

KIC Prophet: Zero Defect Production Tool

New Technology for Thermal Management

The KIC Prophet Thermal Manager gives users of SMT reflow ovens, curing ovens, wave solder machines, and high temperature furnaces the capability to monitor and record the thermal profile of every product entering their ovens.

The current state of the art in thermal management is to attach thermocouples to a product, and using a wireless device, run the device and the board through the oven recording the product profile. The purpose of running a profile is to verify that the oven is in control, and typically this is done on a regular basis: monthly, weekly, or once a shift. This is done because an oven is an inherently dynamic environment. Its thermal characteristics are constantly changing, and though these changes are usually very slight in modern forced air convection ovens, they must be monitored regularly in order to verify product quality. The other time that it becomes necessary to run a profile is when there is a problem on the production line. Anytime there is a defect or loss, the oven must be checked to establish that it is not the source of the problem.

There are three problems with the current state of the art. First, using a product profiler is time consuming and often results in production downtime. Second: it is a static process. Each profile run is the equivalent of a snapshot taken with a still camera, and the oven user is forced to assume that the oven is not changing in between “snapshots.” This can be problematic if there is an intermittent problem or failure in the oven. Third: if there is a problem, there is no way to tell how much product has been affected. Essentially, all production between the time when the defect is discovered and the last time the oven was profiled becomes suspect. The KIC Prophet Thermal Manager addresses all of these issues with advanced technology for monitoring the thermal process and increasing productivity.

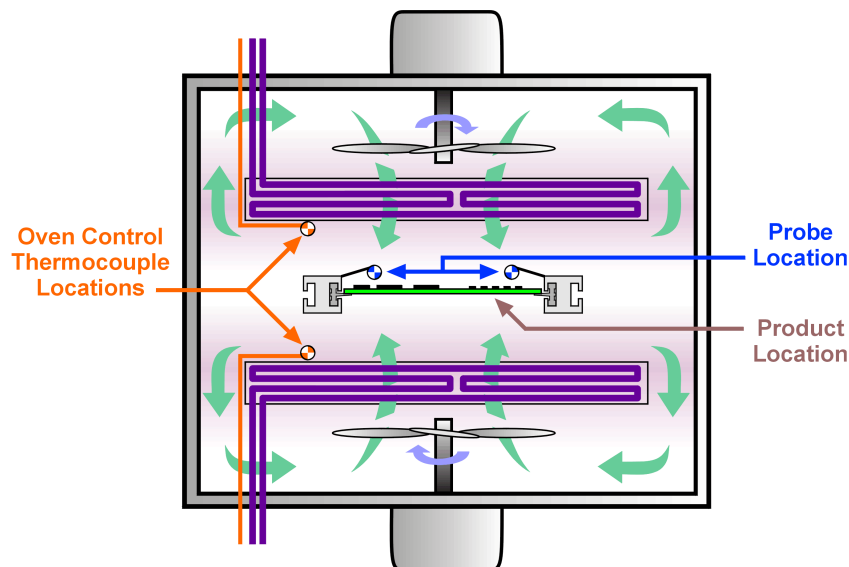


Diagram showing the location of Prophet Probes in relation to zone control thermocouples within the oven tunnel

Real-Time Process Profiler

Unlike the standard thermal profiler, The KIC Prophet is the equivalent of having a video camera running twenty-four hours a day in the oven. The system consists of two probes containing fifteen internal thermocouples which are mounted along the conveyor in close proximity to the product; a thermocouple processing unit (TPU) that sends the probe data to a computer; and a completely self contained Windows based software package. The key difference between the Prophet System and conventional product profilers is that the thirty thermocouples in the probes (see diagram) continuously monitor process temperature. Temperatures are continuously displayed as "Process Profiles" on a PC screen (see fig. 1), and data is permanently recorded on the hard disk. During production, any temperature drift and its location is instantly visible. Because the KIC Prophet is outside the oven control loop, it can reveal critical temperature deviations at the conveyor that are often hidden from the oven control thermocouples.

