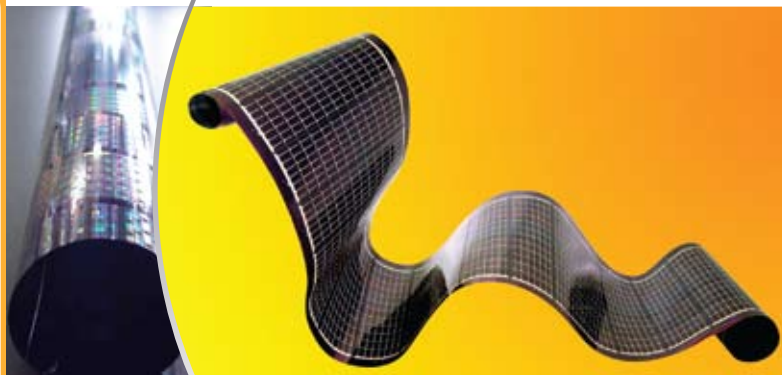


# PowerFilm®

[www.powerfilmsolar.com](http://www.powerfilmsolar.com)

PowerFilm® is a developer and manufacturer of thin, flexible solar panels based on a proprietary low cost production process. The company's objective is to target the building integrated solar power market and to continue to supply products for selected portable and remote solar power applications. PowerFilm is based in Ames, Iowa, U.S.A.

PowerFilm was founded in 1988 by Dr. Frank Jeffrey and Dr. Derrick Grimmer, both former research physicists from 3M, the diversified global technology company, with a combined 65 years of experience in semiconductor and solar energy research and development. Dr. Jeffrey and Dr. Grimmer first collaborated on thin film solar cell research while employed at 3M's research laboratories. When 3M made the strategic decision not to pursue thin film technology any further, Dr. Jeffrey and Dr. Grimmer resigned to establish PowerFilm and independently continue their research activities.



The company was founded to develop and manufacture thin film solar panels in high volume and at low cost. The company's development since incorporation has largely been funded through approximately \$14 million in development contracts and grants received from U.S. government bodies. These contracts and grants have been provided to support the company's development of a manufacturing process for low-cost solar panels and specific product development for the U.S. Army. PowerFilm has been able to use the know-how gained when developing products for the U.S. military to launch portable and remote solar power products with commercial partners for outdoor and recreational applications. The revenues from the sale of these products have been used to further support the company's growth.

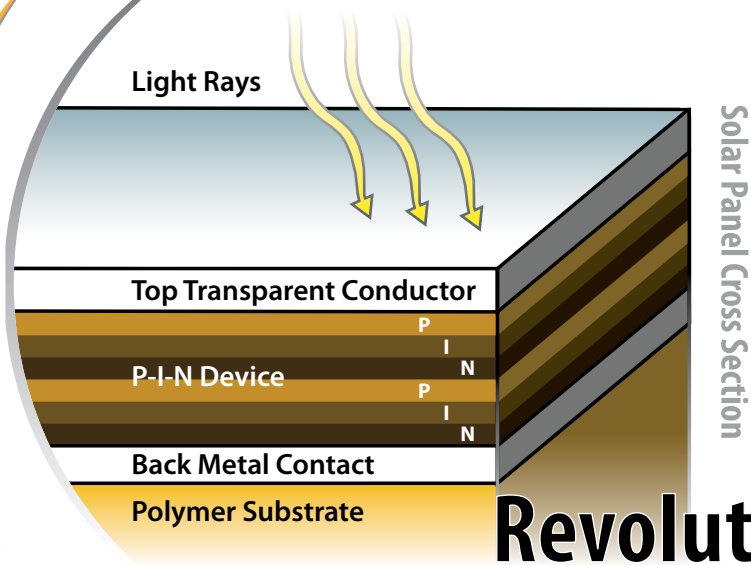
The company has been selling solar powered products since the early 1990s. With a proven and industrial scale process for manufacturing thin, flexible, low-cost solar panels and with validation of the company's solar cell technology through product shipments to the U.S. military and customers in the portable and remote solar power market, the company is now expanding production capacity to meet the rapidly growing demand from the building integrated solar power market.

