Docket #: S12-508

Energy Efficient Pulsed Vacuum Electron Device

This “pulsed depressed collector” is a vacuum electron device designed to efficiently recover energy from high power pulsed RF sources. The technology was developed at SLAC National Accelerator Laboratory and uses a novel feed-forward scheme to recapture the energy that is traditionally wasted during the rising and falling edge of a beam current pulse (in addition to energy within the flat top). This collector could be easily integrated into existing systems without extensive refurbishing because it is compatible with current modulator and power supply technologies. The invention has a variety of applications utilizing high power RF tubes such as communications, radar, medical accelerators and particle accelerators.

Stage of Research
In analytical case studies, the inventor has simulated increased efficiency from 29% to 57% in an XL4 klystron and from 27% to 68% in a 5045 tube. Experimental confirmation of the analytical model is presently underway.

Applications

- **Vacuum electronics** (e.g. klystrons, magnetrons, gyrotrons and travelling wave tubes) for:
  - communications
  - radar
  - medical accelerators
  - particle accelerators

Advantages

- **Energy efficient** - simulated system efficiency of >55% (compared to current efficiency of 29%)
- **Easily integrated into existing systems:**
  - vacuum tube geometry is not altered
  - functions with a variety of modulator topologies (solid state, PFN, Marx and induction modulators)
- **Cost-effective:**
  - extra power supplies are not required
  - many energy-recovery stages added with minimal additional hardware

Publications

- Kemp M, Jensen A, and Neilson J, "Pulsed Depressed Collector for High-Efficiency RF Systems" (SLAC Publication SLAC-PUB-15349)

Patents

- Published Application: 20140217885

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