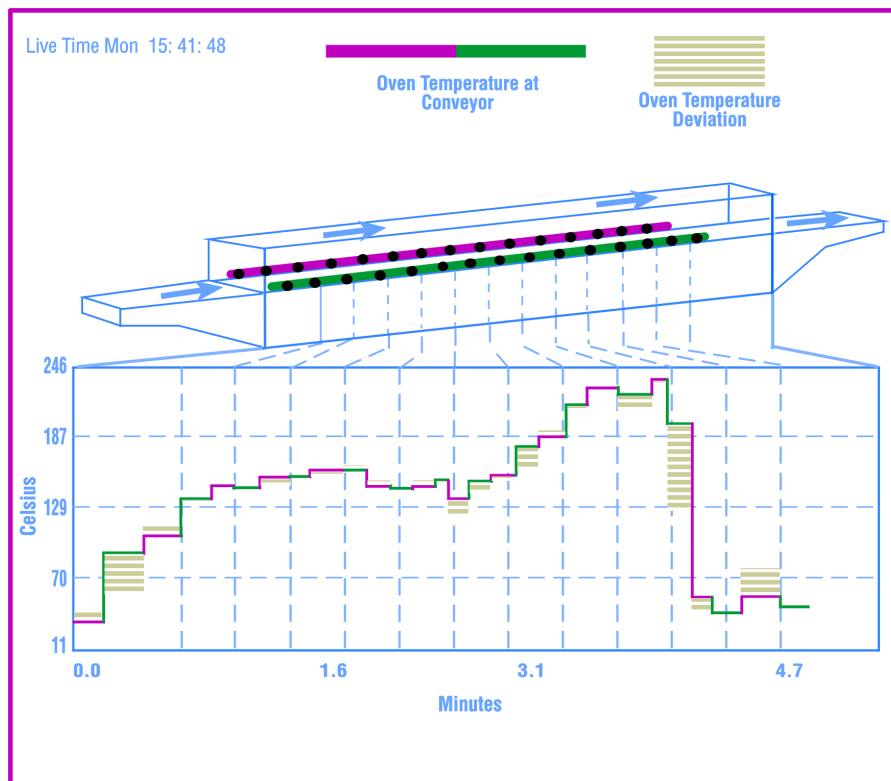


Figure 1: The process temperature at 30 points along the oven conveyor is continuously displayed and recorded

Once an initial product profile has been run, the Prophet software calculates the relationship between process temperature and product temperature, establishing a "baseline profile." During production, the software continuously calculates how this profile has changed based on measured changes in process temperature. This calculated profile is referred to as a "virtual profile." The virtual profile is updated every thirty seconds and permanently recorded (see fig. 2). This can be viewed at any time by entering the date and time in question. If at any point the product profile falls outside user defined limits, an alarm will sound. If a closed loop system is integrated, the alarm feature can be used to shut down the feed conveyor. This capability makes the Prophet an excellent tool for zero defect production, as it eliminates potential product defects due to thermal variation.

