E-diagnostics and FDC Implementation on Process Equipment by Eric Dunton

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1. Introduction

The backend packaging industry is moving towards fab wide FDC (Fault Detection and Classification) systems to deliver higher quality end products. A more powerful alternative to fab wide FDC is integrating FDC on the process equipment. E-diagnostic and predictive analysis software packages implemented on next generation process equipment can help to prevent scrap, increase serviceability, improve yield, and fingerprint systems by determining which parameters are affecting processing most. Consumable degradation and inherent process variations can challenge Advanced Packaging engineering teams in their efforts to maintain strict process control.

2. Approach

Process and equipment information can be collected in real-time from multiple sensors on the equipment. Data collection is done by polling status variables through an Ethernet connection to the process equipment control computer. Currently we are monitoring >800 signals at 1 Hz. The number of signals monitored as well as the frequency can be set by the user to get the resolution of data required. The collected data is stored on a standalone server either on the system or located remotely. User-defined models, that are generated in a simple drag and drop interface as shown in Figure 1, can manipulate this data to help identify relationships between the system signals and system performance and/or on wafer results. These models are the building blocks upon which even more powerful models can be developed to analyze real time process results and system performance. The collected data can be viewed as either non-lot based, see Figure 2, for long term trends, or lot based for review of specified time segments of the data. Lot based data time frames are designated by user defined models. The user also defines analysis units that can be used to do statistical analysis on specified signals during lot based processing.

3. Results

3-1 Scrap Prevention

Simple review of voltage analysis units allows the user to set limits for variation that will alert the operators prior to creating an issue on the product wafer. See Figure 3 for example of ability to catch variation.

3-2 Increase Serviceability

A model was created to check level variation during a rinse step. Examination of the lot based data along with analysis unit review allows the system to predict maintenance requirements, alert teams of the issue, so service engineering teams can replace the correct part first time. Figure 4 shows the lot based model used to determine part required for repair.

3-3 Yield Improvement

Comparison of data traces with respect to on wafer results from good and bad wafers allow for models that can be used to warn process teams prior to excursions of the on wafer results. Figure 5 shows introduced process variations and results on wafer performance.

3-4 System Fingerprinting

Automated review of data processing post maintenance work can be used to ensure system is back to correct operating ranges. This monitoring can be done from system to system, start up to start up and ensure multiple systems are meeting expected performance criteria. See figure 6 for example of using pre/post maintenance comparison for system recovery and fingerprinting.

4. Conclusion

Ease of model creation, without software coding requirements allows for multiple teams, service or process, to implement models and tests as required. As it is a standalone unit, models and analysis are able to run real time with no interruption to process. The standalone implementation also allows for introduction of new models and tests without the need of new system control software. Models are also easily ported from system to system to safeguard all process equipment. Integrating FDC and e-diagnostics on process equipment helps to prevent scrap, increase serviceability, improve yield, and provides better system fingerprinting.

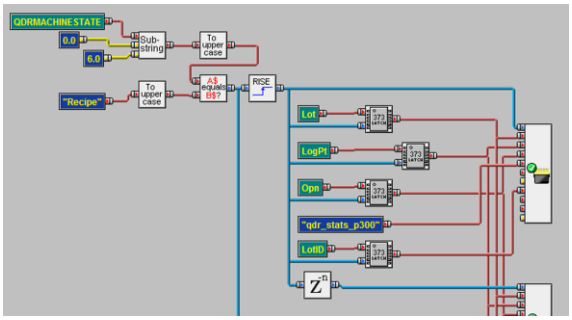

Figure 1. Simple model made with drop and drag icons. Allows for development without coding.

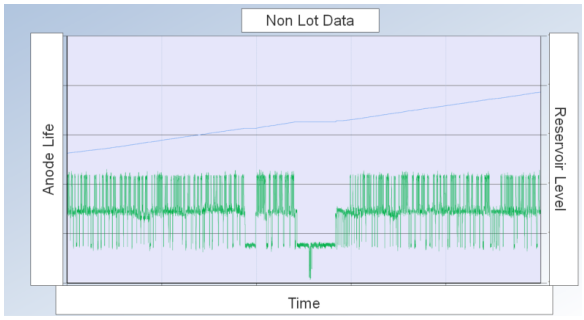

Figure 2. Non Lot based data. Easy review of long term trends.

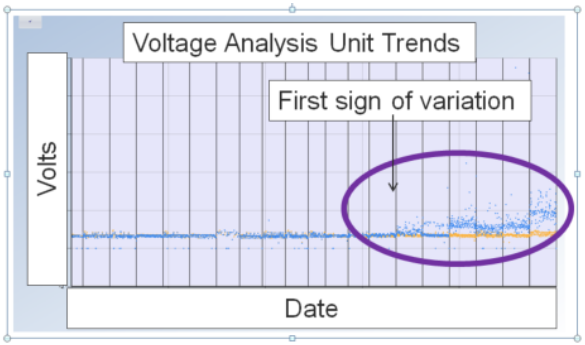

Figure 3. Modeling allows for trend identification, allowing for notification prior to on wafer result impact.

Figure 4. Example of Lot Based Model that shows serviceability improvement capabilities.

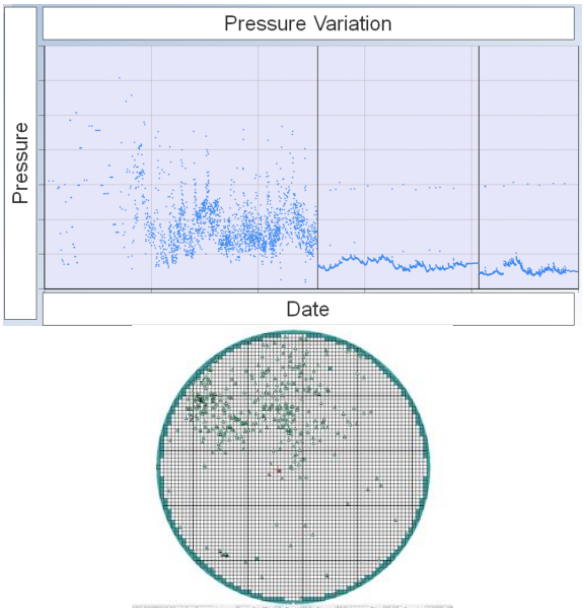

Figure 5. Process variations introduced to determine yield variations.

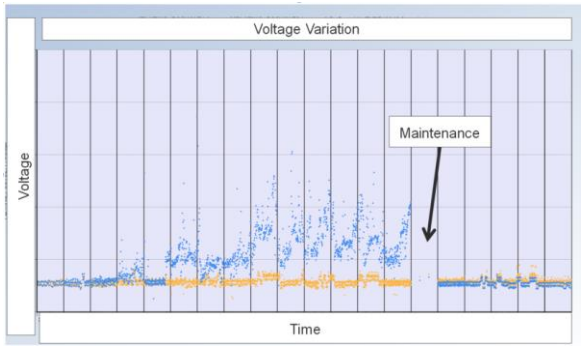

Figure 6. Comparing post/pre maintenance allows for system fingerprinting and faster recovery.