

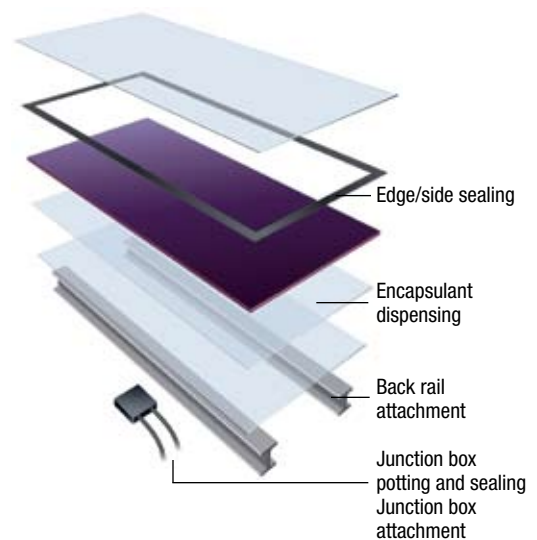
Nordson® Solar Solutions

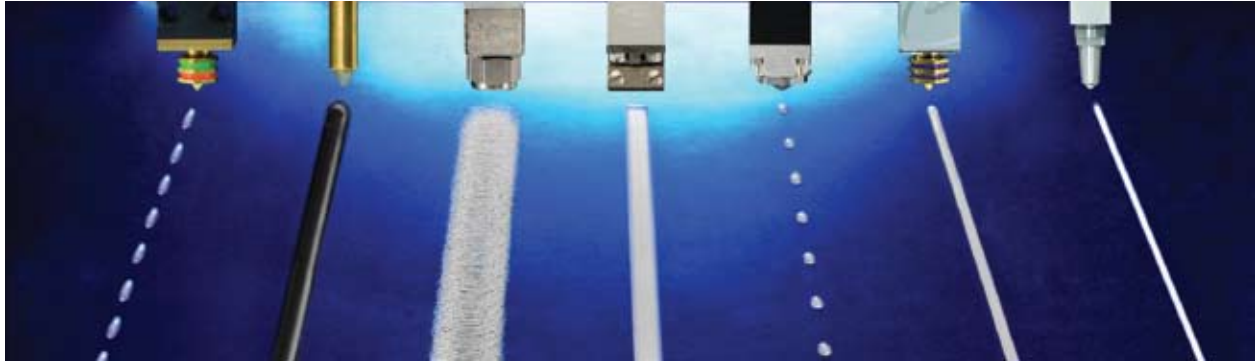
Helping you efficiently produce high-quality thin film photovoltaic (PV) modules

The ongoing challenge for solar energy acceptance is making it reliable and cost-effective over the system service life. Essential drivers to this are to increase module efficiency while reducing manufacturing costs. Increasing efficiency is infinitely more challenging, but lowering cost can easily be achieved several ways including reducing material costs and improving production cycles and output.

The ability to use a much thinner layer of the expensive semi-conductive material, relative to crystalline modules, already has thin film PV modules on the way to grid parity. Additionally, the method of producing thin film modules generally allows for easier upscaling in automated production at reduced overall cost.

Drawing on more than 50 years experience in precision dispensing, Nordson can help improve module consistency and reliability while further lowering manufacturing costs. Implementation of Nordson solutions increases the ability to process a wider range of materials allowing use of the best material for both production efficiency and module durability. And, Nordson systems support your ability to process material in larger bundles so you realize additional cost savings with higher machine uptime and smarter procurement.





Lower Material Costs

Nordson helps you realize lower material costs by allowing purchase of dispensable material in larger bundles. Our systems help protect integrity of materials from problems such as contamination or premature curing. As threat of material degradation and loss of physical properties is diminished, you can start using pails or even drums of material rather than more-expensive tapes or small-volume cartridges.

Through our years of experience, Nordson has worked with virtually every dispensable material including:

- hot melt adhesives, such as ethylene vinyl acetate (EVA)
- warm and cold silicones
- moisture-curing materials
- two-component materials
- butyls
- cold liquid adhesives
- polyamides
- sealants
- TPS

This means we can help you determine the best material in the most efficient form for each of your thin film PV module assembly processes. Whether you need liquid or pellets or solid materials, Nordson has an unloader or melter system for you.

