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Abstract—In this article, it is interesting to find that the virtual synchronous generator (VSG) with sufficient damping can exhibit the global stability phenomenon, i.e., the grid-connected VSG keeps asymptotically stable irrespective of the fault clearing time. The expression of the dissipated energy induced by damping is first derived from the energy conservation law. The dissipated energy equals the damping factor D times the area in the phase plane encircled by the system trajectory and the x -axis. Accordingly, a simple approach to realizing global stabilization is proposed by tuning the damping of the grid-connected VSG. It is proved that once the constant potential energy decrement over every period is less than one minimal dissipated energy, the kinetic energy at the unstable equilibrium point (UEP) of each period drops gradually, and the global stability can be achieved. Furthermore, an equal energy surface composed by the potential energy of the UEP is constructed to estimate the minimal dissipated energy, yielding an analytical and conservative damping tuning rule of VSGs for global stability. Simulation studies based on PSCAD/EMTDC have validated the correctness of the proposed global stability condition and the effectiveness of the damping tuning method of VSGs.