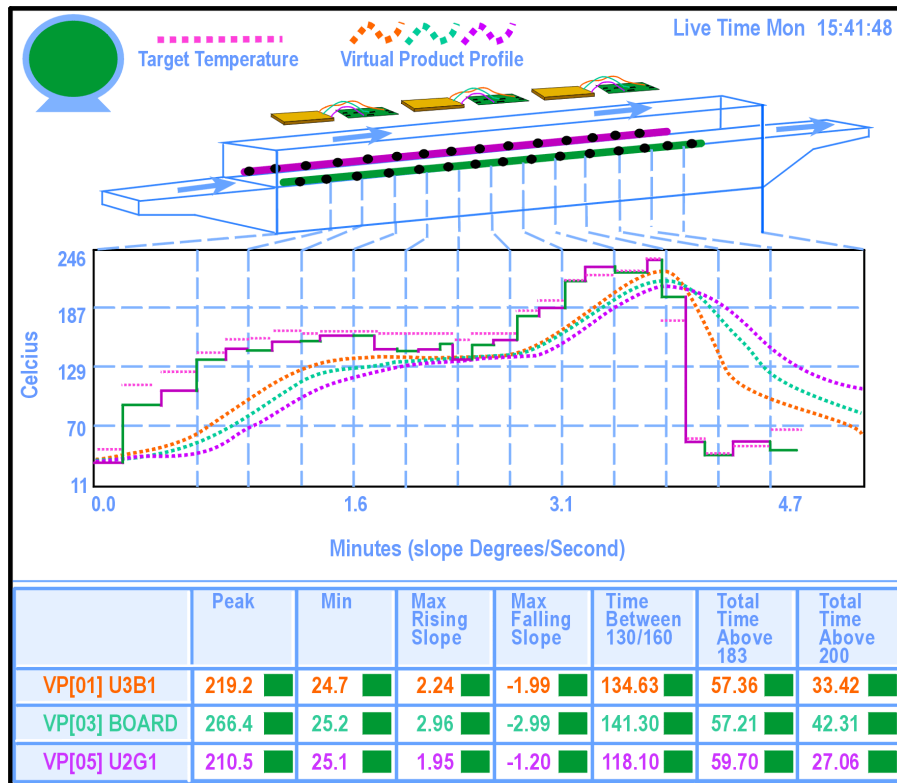


Figure 2: From the 30 process temperatures being monitored continuously, a "virtual" product thermal profile is calculated.

Options For Every Application

The Prophet system is available with options that can be tailored to fit any manufacturer's needs. These include: Live Data Output, Statistical Process Control, Auto-Predict, Board Sensors, and Barcode Readers. Live Data Output sends process data continuously to other software packages, making data available for Statistical Process Control, ISO 9000 documentation, and other applications. Statistical Process Control can be applied to the thermal process with an integrated Prophet System SPC package: QC-CALC. The Auto-Predict software eliminates guesswork in developing oven profiles, or "recipes." In seconds, KIC's Auto-Predict will calculate thousands of combinations of conveyor speed and zone temperature, then rate them to provide an optimal profile.

The newest options available on the KIC Prophet System are the Board Sensor system and the Bar Code Reader. The Board Sensor utilizes optical sensors placed at the entrance and exit of the oven, and will record and display: Actual Conveyor Speed; Production volume; and Thermal load as a percentage of oven capacity. It also provides a lost board alarm when a product fails to exit the oven. The Bar Code Reader allows KIC's software to time and date stamp every product that enters the oven. At any time, the process data on any bar coded product can be reviewed by scanning the barcode. The Board Sensor and Bar Code Reader allow a manufacturer to track and record the thermal profile of every individual product processed in their ovens.

Real-Time Thermal Manager

With the addition of one or more of the available options to the KIC Prophet System, it becomes the ultimate Thermal Manager. Zero defect production can be achieved by Real-Time monitoring of all areas that can cause thermal deviations: product loading, product profile, including peak temperature and time-above specified temperature, and conveyor speed. Total process documentation and product traceability simplifies quality control and troubleshooting, helping to determine the origin of any thermal problems that may occur. The KIC Prophet System makes it possible to eliminate the downtime inherent in the use of conventional product profilers; to continuously monitor the thermal process and stop it automatically should a problem arise; to optimize oven recipes and quickly develop new recipes without guesswork; and to have total process documentation and product traceability. (see fig. 3)

