Automation Control for Glass Cleaning Equipment

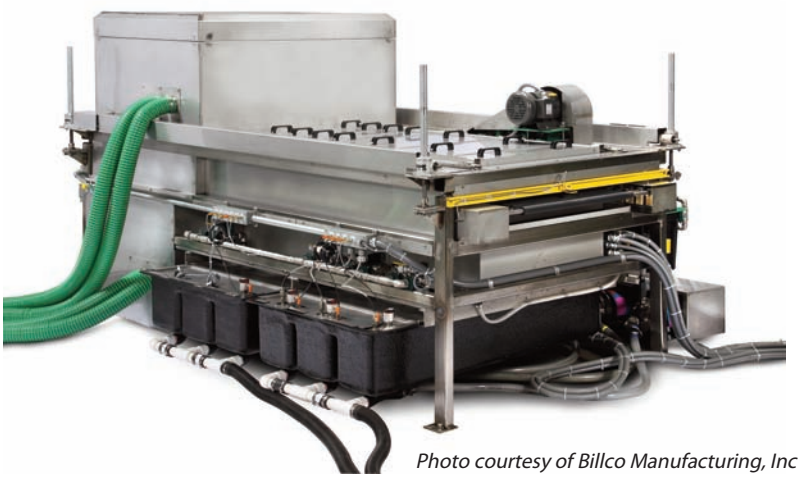


Photo courtesy of Billco Manufacturing, Inc
www.billco-mfg.com

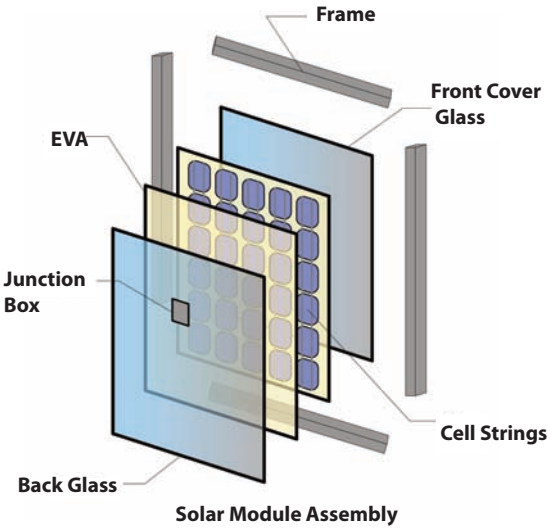
Advantages

- **Connected Components Building Blocks –** Pre-built and tested engineering and application toolsets speed design and shorten development and startup time of components
- **Modular Code** – Additional control zones can be added easily by building code with common functions encapsulated into Add-On-Instructions (AOIs)
- **Operational Parameter/Recipe Access** — Operator interface used to select and store operational parameters and set points
- **Faster Development/Troubleshooting —** Pre-built and tested AOIs with Human Machine Interface (HMI) faceplates provide detailed diagnostics
- **Process Optimization** — Closed loop process control of temperature, pressure and flow improves the cleaning process and limits glass breakage
- **Data Access** — Information enabled code structures pre-built for quicker implementation of data collection needs such as Overall Equipment Effectiveness (OEE) and historical process data
- **Integrated Drive Control** — Pre-built and tested AOIs and HMI faceplates speed deployment of networked drives and provide enhanced diagnostics

Overview

Developments in photovoltaic (PV) technology have pushed glass and glass washing equipment to the forefront of glass applications. Glass washing machines are fundamental components for critical pre- and post-processes used in solar panel manufacturing and assembly. Minute traces of ionic particles on solar glass can compromise energy transference, directly affecting the efficiency of the module. These ions may be deposited by previous processes or transferred from machine component corrosion, abrasive washing processes, ineffective drying or imprecise machine function.

