Process Solutions

Flexible and Reliable Control Solution for Semiconductor Manufacturers

Honeywell's HC900 Process Control System helps semiconductor manufacturers maximize productivity and increase uptime for HVAC equipment used in clean rooms, production laboratories and other critical space environments.

The semiconductor industry is growing at a rapid pace, particularly in markets such as China, which are focused on meeting the increased global demand for integrated circuits (ICs), light-emitting diodes (LEDs), liquid crystal displays (LCDs), and solar panels.

Manufacturers with critical space requirements in their facilities set very strict standards for the technology they use; equipment has to operate 24/7/365 in order to maintain a stable production environment and high-quality end products.

Figure 1. The reliable operation of HVAC systems is key for semiconductor plants with critical space requirements.

The quality of the air in these facilities is strictly controlled and must be maintained at precise levels relative to temperature, humidity, pressure, flow rate and cleanness. Any failure in the heating, ventilation and air conditioning (HVAC) equipment could result in production losses costing thousands of dollars. The quality of the air is even more important than energy savings.

Rigorous Operating Challenges

In the semiconductor industry, environmental monitoring/control of research laboratories, clean rooms, data processing centers

and heating/cooling plants has implications for a manufacturer's overall operational and business performance.

Airborne contaminants render various defects on an electronic device (e.g. wafer or glass substrate). These contaminants could easily damage the device due to their proximity and localized high concentration.

The HVAC design for a semiconductor manufacturing facility is typically focused on increasing the cleanliness of critical environments and tightening temperature and humidity parameters. With the advent of stricter industry regulations and operating constraints, HVAC systems must be upgraded to provide greater airflow, tighter control, and more flexibility.

In addition, a large percentage of the total plant power consumption is tied to operating air conditioning systems. Semiconductor companies must find ways to achieve energy savings in order to remain competitive in the market and address global environmental concerns.

Choosing a Control Solution

With current business demands, semiconductor plants need to maximize productivity and increase uptime for HVAC equipment. Advanced automation technology is needed to accommodate greater air and exhaust flow, and tighter temperature and humidity control, as well as improve operational flexibility.

When evaluating new automation technology, end-users typically ask: Will this control solution help ensure stable production and consistent product quality in accordance with customer requirements? How will it improve our return on investment?

HVAC engineers not only consider the functional requirements for control equipment, but also its reliability, ease of use and

maintainability. In addition, they try to select solutions that will enable them to remotely diagnose problems with their processes.

The key criteria for control systems used in HVAC applications include:

- Redundant CPUs
- Redundant power supply
- Hot swappable boards
- Advanced PID algorithms
- High measurement accuracy
- OPC database capability (HVAC systems are typically proprietary)
- Advanced control algorithms
- Open interface (Most HVAC systems employ proprietary "only" HMI interfaces)
- Flexible I/O (HVAC systems normally have rigid designs)

HC900: Designed for Demanding Applications

The Honeywell HC900 is an advanced process and logic controller based on a modular, scalable design that is sized to meet the automation needs of a wide range of HVAC equipment. The HC900 can be used for a host of diverse control tasks – from process programmable logic controllers (PLCs) to low-end distributed control system (DCS) applications. The controller's touch screen operator interface provides user-friendly pre-built or custom displays, along with trending, data archiving and a host of other capabilities.

The HC900 is a superior solution to most PLCs for semiconductor industry applications. It offers a selection of controller CPU modules, multiple I/O rack sizes, and local or remote I/O racks providing a flexible architecture that can accommodate the most demanding application. Modularity, built-in redundancy, versatile I/O configuration and connectivity, plus the ability to configure complete process solutions and archive their program parameters for easy retrieval and implementation, permit customized, pinpoint control.

The HC900 utilizes a secure engineering software tool that minimizes project development and commissioning time, and helps to protect intellectual property. This Windows™-based application uses graphic objects to represent function blocks, greatly simplifying control strategy development and improving configuration record keeping. The software is license free, allowing users to obtain free updates via the Honeywell website at no charge. In addition, Honeywell's PC-based Station

Designer software enables fast implementation of the controller HMI.

