industry: semiconductor
author: **eric ellis,** chief system designer

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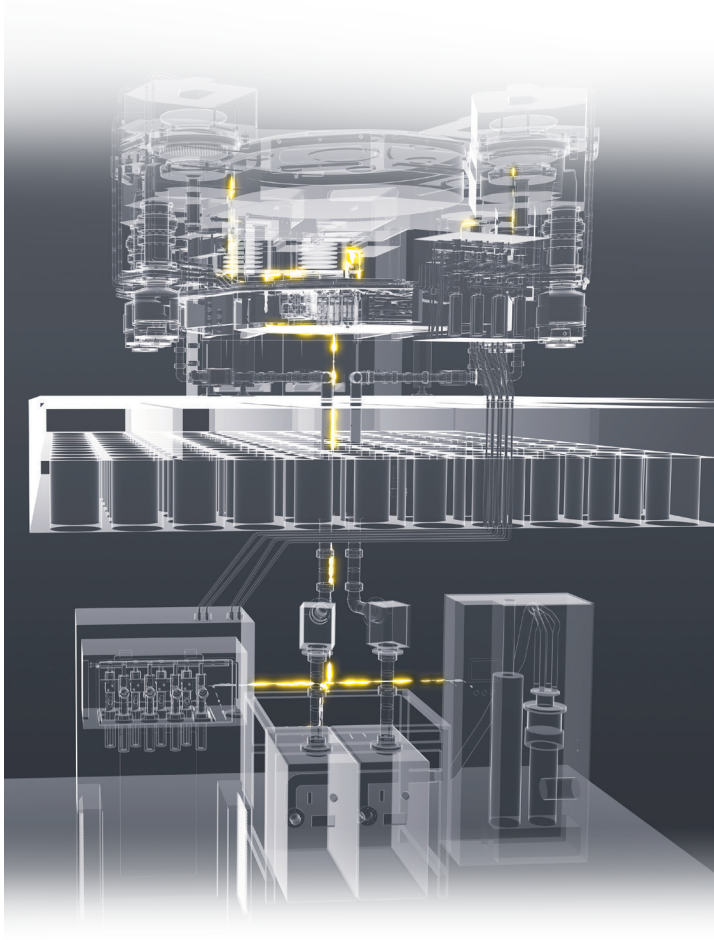
Achieving Temperature Uniformity in Gas Line Heating Systems for Semiconductor Manufacturing



Traditional gas line heating systems fail to offer sufficient thermal data and heating control. Watlow's ***STREAMLINE***™ thermal system with ***ATS***™ technology is an innovative solution.

Summary:

Semiconductor tools with gas lines, forelines and exhaust lines require precise heating and thermal process control. Traditional systems are complex and cumbersome and often fail to offer sufficient thermal data and heating control. Without optimal thermal performance, line shutdowns are inevitable and costly.

Watlow's ***STREAMLINE***™ heating system with ***Adaptive Thermal Systems***® (***ATS***™) technology creates a centralized thermal system with improved temperature uniformity, reduced footprint, extensive diagnostics and faster development times.

The Problem with Traditional Thermal Systems

Semiconductor manufacturing needs to be a tightly controlled process, especially when it comes to thermal changes of materials and components. When the process is not properly controlled, small issues build until a shutdown is needed. Even short interruptions can cost **upward of $50,000 (or more)** per event.

Such issues tend to revolve around three limitations of traditional thermal systems: Thermal stability, lack of thermal data and the complexity of the system itself.

Lack of Thermal Data and Precise Control

The inability to track thermal data prevents manufacturers from maintaining the health of the thermal system. Even a brief fluctuation in the temperature can create a phase shift, causing gasses to condense around apertures and critical components of the heating system. It is precisely that condensation that leads to issues, further disrupting thermal stability and eventually causing more severe problems. Without a central system to collect and monitor thermal performance, traditional systems fail to provide the precise control needed.

The semiconductor market goes through business cycles wherein supply struggles to meet demand. Consider the auto industry's **semiconductor chip shortage** due to the COVID-19 pandemic. With real-world barriers to surmount during unprecedented times, the last thing a business needs to deal with is avoidable operational shutdowns.

Thermal Stability and Condensation

In order to achieve the best fabrication results, process gas must be dispersed at the required flow rate and precise temperature. During gas flow and distribution, it is vital that thermal issues are minimized.

Complex Installation and Maintenance

Engineers and designers are tasked with designing and maintaining thermal processes within semiconductor manufacturing. In traditional systems, this often means more sensors and controllers. Each gas line requires an independent controller, each of which must be carefully monitored to ensure the system functions properly. More devices mean more complexity, and often they do little to address the core issues of creating overall temperature uniformity.

Installation and maintenance of these varying components is also cumbersome. Maintaining them, and the maze of wires they create, can lead to costly and time-consuming maintenance for engineers.

Watlow's experience working in the semiconductor market allowed us to develop a heating system solution that simplifies the chaotic complexity of traditional systems.