In the crystalline manufacturing process (solar cells built on silicon wafer substrates), the solar cells are typically encapsulated between layers of material including the front glass, an ethylene vinyl acetate (EVA) layer and a back substrate. The back substrate can be glass, anodized aluminum or a polymer such as Mylar® or Tedlar®. The EVA is melted to encapsulate the delicate solar cells and the cover glass forms a protective layer against the environment.



Solar Module Assembly

LISTEN. THINK. SOLVE.

Glass washers are essential to assure the module cover glass is thoroughly clean before the encapsulation or laminating process. All dust, residue, and fingerprints must be completely removed from the glass to avoid defects that could cause the laminate to fail prematurely.

A greater level of cleanliness is required by thin film photovoltaic manufacturers as the glass needs to be pristine before subsequent layers of materials are deposited. It is critical that the glass is rid of any contamination caused by residues or foreign particles.

Manufacturers of glass washers often provide different models based on how the glass will be used. Options and features available on the glass washers will be dependent on the manufacturing process and cleanliness level required.

Glass washers, available in both horizontal and vertical formats, can be stand-alone or integrated into a fully automated production line. They also require tie-ins to facility systems including de-ionized water and utility drainage systems. Stainless steel components are used for increased durability and reduction in potential contaminates caused by atmospheric and hydro-corrosion of regular steel.

Typically, glass washers will consist of multiple zones that include pre-wash, wash, rinse and dry. The number of zones and the zone type will vary based on the washer.

Pre-wash – Spray manifolds or high pressure jets are used to remove dirt from the glass surface before entering the washing zone.

Wash – A detergent solution and hot water are used to clean the surface. Some washers use brushes or oscillating scrubbers in the wash zones, while others deploy contact-free cleaning methods using high velocity spray nozzles or high fluid agitation through ultrasonic rinsing. These methods avoid molecule transference and remove microscopic impurities from the glass surface.

Rinse – Most washers use a multiple rinse cycle with spray manifolds or nozzles to rinse the glass. Fresh water, often de-ionized, is used to prevent minerals from depositing on the glass as it is rinsed and dried.

Dry – High pressure blowers with air knifes are used to dry the glass. A thorough drying technique is critical for photovoltaic processing since even very small amounts of moisture can deposit particles on the substrate.

A conveyor carries the glass sheets through the zones on rubber coated rollers to safeguard the glass from marks and scratches.

The sensitive nature of photovoltaic glass substrates requires extensive failure mode and affects component analysis as well as constant data tracking. Through continuous process monitoring and making changes based on collected data, the glass washer operator can allow for instantaneous adjustments to processing parameters, thereby reducing energy and water consumption and increasing uptime.

Solution

Rockwell Automation offers several solutions to help monitor and control glass cleaning equipment. For glass washers that provide basic cleaning, a control architecture based on an Allen-Bradley MicroLogix™ Programmable Logic Controller (PLC) is one option. For glass washers that provide critical cleaning and require more zones and thus more control, an architecture utilizing an Allen-Bradley CompactLogix™ Programmable Automation Controller (PAC) is another option.

With the MicroLogix PLC, machine builders can take advantage of a powerful controller in a small package and easily connect to other components like a drive and an operator interface. Taking advantage of the Connected Components Building Blocks (pre-built and tested engineering and application toolsets) speeds design and shortens development and startup time. These building blocks offer preferred interoperability of the broad portfolio of component class products from Rockwell Automation.

Using the CompactLogix PAC, OEMs can take advantage of the Rockwell Automation Integrated Architecture™. Integrated Architecture brings together a powerful multi-disciplined control engine, seamless networking, a scalable visualization platform and the information technologies needed to help you lower your Total Cost to Design, Develop and Deliver^{SM} a machine.

Unlike conventional control architectures, the Integrated Architecture provides fully integrated, scalable solutions using a single control platform and a single development environment. This helps machine builders shorten design cycles and enhance business performance.

