Leading the Way in Assembly Engineering

26-Jan-06

DFM in Electronics Manufacturing

Presented by:
Mika Johnsson

For:
Global Workflow 2006
Valor is present in over 23 countries with direct sales offices and distribution networks.

Worldwide support organization for enterprise level implementations.

85% of the worldwide electronics blue chips are Valor customers.
Some of Our Customers
Valor

Valor is the global innovative leader in the supply of DFM (Design-for-Manufacture) and CAM (Computer-Aided Manufacture) solutions
Electronics Manufacturing Industry Trends

- Increased PCB complexity: more layers, more vias, more components, new component types, etc.
- One base design used for multiple PCB variations
- Build-on-demand instead of warehousing
- Shorter time-to-market
- Shorter product life-cycle
- Global competition requires lower costs
Manufacturer’s Information Explosion

- Drill Data
- Gerber Data
- Manufacturability Reports
- Bare-board Fabrication
- Material Requirements
- Assembly Drawings
- Machine Programs
- ICT Programs
- Mechanical Drawings
- Netlist Data
- EDA (CAD) Data
- Bill of Materials
- Approved Vendors List
- ECO/ECN Requests
- Visual Aids
- Material Requirements
- Bare-board Fabrication
- Assembly Drawings
- Machine Programs
- ICT Programs
- Mechanical Drawings
- Netlist Data
- EDA (CAD) Data
- Bill of Materials
- Approved Vendors List
- ECO/ECN Requests
- Visual Aids
Keys to Successful Manufacturing

- Intelligent interface to EDA systems
- Accessibility to comprehensive graphical data
- Powerful analysis tools
- Communication tools
- Yield improvement
- Ownership of data
- Revision control / configuration management
According to a Study... (by Hewlett Packard)

◆ 60% of overall product cost is determined by decisions made early in the design process
◆ 75% of manufacturing cost is determined by design drawings and specifications
◆ 70-80% of all product defects are directly related to design issues
The DFM Gap

- Adopting new technologies presents many challenges.
- High density, high speed, impedance, PCB stack-up, signal integrity, dynamic electrical performance, component placement, procurement, etc.
Design for Manufacturability

Analyzing the data early:
• Saves revision spins
• Reduces scrap
• Saves labor and hardware costs

Design for Fabrication
Design for Assembly
Design for Testability
Design for Electrical Integrity
Goals of DFM

- Increase product quality
- Increase manufacturing flexibility and responsiveness
- Reduce NPI cycles
- Reduce manufacturing cycle time
- Reduce product time to market
- Reduce costs
- Minimal impact to design schedule and effort
NPI Process

¬ DFM minimizes need for re-design and enables right-first-time manufacturing
Valor Technologies

Design to Manufacturing process

Conceptual Design → Schematic Design → Layout → NPI → Ramp to Volume

Valor technologies maximize engineering efficiencies

- Volume Production
- Low Cost
- High Quality
- Short Cycle
Valor Technologies

ODB++
- Comprehensive CAD/CAM printed circuit assembly data model
- Integrated, intelligent product data transfer format
- Integrated Design, Fabrication and Assembly based on a single standard
- In use by thousands of electronics companies worldwide
- Supports DFM/CAM/Assembly-Test process preparation
- Open format basis for IPC 2581

MPS (Manufacturing Process Simulation)
- Accurate kinematic modeling of assembly processes
- Hundreds of machines simulated
- Best-in-class optimization technology
- Maximizes assembly line utilization
Valor Technologies

VPL (Valor Parts Library)
- Online electronics component library
- Standardized physical modeling of components
- ISO 9001 certified data service to the industry
- Supports 30 Million components, increasing daily
- Multiple added-value touch points:
  - ECAD, MCAD, NPI, CAM, Manufacture, Assembly, Test, Inspection

DFM (Design for Manufacturability)
- Constraint based DFM analysis
- Unique shape based algorithms
- No. 1 physical analysis capability
- Covers PCB Assembly, Test, Fabrication

ERF (Engineering Rules File)
- DFM process constraints
- Applied to multiple CAD/CAM processes
- Supports design-anywhere build-anywhere
Valor - Product Family Overview

