This paper proposes a new configuration for static ground power unit (GPU) based on the novel 25-level hybrid active neutral-point-clamped (HANPC) converter. The superiority of the proposed converter, as compared with conventional and other suggested multilevel converters, is significant decreasing the number of switches and minimizing the number of flying capacitors (FC) in converter. This improvement is possible by using suggested low-voltage submodule converter to the ANPC converter and proposed modulation method. This results in reduction of the size and cost of converter and makes it more feasible and reliable. Applying the active voltage balancing method for FC in the proposed HANPC converter guaranties fast charging and voltage-level regulation of FC without using balance booster circuit. Improving output voltage spectrum leads to inductance reduction of output L-C filter which enhances static GPU performance. The simulation and experimental results verify the validity and feasibility of the proposed converter.