The Power of *ATS* Technology in the *STREAMLINE* System

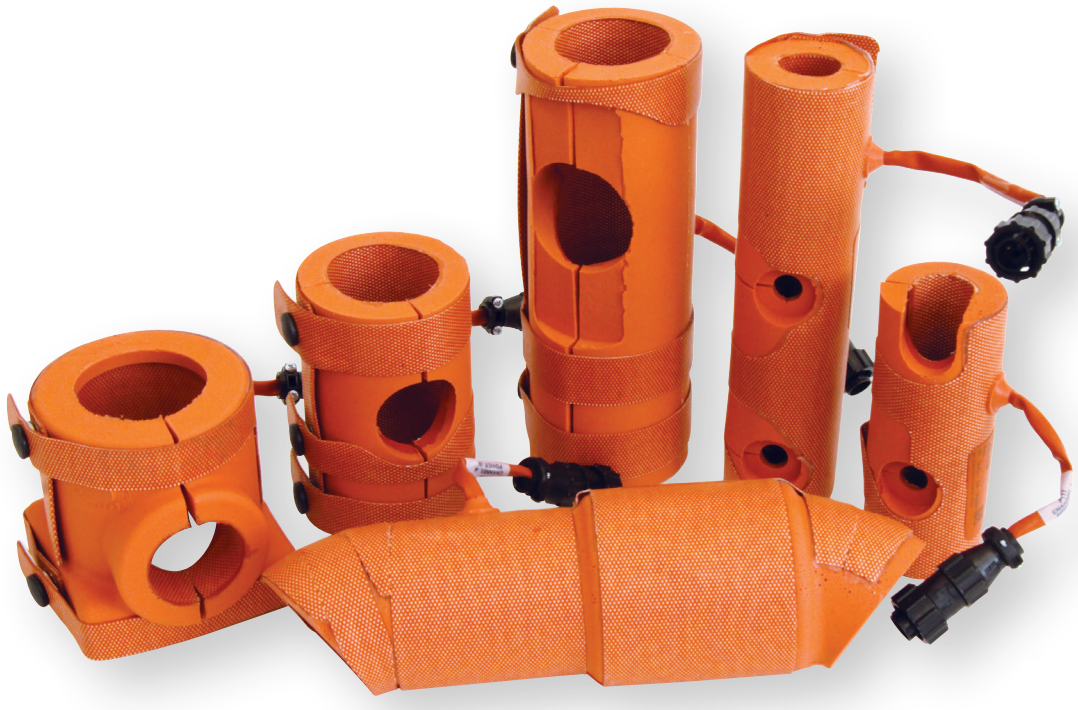
To address thermal data needs, ensure thermal uniformity and reduce the complexity of line systems, Watlow offers a solution with its ***STREAMLINE*** heating system.

The STREAMLINE heating system has three main components: An ***EZ-ZONE® RMT*** controller with ***ATS*** technology and silicone rubber heaters that are manufactured to work with the ***EZ-ZONE RMT*** and a communications device.

What is *ATS* Technology?

ATS is the suite of technologies Watlow® designed to combine heating, sensing and control through a simpler system that is more responsive and efficient. There are four main technologies driving this innovation:

- **Power conversion:** This technology controls the voltage applied to the heating elements, enabling discrete control and improved thermal performance.
- **High temperature coefficient of resistance (TCR) materials-based temperature control:** When this material is used to cover heaters, they become sensors as well. This combination of heating and sensing allows for accurate temperature readings at the surface. Furthermore, this material creates sensors where none could be placed before, which leads to greater temperature uniformity.
- **Integrated thermocouple heater (TCH) junction temperature control:** This technology reduces the number of wires and saves space by turning the heater into a sensor. This also allows for precise temperature measurement without additional sensors.
- **Multi-loop control and sensing:** By integrating a unique power-switching approach with high TCR sensors, in a multiplex wiring scheme, this technology creates a high count zone while reducing wire count.



ATS technology is at the core of what makes the ***STREAMLINE*** heating system less complex and more efficient than traditional thermal systems. Not only does the technology allow for real-time data, but in addition, zones can be highly configured while reducing the amount of space required.

Benefits of Watlow's *STREAMLINE* Gas Delivery Thermal System

The ***STREAMLINE*** system simplifies monitoring system performance with a centralized system of control. The benefits of this simplified system include:

- **Reduced Complexity and Increased Thermal Responsiveness:** Traditional systems become more complex with each new sensor added for additional temperature control. Moreover, each system requires its own controller, further adding not only to the complexity of the system, but also to the maintenance it requires.

  The ***STREAMLINE*** system uses ***ATS*** technology to reduce the system's complexity. Because heating components can also act as sensors, the need for wires and extra components is greatly reduced. Furthermore, the sensors are able to read the temperature at the surface of the gas lines, resulting in greater responsiveness, which helps prevent line shutdowns and unnecessary waste.

- **Increased Temperature Uniformity and Precise Control:** A major benefit of the ***STREAMLINE*** system is the reduction in temperature variance, which can be cut in half with ***ATS*** technology. With quick responsiveness and precise temperature monitoring from a central controller, the ***STREAMLINE*** system provides significantly more data and control during the thermal process.

