INFICON

TECHNICAL NOTE

DC Power Fault Detected by FabGuard®

FabGuard Sensor Integration and Analysis System is a fully automated, real-time early fault detection and analysis system for improving semiconductor equipment and process productivity and various INFICON *in situ* diagnostic sensors. The powerful analysis techniques of FabGuard are capable of "smart diagnostics" by combining sensor and tool data for fault detection and classification. FabGuard puts *in situ* sensors to work to:

- Baseline normal process and tool behavior
- Analyze process data in real-time to detect problems and pinpoint problem sources
- Issue warnings and alarms

One benefit of FabGuard is continuous real time monitoring of how close variables measured by the process tool are to their setpoints.

Figure 1 shows a screen capture of the data collected by a Tool Data Sensor (TDS) for one wafer during a PVD process. SECS was used to collect five variables from the tool for this chamber. The five variables are: DC power setpoint, pressure manometer, pressure ion gauge, DC power actual, and Argon AFC.

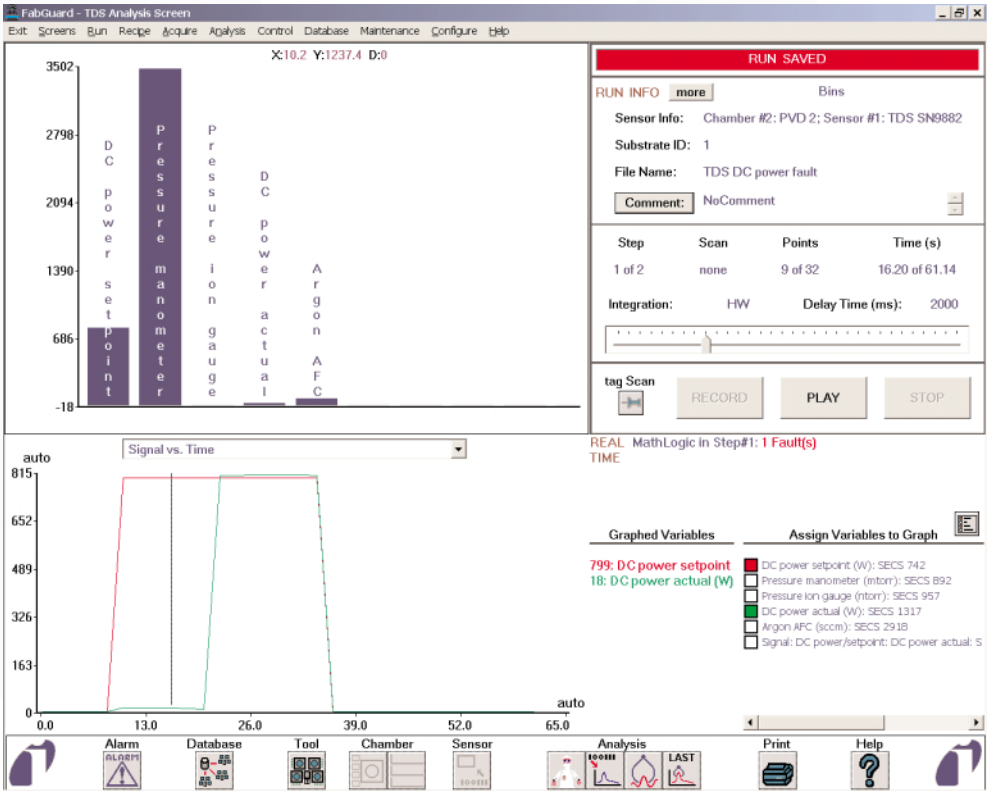

Figure 1 - Data collected by a Tool Data Sensor for one wafer during a PVD process.

The lower left section of the screen contains a plot of data versus time for one or more variables. The vertical line at 16 seconds indicates the user-selected time used in the upper plot. The upper plot is a snapshot of all five variables at one specific time during the process. In the lower plot, two variables are selected for display: DC power setpoint (red) and DC power actual (green). Notice that the DC power took about 10 seconds to reach its setpoint. This 10 second delay is quite significant since the DC power should only be turned on for a total of 20 seconds. For this wafer, the deposited film thickness would have been only about half of what it was supposed to be. The cause of this fault was traced to a DC generator that was beginning to fail. FabGuard detected this fault long before the tool itself would have.