## PowerFilm Solar – Thin Flexible Solar Panels

PowerFilm has developed a range of thin, flexible solar panels in a variety of sizes and configurations. The company's solar panels are manufactured on a flexible, thin plastic substrate that is as thin as 1/1000th of an inch thick, producing solar panels that are much thinner and more lightweight, flexible and durable than rigid crystalline panels. This technology enables easier integration into roofing materials and allows for simple, robust, low cost building installations. To create its solar powered products, PowerFilm has pioneered the production of thin, flexible solar panels on plastic substrates through a proprietary roll-to-roll manufacturing process.

## Thin Film Electronics

In addition to its solar panel products, PowerFilm has sought to leverage its core roll-to-roll manufacturing competence to develop additional thin film semiconductor devices. The company has formed a technology partnership with Hewlett Packard Corporation, one of the world's leading technology companies, for the development of flexible, low-cost backplane drivers for next generation flat panel displays. This development program has been funded by the U.S. Display Consortium. While this project is still in the research and development phase, it may enable the company to play a significant role in the future market for flat panel display technology. Future applications for the company's thin film semiconductor know-how could also include RFID tags and electronic paper.



**PowerFilm®**

**Starts on a roll.**

**13 Inches Wide**

**Up to 2,400 Feet Long**

## Revolutionary Technology

### Proprietary Low-Cost Manufacturing Process

PowerFilm has developed a proprietary thin film manufacturing process which consists of roll-to-roll manufacturing of solar cells using an amorphous silicon sunlight absorber layer deposited on a flexible plastic substrate. Individual solar cells are isolated by a laser scribing process. Full panels are formed from the isolated cells through the laser welding interconnects which are printed onto the surface of the material and are encapsulated and combined with various backing materials to create solar panels. The roll-to-roll production line is composed of vacuum deposition, printing, laser scribing and welding machines custom-designed and assembled by PowerFilm.

**Roll-to-Roll Manufacturing – Low substrate handling costs.** Starts on a roll. Ends on a roll. The resulting roll of solar panels are 13 inches wide and can be up to 2,400 feet long, which brings material handling, during production, closer to that of the printing industry rather than the smaller batch-based approach of rigid crystalline solar panel production. PowerFilm was the first and remains the only company in the world that manufactures and sells solar panels on plastic using a true roll-to-roll manufacturing process.

**Flexible Plastic Substrate – Allows roll-to-roll manufacturing and printed interconnects.** Flexible yet durable polyimide substrate results in enhanced flexibility, paper thinness and lighter weight. The substrate is as thin as 1 mil (0.025 mm) thick. In addition, the use of an insulating plastic substrate allows for the laser welding of printed interconnects.

**Amorphous Silicon – Low materials costs.** The sunlight absorber layer in PowerFilm solar panels is a low-cost, environmentally-friendly (cadmium free) and commercially-viable technology. The amount of silicon used in the production of PowerFilm's solar panels is as low as 1% of the amount used in rigid crystalline solar panels. Furthermore, PowerFilm extracts the silicon required for its production process from silane gas and is therefore not subject to the silicon wafer supply constraints of the crystalline solar industry.

**Printed Interconnects – Low-cost cell connection process.** Laser scribing, printing and laser welding on-roll enables the automated interconnection of individual solar cells into panels to be carried out in an automated process. Producing 2,400 sq. ft. of material at a time instead of 4,800 individual cells reduces cost while improving quality and enhancing the durability of PowerFilm solar panels by eliminating the need to cut and connect solar cells manually.

**Encapsulation – Low-cost automated process.** PowerFilm solar panels can be encapsulated in a variety of laminate materials to meet the requirements of diverse applications and usage environments. A variety of materials can provide the optimal protection depending on the required product functionality, level and type of protection (moisture/heat/UV), laminate lifetime and cost. PowerFilm's roll-to-roll manufacturing process using thin plastic film also allows the encapsulation step to be carried out in a roll-to-roll process.

**Bonding and Backing Materials – Low-cost installation.** PowerFilm's technology enables the integration of PowerFilm solar panels with several different backing materials including metal, membrane and architectural fabric. Through its relationships with suppliers, PowerFilm can utilize new materials to produce optimal combinations enhancing product functionality and reducing cost.

**Ends on a roll.**