- **Reduced Development Time:** Due to the simplified nature of the ***STREAMLINE*** system, development time is able to be greatly reduced. Traditional systems require about 14 weeks of development. The need to redesign and rebuild heaters creates additional lead time that is reduced to nine weeks with ***ATS*** technology. Watlow partners with your company's engineers and designers to discover the aspect that ***STREAMLINE*** can most improve in your system. transporting it from stage to stage.

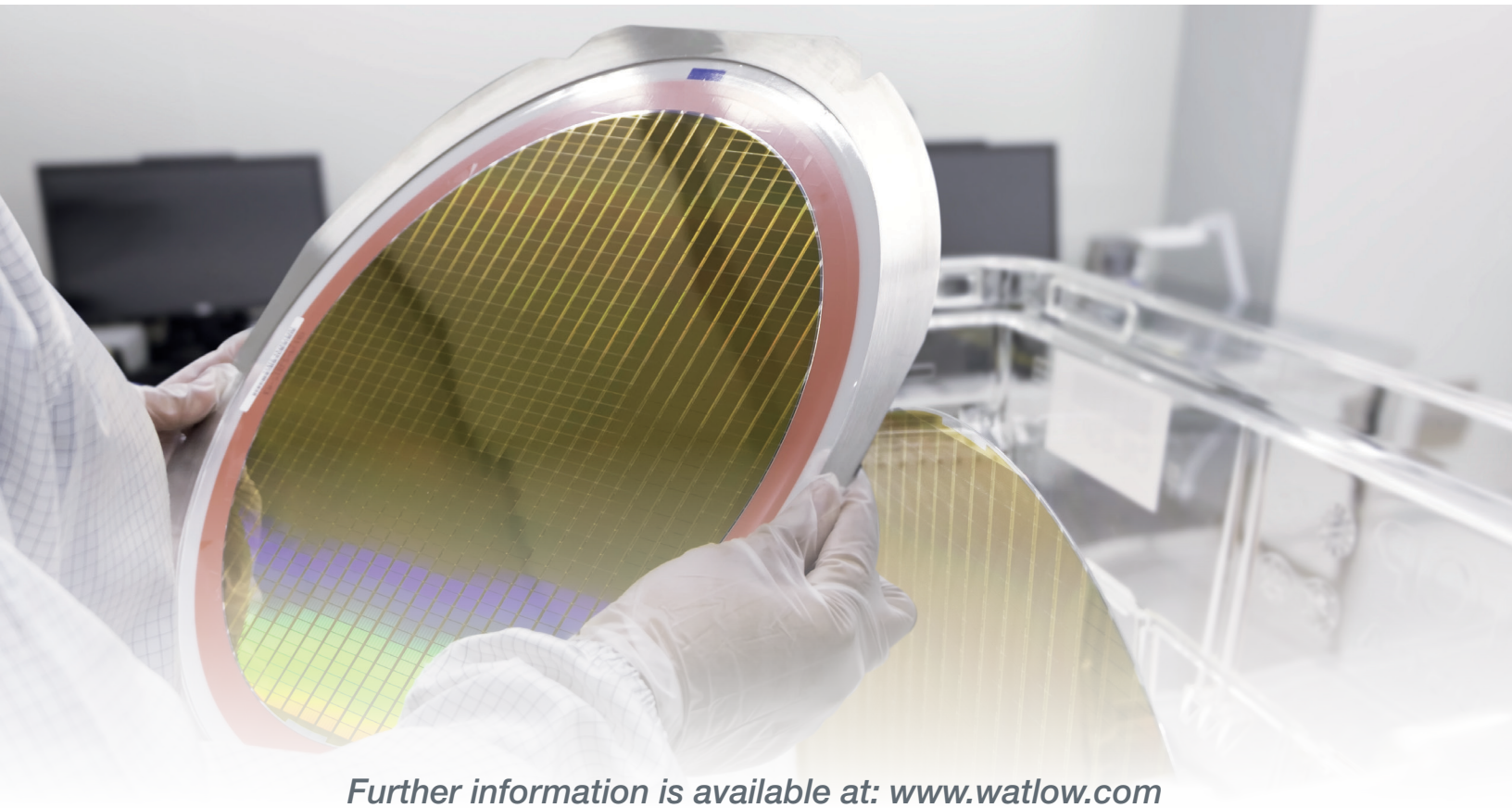
Takeaways

Traditional thermal systems require complex components with mazes of wiring. They take up significant space and need expensive maintenance. In order to add more temperature control, engineers have to add more sensors, which require more wires, along the heating pipes.

Without sufficient thermal data and heating control, semiconductor manufacturers face costly shutdowns that reduce output and increase waste. These headaches are solved with Watlow's ***STREAMLINE*** heating system.

The ***STREAMLINE*** system with ***ATS*** technology is able to combine sensing and heating, providing real-time data with increased thermal responsiveness and temperature uniformity.

Watlow's extensive history in the semiconductor industry allows us to partner with engineers. Together we explore the solutions we have to offer for the pain points in their system. Discover your system's ROI potential; ***contact us today***.



Further information is available at: www.watlow.com