Specification of Hercules® SAPC Server

The Hercules® SAPC Server is a stand-alone, easy to use Statistical Process Control (SPC) solution. It utilizes the well-known BlueBox (made by MKS Instruments) for data communication to the tool and enables mapping of sensor data in the tool data. The communication between tool and tool controller is not affected. Data from several Hercules® SAPC Servers can be used for a common data analysis (tool and chamber comparison).

The BlueBox acquires the tool data via SECSII or HSMS from the tool and the plasma data from the sensor using the TOOLweb® toolside protocol, which is an optional interface of Hercules®. The Blue Box merges both data streams and provides the data via the TOOLweb® fabside protocol to the SAPC Server.

Main Applications:

- Process control through plasma parameters
- Tool hardware control through tool parameters
- Chamber matching
- Fault detection (by plasma parameters) and classification (by plasma and tool parameters)
- Optimization of conditioning
- Process development
- Process transfer

Standard Function:

Process Data Base for one Tool / Mainframe

The Hercules® SAPC server stores the tool data together with the plasma data and logistical information in a file based process data base.
The necessary memory size for one lot can be calculated by:

parameters x 4 bytes x process length [s] x resolution [1/s] x number of wafers / lot

Example:
10 parameters, 200 s process length, 1 measurement per second, 25 wafers ➔ 200 kByte per lot

The file format of the data base is the same as used by the Master with process data base option. Therefore, the data can be also analyzed off-line by the HercViewer or the HercLotViewer. The licenses of both software tools are included.

HercViewer shows process stability within a lot and enables a quick and easy access to plasma process parameters of a single lot. It is used for step-wise and time-resolved analysis

and detects:

- First wafer effects
- Process instabilities
- Tool faults.

The HercLotViewer shows and compares plasma and tool parameters from different chambers and tools up to thousands of wafers. It shows long term process stability by using the logistical data:

- Lot_ID
- Tools_ID
- Chamber_ID
- Wafer_ID
- Process length
- Recipe
- Recipe step

The HercLotViewer is an efficient tool for:

- Long term process analysis
- Product mix issues
- Impact of maintenance measures.

Special features are:

- Chamber and recipe comparison
- Statistical values: mean, median, standard deviation
- Product and quotient of plasma process parameters
- Time-resolved plasma parameters.

Optional Extensions:

Statistical Process Control in Real Time

Step-wise limits can be defined for the statistical moments:

- Mean
  - First wafer effect
  - Conditioning
  - ...
- Median (very robust estimation for mean)
- Coefficient of variation (standard deviation over mean)
  - Arcing/flaking detection
  - Process instability (caused by RF or pressure control)
  - ...

For every chosen value up to 4 limits are possible. The type of limits (upper or lower) and the reaction can be defined. Following reactions are possible:

- No reaction
- Warning on screen

- Error message in log-file
- Error message via e-mail
- Command to tool.

The 'message to tool' feature enables direct control of the process on the tool via HSMS (step abort, process abort, ...). Type and limits of the parameters can be defined for each recipe separately.

Example:

Limits for the main etch step, mean of electron collision rate:

- Lower warning with warning message on screen
- Upper warning with error message in log-file
- Lower and upper error limits with e-mail to the process engineer.

The configuration of the on-line process control module can be determined directly from the HercLotViewer (based on historical data).

Other hardware required:

The BlueBox made by MKS Instruments will be delivered and configured through Plasmetrex. It will be connected with tool and Hercules® for the on-line and real-time data transfer for one tool.

One BlueBox and one Hercules® SAPC Server is needed for each tool.

The BlueBox and Hercules® SAPC Server bundle is designed for highest speed and low maintenance.

- One Hercules® SAPC Server controls one tool with up to 6 chambers.
- The number of different sets of limits (per recipe) is limited to 10.