Google Little Box Challenge showcases GaN power element

Steve Taranovich - March 05, 2016

GaN is overtaking silicon in the power element market for power management solutions as well as power management where high speed is needed. It is significant that GaN has emerged in the Google Little Box Challenge after rigorous testing of contestants' creativity and engineering prowess. There has been much discussion regarding who the winner would be, and now the results have been announced, a team of designers from Belgium won and GaN Systems has revealed that their Gallium Nitride power transistors were instrumental in achieving the winning design. The Schneider Electric and the Virginia Tech Future Energy Electronics Center teams won honorable mentions.

This all started with Google teaming up with the IEEE Power Electronics Society. The rationale in creating this contest was particularly about challenging a significant improvement in power inverters which convert DC from renewable energy markets such as solar panels or batteries to AC for use in industry, our homes as well as automobiles.

Today’s inverters in homes are considered too large for homeowners, although they are typically only the size of a picnic cooler. If they were smaller, Google believes that more homes would entertain using them for solar-power, as well as bringing electricity to remote areas of the world where energy does not now exist. More efficiency in electrical power grids would be another good outcome of this contest.

The competition had over 2,000 teams, and ultimately only 18 finalists emerged.

Google and the IEEE Power Electronics Society chose the National Renewable Energy Laboratory (NREL) in Golden, Colorado, USA to be the testing facility for the competition. Contestants' inverters underwent extended testing at NREL's Energy Systems Integration Facility (ESIF) using state of the art equipment and supervised by a world-class technical staff. The final inverters were subjected to a 100-hour simulation of real-life conditions, including a DC source of electricity that emulated a solar power system, with rapid ramp-ups and ramp-downs in power typical of an intermittently cloudy day, as well as a realistic, changing load simulating a typical home that the inverter needed to supply. Each inverter had to meet most of the same specifications required of commercially-available inverters. After rigorous testing of the 18 finalist designs, the winner was announced at the ARPA-E Energy Innovation Summit in Washington, DC.

The grand prize of $1 Million prize was ultimately awarded to CE+T's Red Electrical Devils from Belgium, for designing, building and demonstrating an inverter with the highest power density and smallest volume (GaN devices have been doing that more and more often in the power arena). The key goal of the challenge was to reach an inverter power density in excess of 50 W/cubic inch in a volume of under 40 cubic inches – a feat which had never been done before, but the winning team managed to produce a power density of 143 W/cubic inch in 14 cubic inches for their 2kVA inverter, outperforming the Little Box Challenge power density goal by nearly a factor of 3, which, according to Google, "is 10 times more compact than commercially available inverters." The reduced gate drive and switching losses of GaN Systems' GS66508P GaN power MOSFETs were critical to thermal and power density goals.

So although the challenge to contestants was to get the inverter volume down to less than ten times what it is today, down below the size of a laptop to win the prize goal of $1M, better than that, the world gets an improved Power inverter design and the Third World and renewable energy will benefit from this effort.