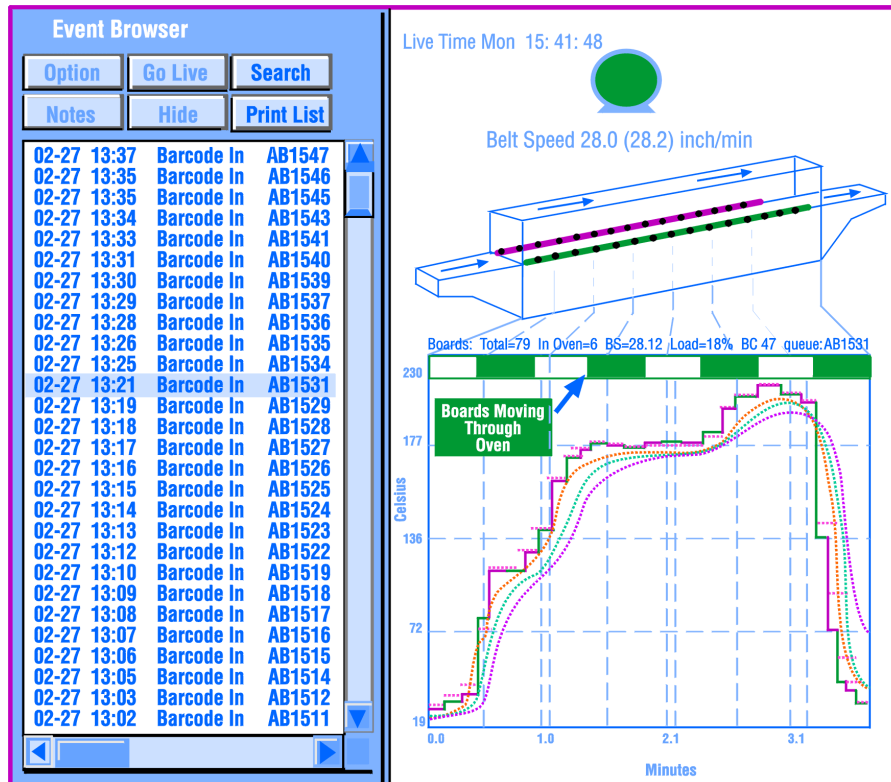


Figure 3: The KIC Prophet can maintain a record, by serial number, of the thermal profile for every product manufactured

The Big Question

The most common question manufacturers have about the KIC Prophet System is this: with modern forced convection ovens being as efficient and dependable as they have become, what purpose does a thermal manager serve? The first benefit is that the Prophet is a valuable tool for troubleshooting the entire production line. The common response to a defect or yield problem is to shut down the line. In many companies, it is mandatory that the oven be profiled whenever there is a production problem, and this can take between ten minutes and an hour — production time that is usually wasted because the problem is rarely in the oven. The Prophet System will tell you in a fraction of a second whether there is a problem in the oven. The second benefit is ISO 9000 documentation. The Prophet records every aspect of the thermal process and saves it automatically. The third benefit is specific to the contract assembly industry, where many companies are using the Prophet System as a sales tool to show their corporate clients they have a commitment to quality and the ability to document everything they do for

their customers. The fourth benefit is to companies manufacturing a variety of products. The Prophet System facilitates the movement of production between assembly lines. Many companies want to run a variety of products in the same oven using the same recipe, and the Prophet System can find that recipe quickly and without guesswork, optimizing production flexibility. The final benefit, total product traceability, is readily apparent. If a product fails, and it has been bar coded, scanning that barcode with the KIC Prophet will allow instant access to the record of that product's thermal process. An example of the value of this feature is the case of a major manufacturer that recently bought four Prophet Systems. Shortly after installing the systems, they were forced to shut down all four lines because every board that had been produced was defective. After researching the problem, they found that one component was at fault. When they approached the supplier of this component, the supplier claimed their products were good and had been overheated in the oven. Because they had the KIC Prophet System, the manufacturer was able to prove that their ovens were running at the supplier's specified temperatures, and the supplier was forced to make a substantial settlement.

Proven Worldwide

The KIC Prophet is currently installed on over a thousand production lines worldwide, and is used by most of the electronics industry's major manufacturers. At Nepcon West '98, in Anaheim, California, KIC Prophet Thermal Managers were installed on conveyor ovens by BTU, Fuji, Heller, Research Inc., and Sikama. Using networking equipment supplied by Intel, seven live ovens were monitored in Real-Time from the KIC booth. Nepcon '98 provided a powerful demonstration that the KIC Prophet System is the new state of the art in electronic assembly, and provides a user-friendly cost effective way to monitor and record the thermal profile of every product to come off the line.

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