# Design Methodology for Bypass Capacitor Selection in Power Distribution Systems

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**Abstract**

*Power delivery is a major challenge in present-day systems. This challenge is expected to increase in the next decade as systems become smaller and new materials are introduced into packages and boards. There has been much discussion on how to choose decoupling capacitors for Power Distribution Systems (PDSs). Since a system supports multiple frequencies, a PDS is best designed in frequency domain. The power system should meet the target impedance across a broad frequency range from direct current DC), up to the highest frequency of interest. To maintain the impedance of a PDS below a specified level, multiple decoupling capacitors are placed at different levels of the power grid hierarchy. The number of capacitors required to meet the target impedance up a frequency is estimated by a simple formula. Capacitor equivalent series resistance (ESR) and capacitor equivalent series inductance (ESL) are very important in determining how many capacitors are required.*