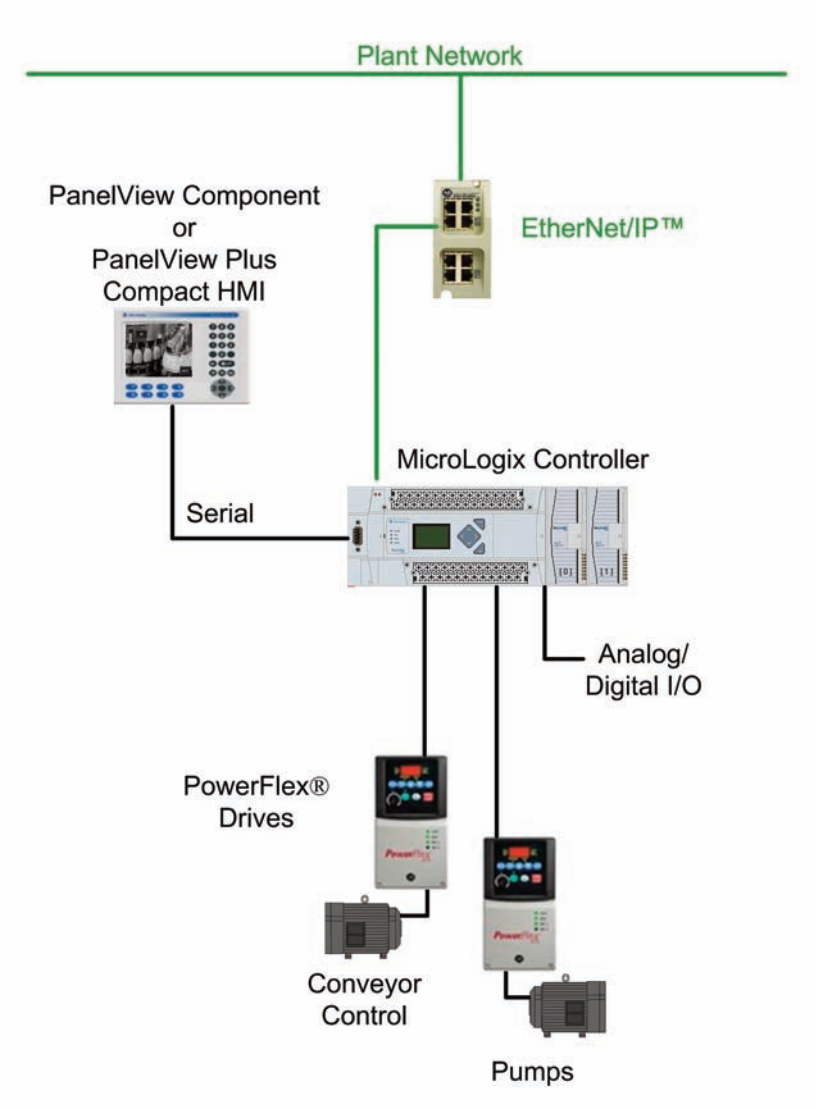
The controller synchronizes all system components. It runs recipes based on the glass size which can optimize the consumption of raw material and improve

productivity. The controller continuously monitors the system for problems and can alert operators of any troubles via the PanelView™ Plus HMI. This can quicken troubleshooting efforts and reduce machine downtime. The PanelView Plus HMI can also display critical machine functions such as the machine state, the recipe being run and recipe parameters like conveyor speed, glass size, water temperature, water pressure and pump velocity.

Additional modules from the FactoryTalk® Integrated Production and Performance Suite can be deployed to help photovoltaic manufacturers reduce energy and water consumption, increase equipment uptime and track each piece of glass with relevant process parameters. Process data can be archived in a historical database using FactoryTalk Historian. Overall Equipment Effectiveness (OEE) can be calculated with FactoryTalk Metrics and used to help improve productivity by understanding downtime events. A production dashboard displayed with FactoryTalk VantagePoint can help production managers run their facility more effectively by focusing on specific areas for improvement.

