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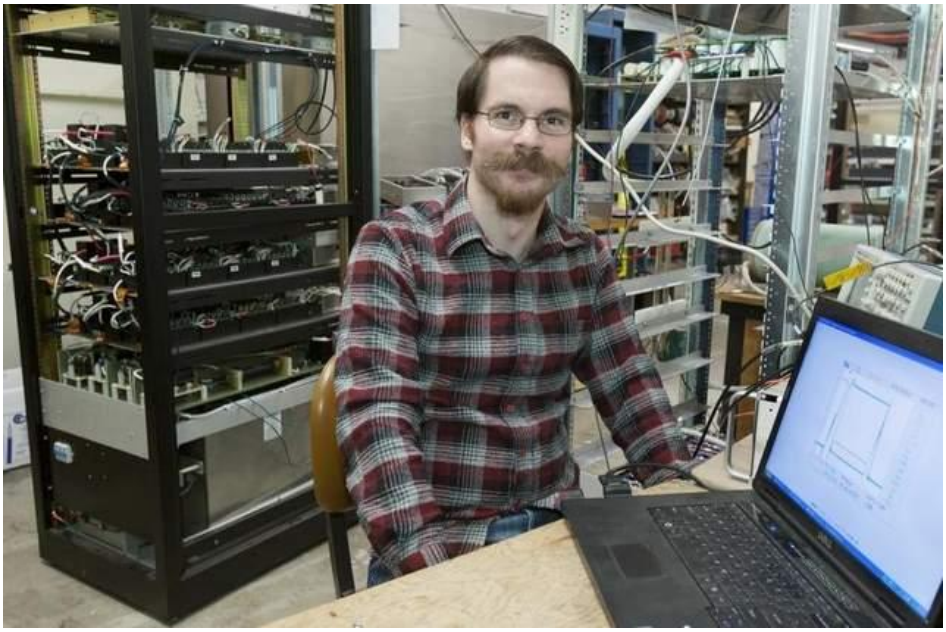
## Made in Tompkins: Applied Pulsed Power's switches improve capacity, speed in medical and other technologies

*By Olivia Hall, Correspondent*



Daniel Warnow, of Cortland, is the engineer at Applied Pulsed Power, in Freeville, in charge of testing the 100 electrical switches for a new, high-speed, magnetic resonance imaging (MRI) device the company is helping build. The machine depends on the Freeville company's solid state switches to deliver high power in short bursts. / SIMON WHEELER / Staff Photo

**FREEVILLE** — Applied Pulsed Power's switches are not the kind that simply turn lightbulbs on and off.

The Freeville company produces specialized, "solid state" switches that allow short bursts of very high power to be used in a broad range of applications, from water treatment to magnetic therapy and nuclear fusion.

"An analogy for pulsed power is trying to hammer a nail into the wall," said Craig Dunham, APP's CEO. "If you take the hammer and just try to push on the nail, that won't work too well. But if you hit the nail, you can drive it in. That's like a pulse of power."

The technology, in just one medical example, shortens the time on an MRI (magnetic resonance imaging) from the conventional 20 minutes to seconds.

Irving Weinberg, a Bethesda, Md.-based specialist in nuclear medicine and diagnostic radiology, as well as president of a company that develops medical imaging and therapy

devices, approached APP about supplying specialized equipment for a project funded by the National Institutes of Health.

“We’re now building MRI devices whose fast, high currents are about 100 times more powerful than existing systems, and they change magnetic fields on the order of microseconds instead of milliseconds,” Weinberg said.

When Steven Glidden, previously a pulsed power engineer at Cornell University’s Laboratory of Plasma Studies, founded APP in 1990, the company’s focus was on lithography–printing patterns on semiconductor chips for computer memory and processing. Over the past 10 years, the emphasis has shifted, and today, APP’s 12 employees produce and sell over 1,000 switches a year.

“It starts with a semiconductor, a chip like what you have in your computer,” Dunham said. “With the help of an SBIR (government Small Business Innovation Research) grant, we developed a way of packaging it to reduce the resistance to turning on and off quickly. So the devices we make are much faster.”

Basic switches the size of a book of matches can handle 5,000 volts and 14,000 amps, and are often bundled together for higher power levels exceeding 100,000 volts.

Dunham hopes these powerful devices will continue to replace older pulsed power switching technologies, such as vacuum tubes and spark gap switches, which remain dominant in the market.

“We have a compelling value proposition, because our solid state switches have a much longer life, require less maintenance and are more reliable,” he said.

Take a system that breaks up kidney stones with external shockwaves, for example.

“They used to use a spark gap that would blow itself up after two months,” Dunham said. “Now, they get a year or more out of the switches.”

APP’s five engineers are frequently hired to custom-develop pulsed power systems for a variety of applications. These include a two-mile particle accelerator at Stanford University, Cornell’s COBRA high current generator — which uses a terawatt pulse, “an incredible amount of energy,” according to Dunham — as well as projects in national laboratories around the United States and as far away as the United Kingdom and Japan.

In the medical field, pulsed power is driving some treatments for cancer, laser eye surgery and ultra-fast MRIs.

“A conventional MRI study takes about 20 minutes. Part of the reason for that is that the pulse sequences that are used take a long time to be played out,” said Weinberg, the Bethesda-based specialist.

“If you change the fields too quickly, on the order of milliseconds, you run the risk of causing unpleasant nerve stimulation. Our hypothesis was that if you change the fields really quickly, that wouldn’t occur. We used APP equipment to prove this in a clinical trial that was published. ... That principle is being used to make MRI systems that give you images in seconds rather than 20 minutes and also to move magnetic particles around in the body, which requires stronger magnetic fields than you can usually get with an MRI.”

The technology will not only reduce significantly the amount of time required for imaging but also allow doctors to depict bone, which is currently not visible in MRIs.

“So we’re looking at applications in dentistry or trauma, where if you don’t have a fast enough MRI, you just can’t do the job,” Weinberg said.

Next in the pipeline is image-guided therapy with magnetic particles that deliver drugs to cancers or other diseases in the body, while APP is also working on systems to treat water with bursts of pulsed power — just a couple of examples of future applications the company’s technologies are helping to propel.

Some of the 100 solid state switches that Applied Pulsed Power has installed for a new high-speed MRI machine they are helping build. / SIMON WHEELER / Staff Photo