

## **Moving Forward – Technical Advances in Resistance Welding – Closed Loop Welding Systems and Process Controls**

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The ongoing need to develop manufacturing processes and controls that insure product quality through all phases of manufacturing process should be a primary goal for the Vacuum Electron Device Industry and is an ongoing effort at Semicon Associates. The search for equipment and devices that permits for the introduction of these control schemes has lead us to search outside the “normal” Vacuum Electron Device service industry; into industries where approaches, techniques, and equipment have been developed for somewhat unrelated uses, but do in fact have application to our industry. This paper presents our findings on “Closed Loop Resistance Welding Equipment”, equipment primarily developed for the medical device industry, where the need for quality instrumentation and process control meets or exceeds the requirements of our industry.

The presentation concentrates on two aspects of Closed Loop Resistance Welding and their benefit to the industry. The first attribute will deal with the cost justifications benefits and the second, technical and quality benefits. The cost benefit data shows implementation can lead to:

- As much as a 15 to 40 % reduction on operator skill sets;
- Nearly a 100 % reduction in operator-to-operator variation (programmability and security);
- Elimination of scrap and rework costs, by offering an ability to monitor weld-to-weld data and real-time process controls;
- And finally, a 35 % reduced set-up time, by offering repeatable and digitally controlled processing parameters.

The technical and quality benefits presented includes:

- Defining a Closed Loop Resistance Welding System Features:
  - 50 to 2400 Amp range
  - 0-99 ms upslope, weld, down-slope and dual pulse features
  - Feedback modes - I, V, P
  - Process Tools APC, Pre Weld, and Limits
- Process Control Implementation
  - Data Collection and Statistical Process Control
- Failure Mode Recognition and Signaling
- The Process of Establishing an Operating Materials Matrix
- Repeatability and Reproducibility Measures

These are attributes the Vacuum Electron Device Industry can readily and easily implement to reduce cost, improve process reliability, and quality.

**Conclusion:**

This presentation addresses how by implementing closed-loop welding system the “Vacuum Electron Device Industry” gains not only improved process efficiency but also greatly improved process and quality control at a reduced cost.