**Enterprise 3000 (Design)**  
Design for Manufacturability system for zero-defect first-time manufacturing (over 700 checks)

**Genesis 2000 (Fabrication)**  
Next-generation pre-production CAM for automated production set-up of bare boards

**Trilogy 5000 (Assembly Engineering)**  
Pre-production preparation solution for virtual simulation, optimization and testing of PCB assembly processes

**TraceXpert (Assembly MES)**  
Best-in-breed solution for exact traceability, production monitoring and materials management

**Valor Parts Library (VPL)**  
Unique parts library with over 35 million accurate component geometries supporting Design & Assembly processes
Trilogy 5000 Comprehensive CAD-to-manufacturing solution, based on one intelligent database
Valor Parts Library (VPL)

- Missing components
- Incompatible components
- Incomplete design data
- Initiate engineering change requests

Engineering Station

BOM Manager

Component Data Integration

Feedback to:
Customer, Logistics, Purchasing

Design Data Input

Assembly Merge

- Check form/fit equivalence between alternates (VPL)
- Automatic virtual placement of package models
- Best-fit algorithms simulate SMT reflow process
**Engineering Design Data**

- BOM Manager
- Component Data Integration
- Feedback to: Customer, Logistics, Purchasing
- Sharelist DFM Feedback
  - DFM reporting to Design/Customer
  - Structured and comprehensive
  - Point-by-point manufacturability feedback

© Copyright 2006 Valor Computerized Systems Ltd. All trademarks are the property of their respective owners.
BOM Manager

Feedback to:
Customer, Logistics,
Purchasing

Machine vendor independent solution
Best-in-class machine simulation technology
Integrated optimization and line-balancing
Ensures minimum assembly costs
BOM Manager

Feedback to:
Customer, Logistics,
Purchasing

Engineering Design Data

Assembly/Test Analysis

Bare Board Analysis

Engineering Station

Documentation Editor

Machine Shapes Manager

Assembly Engineering Line Balancing Product Grouping

- Automated documentation generation
- Template driven
- Intelligence from ODB++ and machine-programming
- Color-coded manual assembly instructions & drawings
- Machine set-up instructions

© Copyright 2006 Valor Computerized Systems Ltd. All trademarks are the property of their respective owners.
Factory Floor Instructions & Documentation
- On-line distribution and viewing
- Hard-copy

AOI / AXI Machines
- Orbotech, VI-Technology, Omron, Agilent 5DX
- and more, according to customer demand

PCB Fabrication Data
- Gerber-less fabrication
- Fabrication from single data source
- Based on "Assembly Panel"

Solder Stencil Manufacturing
- Optimized according to DFM criteria
- Based on ODB++ pin & pad models

In-circuit Test Fixtures & Programs
- Based on DFT verified accessible test points
- Future support for multi-vendor test-machine output

Assembly Lines:
- Fuji, Sanyo, Universal, Panasonic, Siemens, and more...
TRILOGY 5000
PCB manufacturing process preparation solution

- One Intelligent Database
- Integrated Solution
- All Outputs Synchronized
- Comprehensive Process Preparation
- Maximizing Quality
- Maximizing Productivity
Intelligent Data Exchange with ODB++

- Captures all PCB design, fabrication and assembly knowledge into a single unified database
- Improves communication and reduces Time-to-Market
- Eliminates time consuming re-engineering
- Fully expandable and adaptable to industry needs
- Explicit, hierarchical structure:
  - Accurate physical descriptions
  - More flexibility for production related issues

Industry leading platform for Virtual Manufacturing Modeling
Valor Parts Library

◆ A central component of Trilogy 5000
◆ Contains information about electronic components including:
  ◆ Exact geometry of component packages
  ◆ Various attributes about packages, parts, assembly stations and component manufacturers
  ◆ Various mappings between names, codes and aliases
◆ Intended for accurate Design for Assembly (DFA) capabilities
◆ Can be viewed and edited by the Parts Library Manager (PLM)
◆ Provided as a Value Added Service option by Valor

Unique offering in the industry today
Benefits of Using Actual Component Dimensions

- Actual component spacing during analysis
- Actual solder mask clearance
- Actual solder paste volume/shape
- Helps test tool design
- Helps mechanical design
Component Data Comparison

**Gerber Data**
No component Information.

**CAD Data**
Component keep-out area.

**VPL Data**
Exact component outline and pin contact area.
Accurate Components Ensure Accurate Analysis

Before VPL substitution
Inaccurate outlines and pin definitions.

