FLUKE®

Testing power output at Sharp Solar

Application Note

Testing Functions **Case Study**

Tools: Fluke DMMs, clamp meters, and amp clamps

Measurements: Voltage, current output on 600 V inverters

Profile: Sharp Solar

For John Hardwick, there's only one way to describe the sight of an electric meter running backwards.

"It's a beautiful thing," says Hardwick.

As national training manager for Sharp Solar, Hardwick is making a career of rolling back the nation's dependence on fossil fuels.

Sharp Solar is the world's top producer of systems that turn sunlight into electric power for running refrigerators, computers and household lighting—and spinning those meters back.

In three years Hardwick, 28, has trained 1100 contractors, roofers and electricians to install and test solar generation systems, some powerful enough to produce 200 to 500 volts dc and supply more than enough power for an entire home.

When the class turns to system testing, Hardwick and his students reach for their Fluke digital multimeters.

"Everybody knows Fluke," says this fourth-generation electrician. "It's a household name."

From flashback to flash of inspiration

Just a few years ago, solar power seemed like a 1970s flashback. But in the labs, the technology was growing more efficient. Then, when electric power and natural gas prices accelerated and crude oil spiked past US $70 a barrel, solar got hot.

Hardwick says when U.S. President George W. Bush recently cited solar as part of the energy solution, he became the first U.S. President to mention the technology since Jimmy Carter. Solar arrays deliver power at the White House and the Bush ranch in Crawford, Texas.

The new dawn for solar power means that, though Sharp produces 500 megawatts of solar generating capacity each year (enough to power thousands of homes), the company now has an order backlog of three to four months.

Sharp designs its roof-mounted, silicon-based photovoltaic panels to be easily connected into a solar "array." A combination of rectangular and triangular shapes makes the modules adaptable for any roof shape. The installer then connects the array to a sophisticated inverter that creates a synthetic alternating current sine wave that matches the voltage, frequency and phasing of the available utility power.

Sharp Solar trains contractors, roofers and electricians to install and test its solar generation systems.

The inverter converts dc power from the rooftop into ac suitable for household use.

The financial payoff from solar depends on a number of factors. Climate, home energy demand, building orientation and local power rates must be factored in. Government policy can be just as important. Many states offer tax advantages and rebates that offset a significant part of the cost of a solar installation, and most have enacted "net metering laws" that require utilities to buy surplus power from small producers.

In California, according to Sharp, an average home uses 6500 kWh of electric power each year, and could meet 93 percent of that demand with a 3 kW solar system. A 4 kW system would produce a 24 percent solar power surplus. Feeding that excess energy into the public power grid would generate a net credit on the homeowner's power bill.

Testing and safety

Hardwick conducts training at Sharp locations in the U.S. at Mahwah, N.J. and Huntington Beach, Calif. The two-day program covers a range of topics, from Sharp history, solar program basics and site evaluation to system installation, inverter operation, tools, testing and safety. State licensed contractors who complete the course and pass Sharp's examination receive formal certification for installations under the Sharp warranty.

Each solar module produces from 62 to 208 watts, and up to ten modules can be connected in series to form a single array. Each module is connected to a continuous equipment ground. In the US, Article 690 of the National Electrical Code governs solar installations.

Hardwick's students use Fluke meters with amp clamps and Fluke clamp meters to test the modules as they are unpacked and again after installation. They check output voltage and amperage and make sure the units are connected in series.

They then connect the arrays to the Sharp 3500 watt inverter and check voltage levels inside the inverter before turning the device on. The unit receives 200 to 500 watts dc from the arrays and puts out 220 volts ac power, with a conversion efficiency of 93 to 95 percent. The inverter is separated by safety switches on both dc and ac sides, and connected to the house power system through a standard breaker.

In addition to converting the power from dc to ac, the Sharp inverter can manage and maximize power production from three arrays at a time. In an installation on several roof surfaces, for instance, the inverter can ensure that the surface with greatest solar exposure delivers all the power possible.

Test instruments must be capable of measuring up to 600 volts and 30 amps or more, ac and dc. At the level of power a solar array can deliver, safety is always a consideration, and one Hardwick has a personal feel for, thanks to an incident he vividly recalls.

"We were checking ac voltage, preparing for a solar installation. I was using an old meter—older than I was—and it wasn't a Fluke," he says. "The meter blew up in my hand. I was lucky; it didn't burn me, but it scorched my fingers black. That meter is gone, and I learned a lesson."

Hardwick and the Sharp service group use Fluke meters exclusively. "My dad taught me that when I was eight years old," says Hardwick. "He said 'use Fluke.' I used to go with him and help him do residential wiring on the weekends. He'd wake me up Saturday at 8 a.m. and say 'we're going to go wire a house.'"

Hardwick says the training Sharp provides gives contractors an introduction to a new line of business—and the pride of knowing that they're doing the right thing.

"They leave the training amazed and energized," says Hardwick. "This is something new for them to talk about. They feel good when they tell their kids they're solar installers. Most of them do their own house first, and then they have a little laboratory.

"The price of energy is not likely to go down," he adds. "Solar makes sense."

A history of Sharp thinking

Sharp got its start back in 1915, with its invention of the mechanical pencil. In addition to its solar systems, Sharp produces Aquos™ liquid crystal display TVs, microwave ovens and air purifiers. The company began its solar cell development in 1959, introduced solar-powered calculators in 1980 and designed the first solar system specifically for household use in 1994.