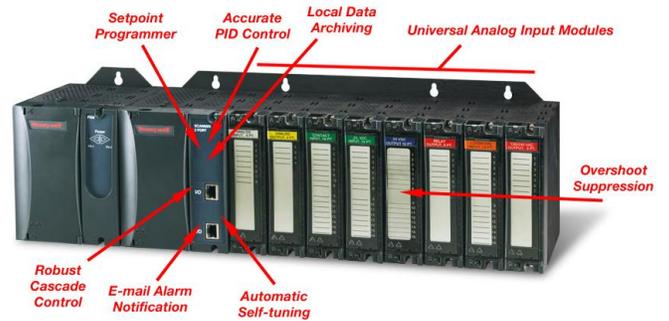Figure 2. Honeywell HC900 Process Control System.

The HC900 includes a number of key technology features not commonly offered by PLC suppliers.

Accurate PID Control

The HC900 provides precision PID control for single- or multi-loop applications. It also supports duplex control for applications with individual sets of tuning constants. Position-proportional control for motorized valves and actuators is standard and no special I/O module is required. The unit's process measurement and control accuracy is +/-0.5% of configured sensor input range. Additionally, the HC900's algorithm set is tailored for analog control applications where set point programming, carbon potential, cascade, feed forward and ratio control are common requirements.

Universal Analog Input Modules

Inputs may be mixed on a module and can include multiple thermocouple types, RTDs, ohms, voltage or milli voltage types – all easily assigned using the HC900's Designer Software. High point-to-point isolation simplifies installation and saves the expense of external isolation hardware.
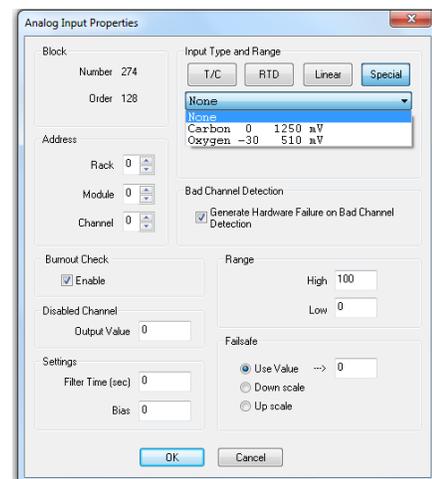

Figure 3. Universal Analog Input Modules.

Local Data Archiving

Local data archiving can be provided by the HC900 to ensure process history is maintained even in the event of a supervisory system or HMI failure. This is especially valuable for regulated industries where accurate process record keeping is critical.

E-mail Alarm Notification

Furnace alarm conditions can be sent by the HC900 via e-mail to a remote PC or pager, providing simpler and faster notification of a process upset.

Automatic Self-tuning

The Accutune III automatic tuning algorithm accurately identifies and tunes any process. This speeds up and simplifies start-up and also allows retuning at any setpoint. At the end of the tuning process, the controller immediately calculates the new tuning constants and stores them in the PID block. Control resumes with the new tuning parameters.
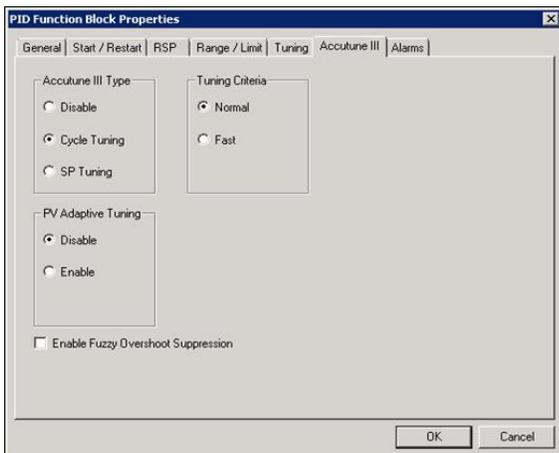

Figure 4. Automatic Self-tuning.

