Introduction to Power Electronics Applied Research Laboratory (PEARL)

The Power Electronics Applied Research Laboratory (PEARL) at the Graduate Institute of Electrical Engineering, National Chung Cheng University, Chia-Yi, Taiwan, was established by the director, Dr. Tsai-Fu Wu, in 1993. The laboratory is equipped with all the necessary equipments to conduct various research projects. The computer simulation, prototype construction, hardware measurement, and performance improvement can be accomplished in the laboratory by skilled graduate students. Research areas of PEARL are concentrated on various applications of power electronics techniques. Main research topics include: multiple-function electronic ballasts for fluorescent lamps, high power density converters, active power line conditioners, uninterruptible power supplies, power converters and driving circuits for plasma display panels (PDPs), charging station for electric vehicles, grid-connection solar/wind power generation systems, high-voltage switches, pulsed high electric field generators, fuel cell power converters, and other power electronics related subjects.

Currently, members of PEARL consist of two faculty instructors, ten Ph.D. students, and twenty-one master students, one technical assistant and one secretarial assistant. Also, four co-instructors from four different Universities joined PEARL as research partners. There are series of educational training programs directed by the PEARL's instructors including advanced courses for power electronics during the regular semester and the practical hardware implementation during the summer session. All the graduate student members of PEARL can gain not only the theoretical knowledge but also the practical experience, and then become well-trained power electronics engineers.

Performing advanced research in the academy and providing technical consultant for the industry are the two major goals of PEARL. For the past three years, thirteen research grants are approved by governmental or private institutions, totaling near 15 million NT dollars or 0.42 million US dollars. By the end of year 2002, 11 patents have been issued and 28 IEEE Transaction papers and over 70 international conference papers have been published. Because of the outstanding achievement, Prof. Wu received the 2002 industry-academy-cooperated research award from the Ministry of Education, Taiwan, ROC.

The major inventions of the issued patents can be summarized as follows:

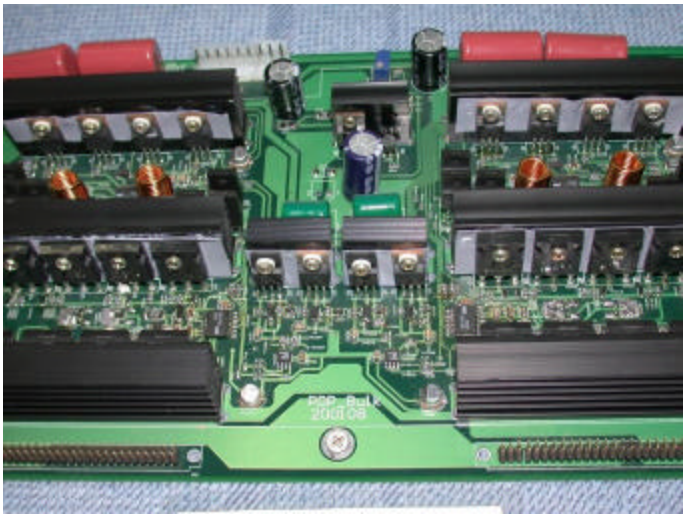
1. Single-stage power converters with a power-factor correction feature are good for ac/dc applications, ROC Patent No. 116,525 and No. 129,043.
2. Single-stage power inverters with a power-factor correction feature are good for electronic ballast applications, ROC Patent No. 116,524, No. 127,198 and No. 138,272.
3. A preheating circuit for detecting the filament temperature of fluorescent lamps can

reduce ion bombardment and effectively extend lamp life, ROC Patent No. 180,692 and US Patent No. 6,339,299.