HOW FABGUARD WORKS

Figures 2 and 3 show how FabGuard automatically detected this fault. Figure 2 is the same as Figure 1, except that different information is selected for plotting in the lower left. Figure 2 plots a calculated value: the DC power divided by its setpoint. In FabGuard, time series values calculated from raw data are called Signal Bins. The DC power/setpoint Signal Bin should be nearly equal to 1.0 whenever the DC power is supposed to be turned on. It is only 0.0225 at the time shown, which is 6 seconds after the DC power was turned on.

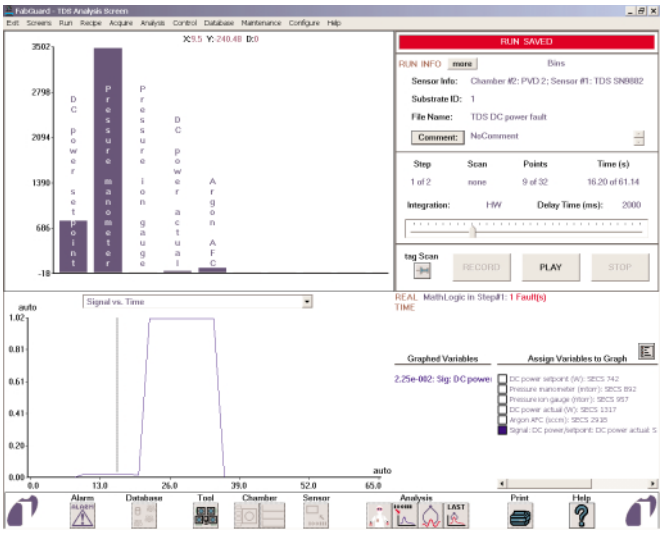

Figure 2. Signal Bin showing DC power divided by its setpoint.

Figure 3 shows the settings for the Math Logic Analysis that FabGuard used to detect this fault. The logic is defined so that a fault is generated if the DC power is less than 0.95 of setpoint or greater than 1.05 of setpoint for 3 seconds or longer. A persistence of 3 seconds was chosen to allow for variability in the turn-on time of the power supply and stabilization of the plasma. This is marked as a critical fault (red alarm) because wafers are in immediate danger if this fault occurs. This analysis automatically detected a fault 14 seconds into the process. An alarm was generated inside FabGuard and an alarm message was sent to the tool. As a result, the tool was stopped and it was determined that the DC power generator needed to be replaced.

Without intervention from FabGuard, hundreds of wafers would have been misprocessed before the DC power generator problem became bad enough for the tool to detect the problem itself.

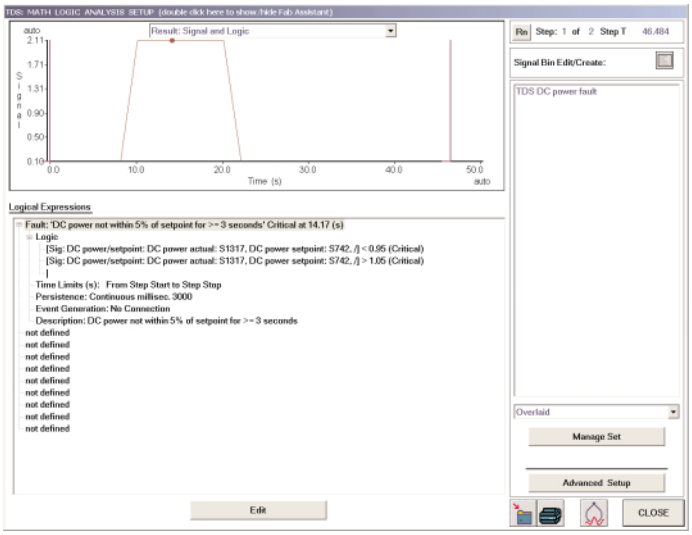

Figure 3. Analysis logic used to detect the DC power fault.

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