multiple power supplies are discussed. The power savings is shown to depend upon the number and magnitude of the available power supply voltages. Rules of thumb are presented to determine the appropriate number and magnitude of the multiple power supplies to lower the power dissipated by the system.

On-chip power distribution grids with multiple power supply voltages are discussed in Chap. 41. A power distribution grid with multiple power supplies and multiple grounds is presented. This power distribution grid structure results in reduced voltage fluctuations as seen at the terminals of the current load, as compared to traditional power distribution grids with multiple supply voltages and a single ground. It is noted that a multi-power and multi-ground power distribution grid can be an alternative to a single supply voltage and single ground power distribution system.

Decoupling capacitors for power distribution systems with multiple power supply voltages is the topic of Chap. 42. With the introduction of a second power supply, the noise at one power supply can propagate to another power supply, producing power and signal integrity issues in the overall system. Interactions between the two power distribution networks should therefore be considered. The dependence of the impedance and magnitude of the voltage transfer function on the parameters of the power distribution system is evaluated. Design techniques to cancel and shift the antiresonant spikes out of the range of the operational frequencies are also presented.