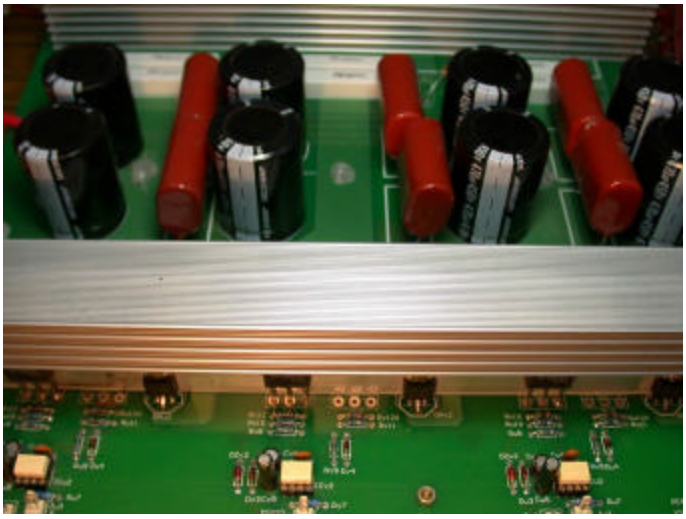
4. Plasma Display Panels (PDP) with five electrodes can enhance luminance of the panels, ROC Patent No. 160,369.
5. A driving circuit with energy recovery was proposed for PDPs to improve luminous efficiency, ROC Patent No. 171,175.
6. A flyback-converter based reset and sustain circuit was proposed to improve resolution and luminous efficiency, ROC Patent No. 172,519.
7. A single-stage converter with electronic ballasting and grid-connection feature was invented for drawing power from photovoltaic arrays, ROC Patent No. 166,764.

PEARL's home page: http://www.ee.ccu.edu.tw/~pw/pearl.htm

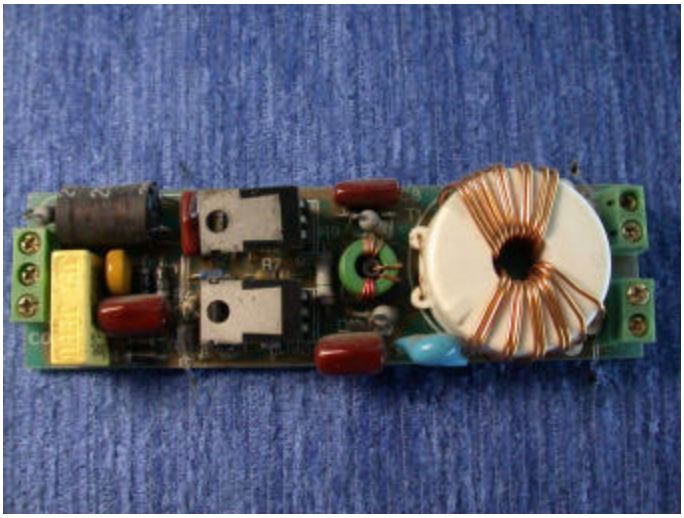
The following photographs show some activities held and several key products designed and implemented by PEARL.



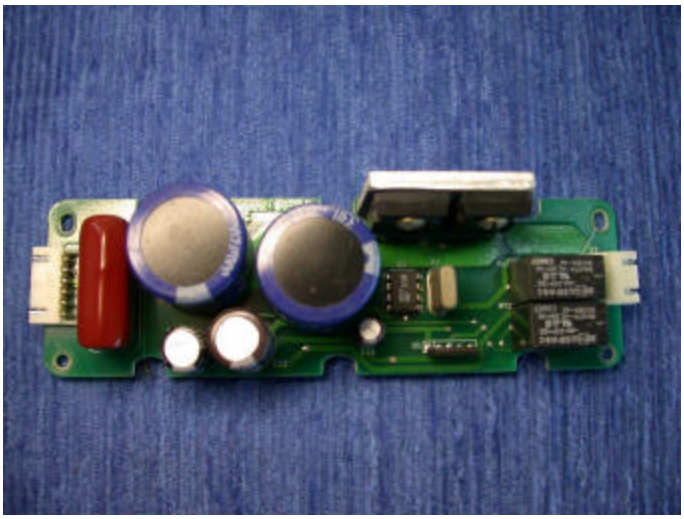
The power converter and driving circuit of PDPs.



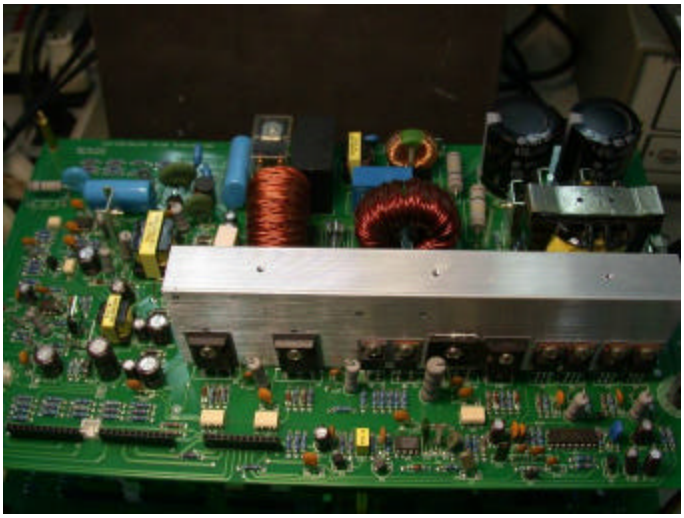
Three-phase 1 kVA grid-connection DC/AC inverter.