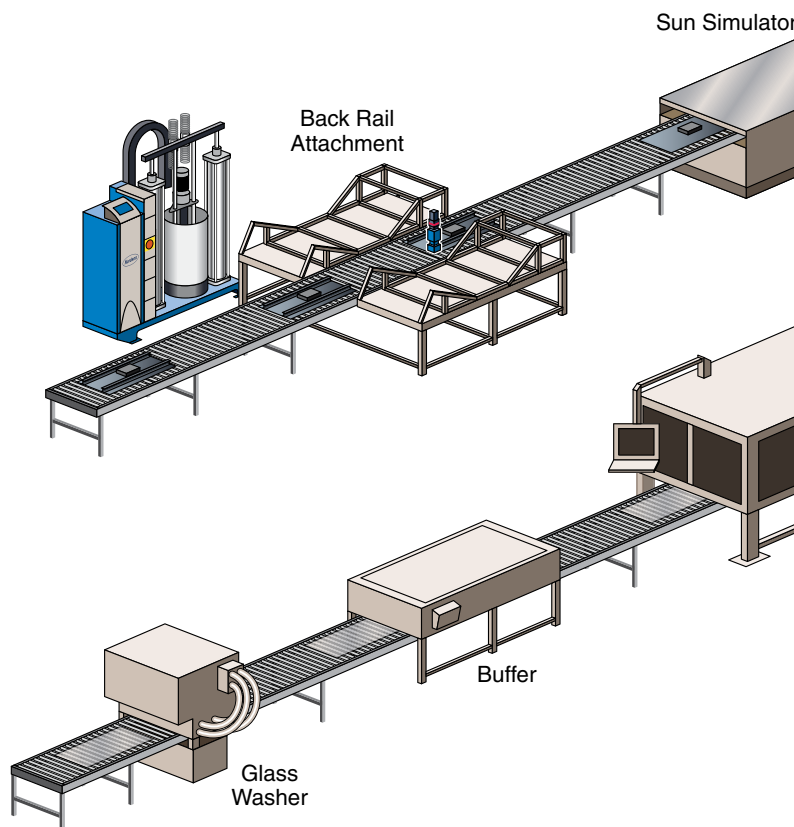
For example, junction box potting is critical as electrical contacts and water do not mix well. Typically the junction box is filled with a two-component (2K) silicone to protect against possible water seepage. Traditional potting processes are often manual or semi-automated, increasing the potential for human error and rework, and thus increasing per module cost. Nordson offers technologies that allow fully automated processing. These automated systems provide more efficient use of traditional potting materials by minimizing excess adhesive application and adhesive waste or residue. Nordson technologies also support a full range of other potting materials including 1K silicones, polyamides, polyurethanes or even UV-curable.

Improve Production Processes

Nordson systems help improve module production further by introducing dispensing techniques previously not common to PV module assembly. Whether improving an existing manual system or automating the process, this can help significantly shorten the time for each production process and increase output by removing bottlenecks.

And, you can produce whatever patterns you need throughout your assembly process. Solid or foamed dispensing can apply beads, tape-like films or spray patterns for reliable bonding and sealing.

Automating attachment of the backrails that provide thin film modules with structural stability and an installation or carrier system is one way to realize process improvement. Traditionally installation of the two to four metal backrails has involved tape applied using manual or semi-automated processes. However, backrail attachment can be fully automated with several in-line glue stations that apply adhesive in liquid form. In addition to the material being a more cost efficient form, the automation speeds up production time while improving the product quality through precise, consistent application.