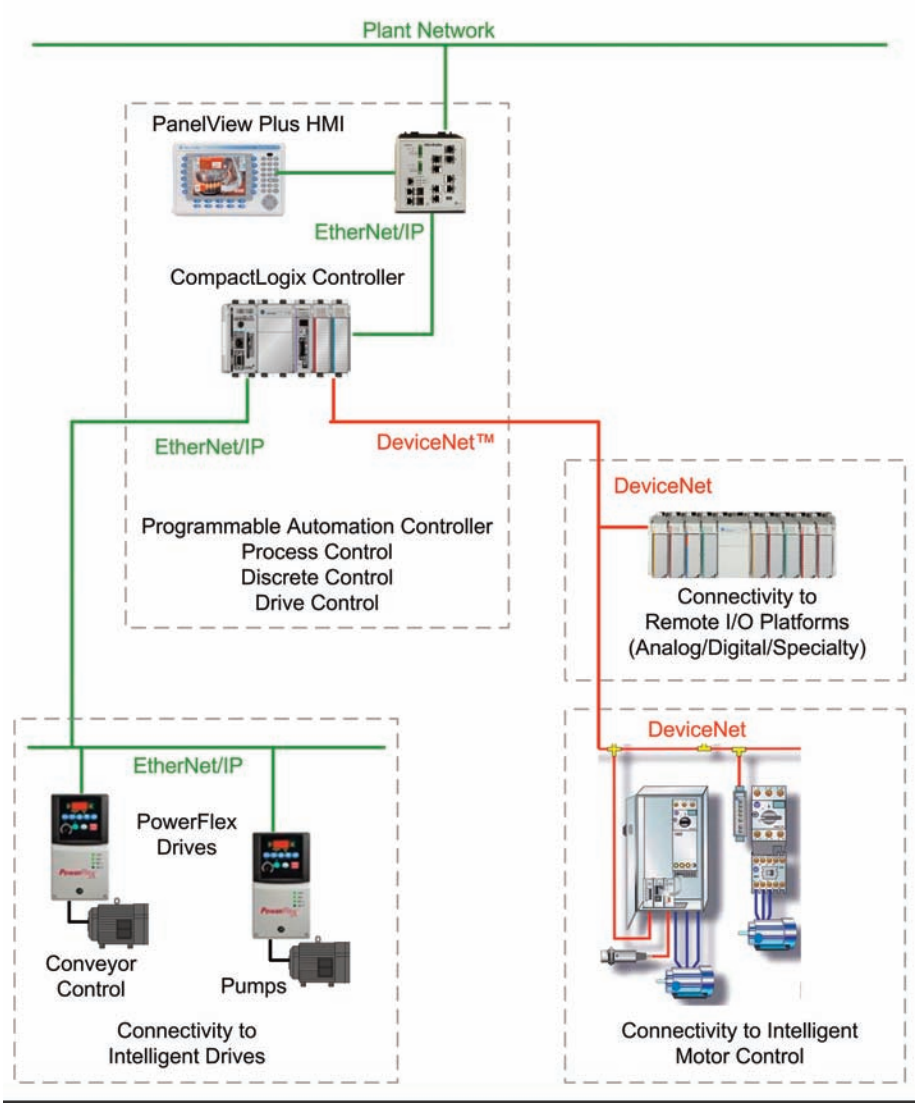
Typical Architecture

Basic Cleaning or Stand-alone System



Typical Architecture

Critical Cleaning or Integrated System



Rockwell Automation solutions deliver improved production capabilities and help reduce the total cost of ownership by providing unparalleled functionality, flexibility and scalability. Machine builders can respond more quickly to customer or market demands, reduce maintenance costs and downtime and easily gain access to actionable plant and production information for improved management and decision-making.

Power, Control and Information Solutions Headquarters

Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
Europe/Middle East/Africa: Rockwell Automation, Vorstlaan/Boulevard du Souverain 36, 1170 Brussels, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

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