

CASE STUDY: Chrysler Maintains Process Control on Multiple Ovens with Thermal Management

"We chose the system because the continuous monitoring was unique to the Prophet."

—Dean Beard

Chrysler Huntsville Electronics Division

The Chrysler Huntsville Electronics Division, located in Huntsville, Alabama, is a massive high-volume electronics component assembly operation. With 2,292 employees and 24 assembly lines, the plant produces radios, engine controllers, body controllers and instrument clusters for delivery to automotive assembly facilities in other locations.



Roger Barnes, solder wave attendant at the Chrysler Huntsville assembly plant, reviews the real-time profiles for four reflow ovens simultaneously, maintaining continuous monitoring of the process and ensuring that any deviation from the pre-set parameters are identified immediately

The plant operates two shifts a day, five days a week, with preventive maintenance performed during the third shift. The facility as a whole produces extremely high quantities of boards: throughput from just one line, on which engine controllers are assembled, amounts to approximately 8,000 boards per day.

The equipment used on Chrysler's 24 assembly lines includes board loaders, screen printers, reflow ovens, adhesive cure ovens, high-speed placement systems and wave solder machines, as well as in-house-built final testers. Advanced systems with state-of-the-art capabilities are used throughout the plant. Equipment selections are generally standardized across the lines, to ensure consistency of performance and output.

QS 9000 Certification

In 1996, as part of a Chrysler corporate initiative, the Huntsville facility embarked on the process of becoming QS 9000 certified. This quality assurance program, which follows a pattern similar to the internationally-known ISO 9000 certification program, includes elements specific to Chrysler's automotive quality standards.

For all the thermal processes used in the Huntsville assembly operation — including reflow, adhesive cure and wave solder — qualifying for certification involved meeting a number of requirements. Primary among these was the collection and storage of process data. To obtain the precise documentation mandated by QS 9000, the company began investigating the marketplace to determine the most efficient means of collecting and storing thermal data.

At the same time, the company explored methods of monitoring oven temperatures on a continuous basis, in order to ensure conformance to corporate-specified thermal profiles with specific upper and lower limits. Previously, according to Dean Beard, Manufacturing Planning Specialist at the Huntsville facility, oven temperatures had been monitored only once a week on most ovens.

During these weekly verifications, profiles were run using a conventional pass-through profiler; the process consumed about 20 minutes of time. The time and labor required to run the profiles were not the major factor for Chrysler. Rather, the critical issue was the maintenance of temperature consistency throughout the work week. During the 40 hours of running time between profiles, "something might have happened that we didn't know about and that could cause defects in the product," Beard states.

The Elements of Thermal Management

In December 1996, Chrysler Huntsville selected and installed a thermal management system on several ovens, to begin the process of collecting data and monitoring temperatures. The system, the Prophet™ Thermal Manager supplied by KIC Thermal Profiling of San Diego, California, consists of several hardware and software elements. Two probes are installed within the oven, along either side of the conveyor. Each probe contains 15 internal thermocouples which record temperatures at board level every 30 seconds. A Thermocouple Processing Unit (TPU) acquires temperature data from the thermocouples and transmits it to a computer.

On the computer, the system's Windows™-based software allows thermal process data to be displayed on demand, both graphically and in a spreadsheet format. The process may be viewed in real-time, or the user can review data from a previous process by entering a specific date and time. As a result, the documentation required for QS 9000 or a similar quality assurance program can be maintained without manual input. "This system was an ideal product to incorporate for that purpose. It collects and stores the data automatically," says Beard.

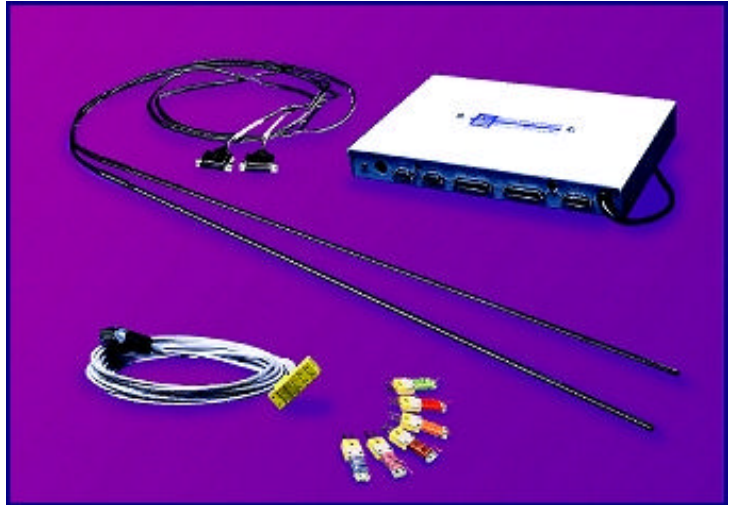
In addition to data storage, the thermal management system offers a variety of options for data transmittal and analysis. These include live data output, sending data in real time to other applications; an integrated package that communicates directly with QC-Calc and other SPC programs; plus an automatic prediction feature that eliminates the need for repetitive manual profiling when calculating a profile for a new product.

Real-Time Process Monitoring

At the same time that the system collected and stored thermal process data, it also provided the real-time process monitoring that the Huntsville facility required to maintain its corporate-specified profiles. "The KIC product looks at our oven about every 30 seconds. That's very critical to some of our processes," says Beard, adding that "we chose the system because the continuous monitoring was unique to the Prophet."