After VPL substitution
Actual body outline and pin contact area.

With true component representations, accurate analyses can be performed. “Component Spacing” and “Pin-to-Pad Analysis” can now provide precise results rather than just approximations.
Manufacturability Examples (1/3)

- Through holes underneath components?
- Is board thickness known?
- Distance from Break-tab board edge
- Is the Footprint good for this Component?
- Do BOM and CAD data match?

- Direction of components
- Type of components
- Height of components
- Body or Footprint
Manufacturability Examples (2/3)

The fiducial marking on the BGA is shorting two nets directly below it.

A test point placed under the body of a resistor.

Badly placed vias touching off component toeprints causing shorts.

Split track causing impedance problems on net.
Manufacturability Examples (3/3)

True component dimensions (from VPL) showing no assembly clearance.

The power supply on this PCB has 2 fixing screws (with associated annular rings) incorrectly fitted to wrong side of PCB.

Via has not been voided on Vcc plane.

Thermal pad has four 10mil ties, 2 of which are broken, reducing thermal relief by 50%.
Types of Analyses: Bare Board Analysis

◆ Drill analysis
  ◆ hole size, aspect ratio, shorts, touching / close holes etc.

◆ Signal analysis
  ◆ spacing, rout, sliver, size, stubs, bottleneck etc.

◆ Power and Ground analysis
  ◆ keep-out areas, plane spacing etc.

◆ Solder mask analysis
  ◆ pads, coverage, missing clearances etc.

◆ Silk screen analysis
  ◆ hole-clearance, SMD-clearance, overlaps etc.
Bare Board Analysis - Examples

- Extra hole
- Signal spacing
- Via to copper
- Solder mask slivers
- Silk screen clearance
- Thermal Connect reduction
Types of Analyses: Assembly Analysis

- Fiducial analysis
  - spacing, isolation etc.
- Component analysis
  - spacing, orientations, labels, traces etc.
- Padstack analysis
  - toeprints, heat dissipation, SMD-pads etc.
- Testpoint analysis
  - spacing, keep-out areas etc.
Assembly Analysis - Examples

Fiducial to copper

Component spacing

Via to toeprint

Testpoint to testpoint
Assembly Analysis - Actions

◆ Optimizing
  ◆ Signal layer
  ◆ Solder mask
  ◆ Line width
  ◆ Solder paste

◆ Yield Improvement
  ◆ Teardrop creation
  ◆ Copper balancing
Benefits of Using Rules in DFM

- A rule specifies the range of values that can be tolerated in order to build the product
- Rules provide flexibility as well as exactness
- Product-specific knowledge and specifications can be transformed into easily managed rules and rule sets
- Different rules for different customers/products
- Standardized DFM – tests are easy to repeat any time
External Resource Files

◆ Enable consistent use of design and manufacturing rules throughout a supply chain
◆ Enable defining different rule sets for different types of design
◆ Allow considering the exact specifications of the machines used to build the product
◆ Manufacturers can provide this information up front to OEM to minimize issues and optimize output:
  ◆ High volume, low tolerances
  ◆ High volume, medium tolerances
  ◆ Lower yield, high tolerances
Rule File Example

Spacing = 20 mils
Under 25 = Illegal
Cannot manufacture

Spacing = 45 mils
Between 25 and 50
Yield = Critical

Spacing = 95 mils
Between 50 and 99999
OK recorded measurement

SMT:c2c; discrete603_discrete603_ww= 25 50 99999

© Copyright 2006 Valor Computerized Systems Ltd. All trademarks are the property of their respective owners.
Thank You!

◆ www.valor.com > News > Articles
  ◆ Electronics Manufacture & Test, November 2003. Jay Gorajia - Clean process with a right MES (Manufacturing Engineering Software)

◆ Any questions?