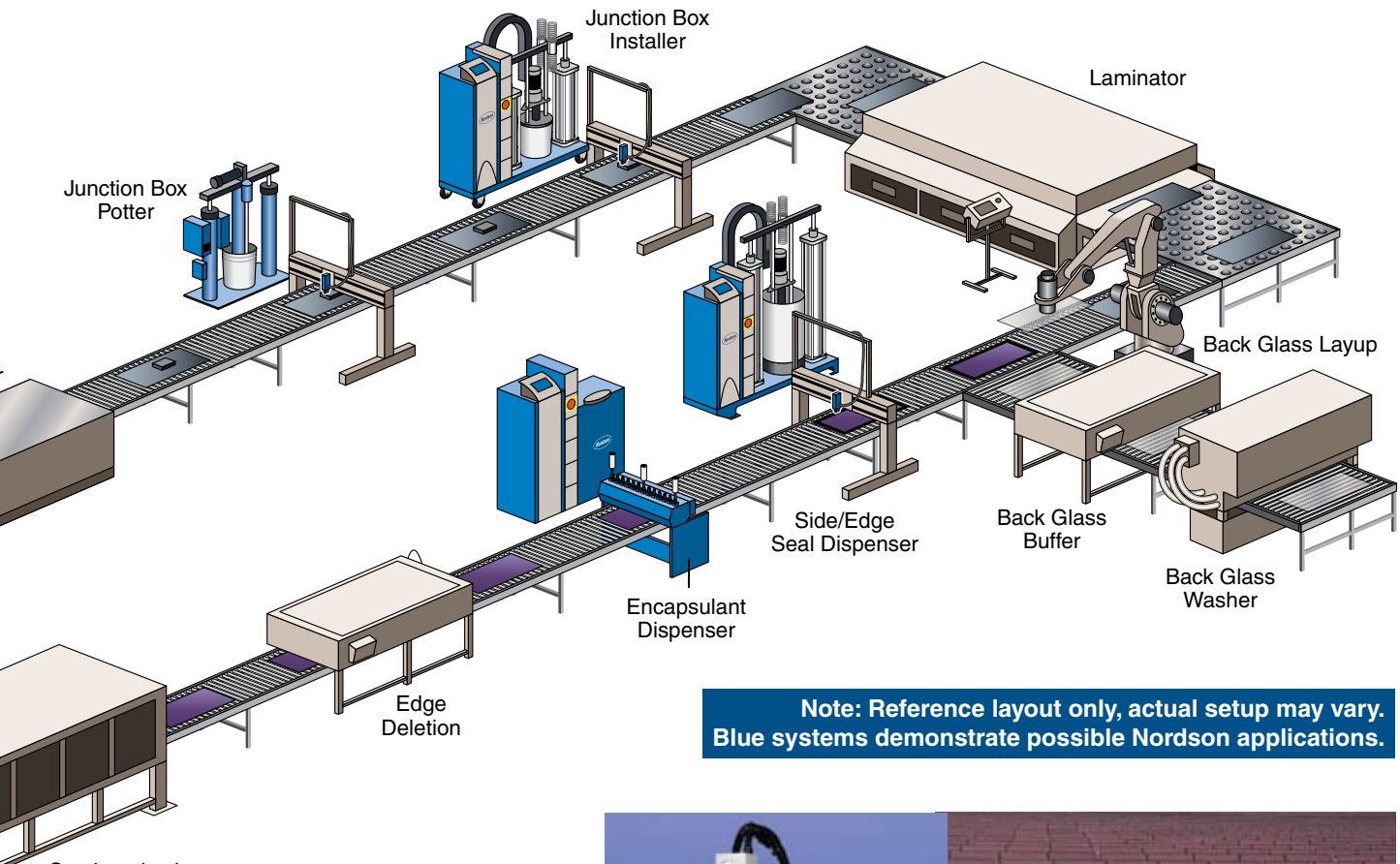
Improve Durability

PV modules are subjected to harsh conditions but must remain impenetrable for decades. The materials and processes used during assembly must protect the internal module components from moisture and corrosion for the modules' lifetime. While the material itself must provide the barrier, the application of the material is also critical. Precise, consistent application, both volume and position, must be maintained to avoid potential gaps or voids of material. Either too little or too much material can allow moisture ingress and corrosion.

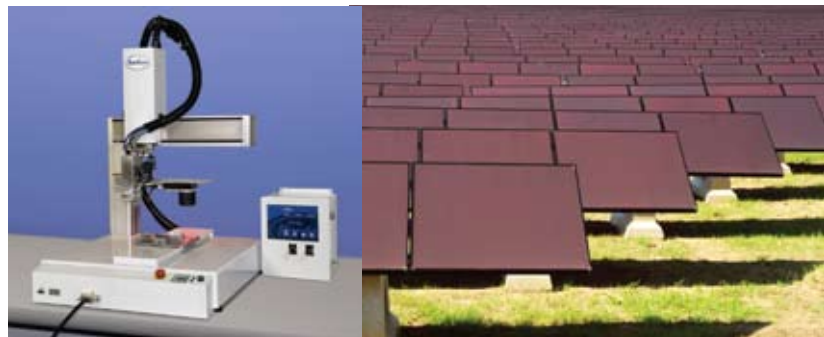
Nordson has dispensing systems that offer precise metering of material and maintenance of pressure, even during production start-ups or slowdowns. The control systems allow

easy development of precise patterns that can be stored or retrieved as needed. And, use of a Nordson verification system allows inspection of the material to check volume and placement within your defined tolerances.

One example of improving durability is automated application of molten butyl as a replacement for manually-applied butyl tapes for side/edge seals. Manual application is labor intensive and lacks consistency. As butyl side/edge seal provides an additional moisture barrier around the edges, having a thorough, consistent seal guards against moisture ingress. Using liquid butyl results in accurate, repeatable application not possible using manual tape application. An additional benefit of liquid butyl in bulk forms is elimination of tape rolls that require frequent reloading, which interrupts production.



Semiconductive Material Deposition, Busing and Laser Scribing





The Green Commitment

While development of solar energy and thermal heating is inherently “green”, Nordson’s involvement is broader. As most of our customers are manufacturers of a wide variety of consumer and industrial products, helping them more efficiently use materials and processes ultimately

helps us all. Faster, more efficient production allows manufacturers to better utilize equipment, both reducing consumption of energy to produce each piece and increasing equipment utilization. Additionally, more controlled, efficient production can reduce scrap and waste generation.

The Nordson Offering

Nordson offers a full line of systems to help you most efficiently and effectively use materials and processes. Products including pumps, melters, applicators, controls and verification systems easily integrate into manual, semi-automatic or fully-automatic production lines. And, an ongoing commitment to research and development regularly results in new processes and applications.

Through our years of experience, Nordson has developed a worldwide support network. A locally-available, global team of highly-trained, knowledgeable engineers, service technicians and 24/7 support staff help you develop, install and maintain dispensing solutions for your solar product assembly. Our people are supported by an infrastructure that includes research facilities, test laboratories and parts distribution warehouses in locations throughout Europe, Asia and the Americas.

Our worldwide team supports you before, during and after the sale to develop the right solution for your PV module assembly production.

Please contact Nordson solar solutions today to see how we can help you efficiently and effectively produce durable, high-quality thin film PV modules.



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