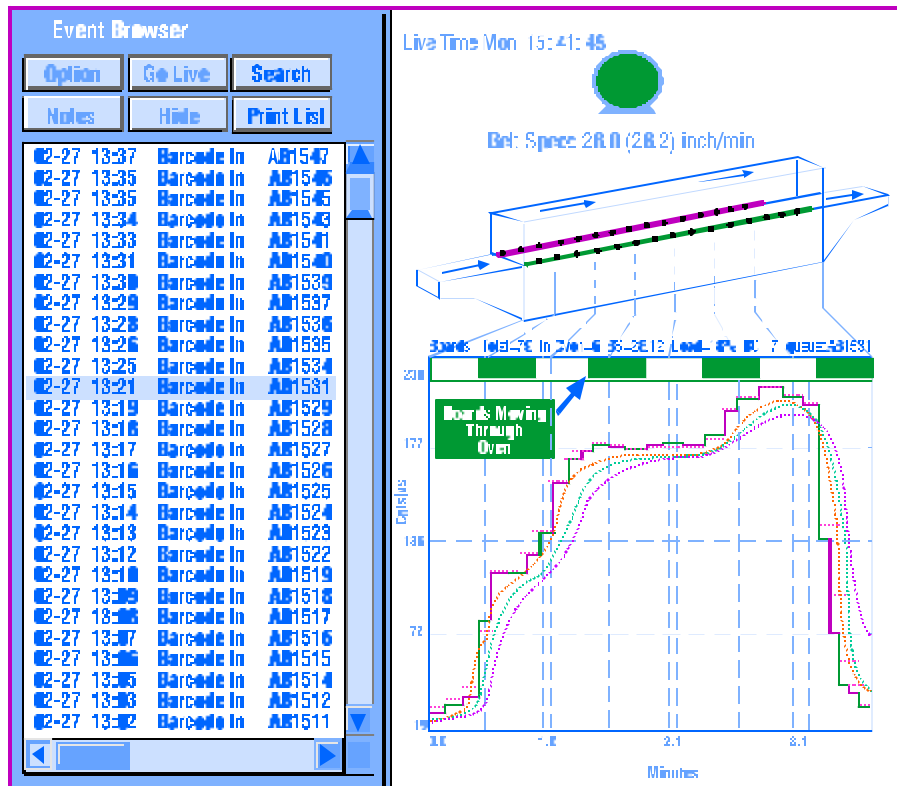
Whenever the thermal management system indicates a problem with a particular oven, Beard explains that Chrysler verifies the finding by using a pass-through SlimKIC profiler supplied by the same company. The profiler is attached to a pre-wired PC board and run through the oven, then the results are compared to those indicated by the thermal manager. Corrective action is taken as required to remediate the process so that production can proceed.

Beard recalls one instance when the system's control function alerted engineers to an unexpected problem in a reflow oven. The thermal management system had just been installed on a line used to assemble body controllers, and production was started. Even though the oven light was green, indicating that the reflow system was fully functional, the thermal manager sounded the alarm and halted the conveyor, preventing board entry.



The hardware elements for the Prophet Thermal Manager include two probes, which are installed within the oven, along either side of the conveyor. Each probe contains 15 thermocouples that record temperature at board level every 30 seconds. A Thermocouple Processing Unit (TPU) acquires temperature data from the thermocouples and transmits it to a computer.

The oven, according to Beard, “was a state-of-the-art system that we’ve standardized on, one of the best in the business.” However, on closer inspection, engineers discovered that the exhaust system was not functioning. “Without the Prophet, the oven would have run and we would have had fumes,” he says. The incident “reinforced our belief that this system does work.”



The Prophet Thermal Manager from KIC Thermal Profiling provides continuous, real-time monitoring for reflow, cure and wave soldering processes, in both graphic and spreadsheet formats. System capabilities include data storage and transmittal, plus live data output to other applications such as SPC programs.

Closed-Loop Process Control

To ensure high-quality output, Chrysler has activated the thermal manager with its monitoring function, plus its integrated closed-loop control system, on two SBEC (single board engine controller) lines. The closed-loop system controls the input conveyor to the reflow oven. As soon as a process problem (such as temperatures exceeding limits) is detected, the system sounds an alarm and stops the conveyor, effectively preventing product from entering the oven. This enables engineers to troubleshoot the oven immediately, before large quantities of boards are processed improperly and possibly damaged.

An additional feature of the thermal management system that is being implemented on one of Chrysler’s assembly lines is board tracking, which monitors the thermal profile of each board as it is processed. This capability allows production data to be traced back to individual products, a critical factor if liability issues need to be resolved.

Since installing its first thermal management systems in 1996, the Chrysler facility has worked towards retrofitting all its reflow ovens and wave soldering machines with the same systems. When the most recent order, totaling 47 systems, has been fully implemented, the Huntsville facility will have 67 Prophet Systems and 12 SlimKICs in use. They will all be used “to monitor our process, making sure everything’s in control,” according to Beard. He anticipates that the closed-loop control and virtual profiling features will also be activated on many of the thermal processes. The overall goal is to ensure a high level of productivity, continuous monitoring, automatic process documentation and product traceability for thermal processes throughout this extensive assembly operation.

For more information, contact:

Dean Beard, Chrysler Huntsville Electronics Division

Tel: 256-464-1281

Fax: 256-464-1348

e-mail: jbeard2939@aol.com

Bjorn Dahle, KIC

Tel: 858-673-6050

Fax: 858-673-0085

e-mail: sales@kicmail.com

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