Overshoot Suppression

Fuzzy overshoot suppression minimizes the Process Variable (PV) overshoot following an SP change or a process disturbance. This is especially useful in processes that experience load changes or where even a small overshoot beyond the SP may result in damage or product loss.
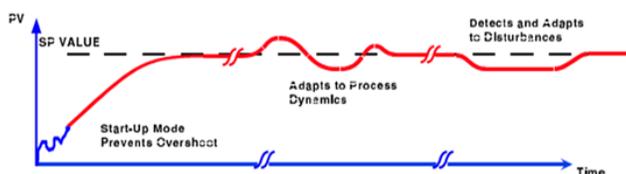

Figure 5. Overshoot Suppression.

Cascade Control

The HC900's cascade loop uses two PID blocks with the back calculation pin of the secondary loop connected to the primary loop. This transfers values back to the primary loop to adjust the PID for changes in mode of the secondary loop.

Setpoint Programmer

An SP programmer block is used to vary the SP values with a time-based profile. This block is a part of the SP program category. The setpoint program containing ramp and soak segments is loaded to the block. Depending upon the segments, the SP value is increased or decreased with time. A single program or profile can contain 2 to 50 ramp/soak segments in length. Up to 1,310 profiles can be loaded to the controller's memory. Each segment in the profile can be ramp or soak, but the last segment must be soak.

Along with ramp/soak SP value, auxiliary analog value output is provided in SP programmer. For each ramp and soak segment, auxiliary output value can be configured. It is the fixed soak value and can be used to provide an SP value for a secondary control loop in the process.

The SP programmer block contains the setpoint guarantee function. It holds the program and the SP value if the process variable exceeds the predefined deviation from SP. Up to three process variables can be configured as inputs to block, which can be used by the guarantee hold function.

Advantages for Semiconductor Plants

Scalable System Configuration

The HC900 process controller's scalability makes it ideal for controlling either a single or multiple systems. The controller can also be provided with redundant and non-redundant CPUs, power supplies and communications, helping to minimize process downtime.

Honeywell's Station Designer software integrates with the HC900 software engineering tool to streamline configuration tasks. The software's intuitive development environment offers more than 4,000 pre-built process graphic symbols, widgets, animation, hide object, if-then-else scripting, and much more.

Powerful Integration with Experion

The HC900 is easily integrated with Honeywell's world class Experion® Solution. Experion provides a server- and client-based architecture, and server redundancy is also available. It offers custom displays and over 300 preconfigured standard displays to reduce implementation time. The user displays allow operators to securely interact with the process via the HC900 controller. Temperature set point profiles and recipes can quickly be

selected and edited as needed. Additionally, users can determine the status of process control loops; record alarms, events and history; and generate reports.
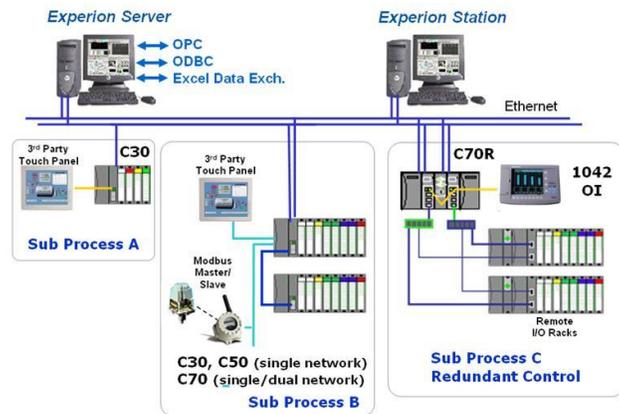

Figure 6. SCADA Support.