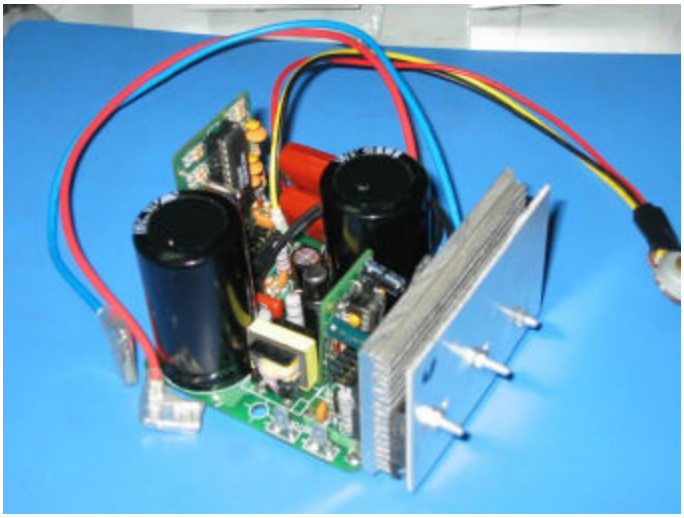
80 W electronic ballast with a dimming feature.



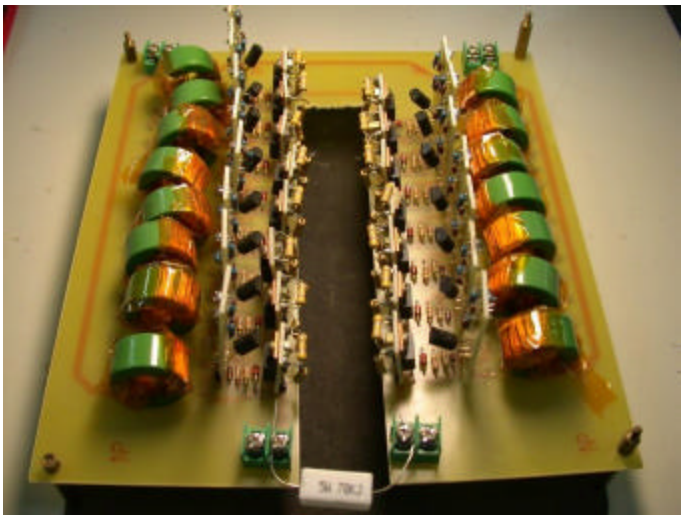
A single-chip microcontroller condtioned electronic ballast for driving nine lamps.



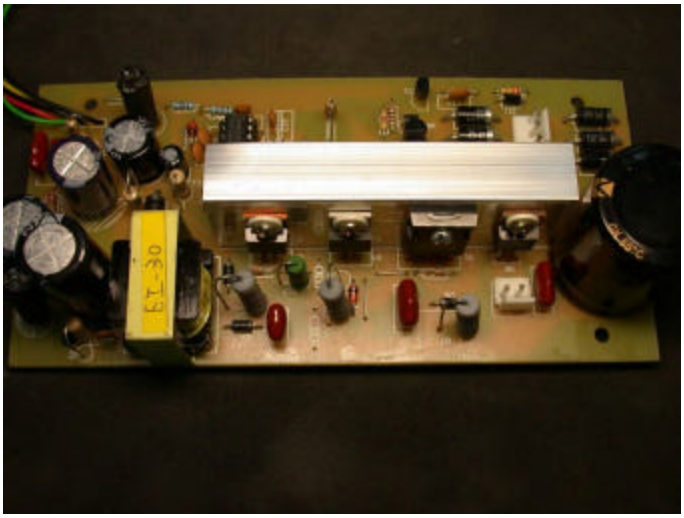
The 1 kVA UPS.



The 2/3 HP motor driver for sanders.



A prototype of a 25 kV pulsed voltage generator.



Power converter for exercise bikes.

The bar-be-cue party held in October 28 2002 to celebrate the Teachers' Day.

The opening ceremony of the homecoming party for PEARL's 10th anniversary.

Climbing the Do-Li Mountain is the monthly regular outdoor activity of PEARL members.