Seamless Third-party Integration

The HC900 can be integrated into new or existing third-party systems via the Matrikon OPC server. This allows connectivity to non-Honeywell programmable logic controllers (PLCs), distributed control systems (DCSs), HMIs and SCADA systems, as well as a host of business applications. The Matrikon OPC Server reduces engineering costs and enables data to be shared across different platforms.
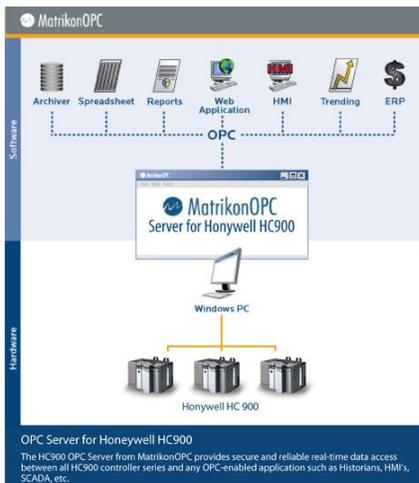

Figure 7. Seamless Third-party Integration.

Improved Operator Effectiveness

The HC900 Control Station offers a number of key features to improve operator effectiveness. These include:

- Rugged NEMA Type 4X operator interface
- Easy-to-operate 10" touch screen display
- Standard and custom graphic elements

- Custom graphics tools
- Function block widgets
- Controller status displays
- Intuitive recipe selection
- Trending and data logging
- Multi-level log-on security feature
- Alarm/event logging with e-mail notification
- Ethernet or serial connectivity
- Embedded web server
- Multiple interfaces

Figure 8. HC900 Control Station.

HC900's 10- or 15-inch touch screen HMI includes an extensive array of standard operator displays and pre-built display "widgets" to complement robust control function blocks. Display widgets are intelligent graphic objects that bind display and controller function block parameters through a single reference. This eliminates the time-consuming process of uniquely identifying the data source for each display parameter. The HC900 control station also provides trending objects that can be integrated into displays to provide a recent history of process performance.

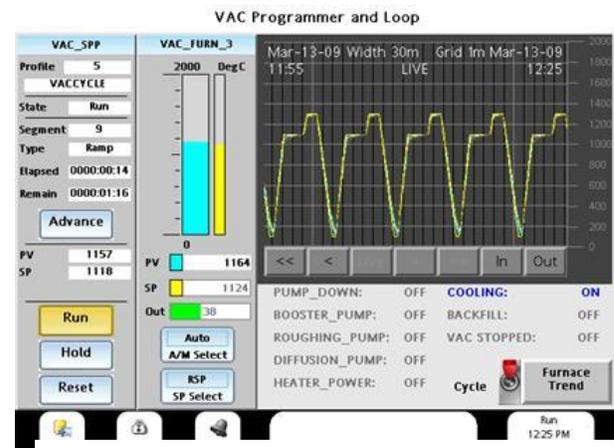Additionally, data logging to an internal compact flash card is

Figure 9. HC900 Touch Screen HMI.

supported with the HC900, allowing access via a network connection and Web server, or a USB memory module. Logs may either be continuous or batch, and stored at specified frequencies using single or multiple file partitions.

Greater Ease of Use

During startup, users are able to monitor the operation of the HC900 and change implemented configurations. The controller's I/O modules can be removed and inserted without shutting down operations – eliminating downtime and associated costs. Furthermore, the HC900 provides open and secure communications via Ethernet and the Modbus/TCP protocol. The controller is Web-enabled with e-mail alarming and Web server technology.

Benefits of the Technology

Semiconductor industry operations can realize substantial benefits for the HC900 solution:

- Improve project efficiency for up to 15% savings
- Save weeks of delay during late-stage design changes
- Improve production by up to 12-15%
- Lower total cost of ownership by up to 20-25%

Global Support from an Industry Leader

Honeywell understands the unique demands of semiconductor manufacturers. Our process automation solutions can help you maximize revenue, increase profits and reduce design and implementation costs. We also provide comprehensive pre- and post-sales support, as well as value-based solutions that help drive business success.

Honeywell is a pioneer in process control and today, more than 8,000 technicians use collective expertise to work for customers in 67 countries around the world. Our global development teams are driven to the highest standards to meet customer product requirements for ease of use and maintenance.

Honeywell also provides world-class customer support via our Global Technical Assistance Center (TAC).

Experion® is registered trademark of Honeywell International Inc.

For More Information
Learn more about how Honeywell's HC900 Process Control System can optimize HVAC applications, visit our website www.honeywellprocess.com or contact your Honeywell account manager.

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